MASTER PLAN FOR ALAPPUZHA TOWN - 2041

Alappuzha Municipality

Atal Mission for Rejuvenation and Urban Transformation

LSGD

Local Self Government Department (Planning)
Government of Kerala

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MESSAGE

Highlighted as the "Venice of East", Alappuzha is one of the important towns on the Western coast of Kerala. Alappuzha attained legendary progress and became the financial capital of Erstwhile Travancore at the time of Raja Kesava Das, the 'Maker of Modern Alleppy', who made Alappuzha a premier port town of Travancore. He constructed several roads and canals to improve the transportation and communications and built many warehouses on the banks of the canal. Alappuzha was declared as municipal town in 1920. With its fascinating natural beauty with sparkling backwaters and waterbodies, beautiful stretches of coastline, Alappuzha became a major tourism destination attracting both foreign and domestic tourists. Even though it was a center of coir industry, trade and commerce, began to decline the status with the development of Kochi as a major industrial hub, it began to decline its importance in trade and commerce. Efforts are made for developing Alappuzha as an economically and culturally vibrant town through tourism and industrial development.

Land being the scarcest and expensive resource, it is imperative to formulate and implement specific scientific measures in land use planning with a long-term vision and comprehensive regional outlook. Even though the Master Plan for Alappuzha Town was sanctioned in 2022 as per section 36 (8) of The Kerala Town and Country Planning Act – 2016 (Act No. 9 of 2016), the town needs an integrated approach to development encompassing all the issues whether it is in infrastructure, environmental or service delivery in various social sectors. Besides, provision of urban services, conservation of ecologically sensitive areas, disaster management, resource mobilization etc. are to be efficiently planned.

The Master Plan for Alappuzha Town - 2041 is an effort towards these. The proposals in various sectors are productive enough to strengthen the economic base of the town and to raise the town into a universally accessible responsible tourism destination. It being one of the most densely populated towns on this planet, waste management has pole position in all the schemes to transcend the town a tourist paradise. Interests of the towns people are silhouetted at the core. I am sure that it will also ensure peaceful, healthy and quality living atmosphere for the inmates of the town.

Recognizing that the tourism sector will play an important role in the future growth of Alappuzha town, the development of related infrastructure, environmental protection and mitigation of the effects of climate change are included in this Master Plan. I recall that the municipal councillors were very actively participated in the discussions for finalizing the plan.

Special acknowledgements to the Standing Committee Chairpersons for their guidance and involvement in the work. Members of the Master Plan Committee also put in considerable efforts in materializing this Plan. I also appreciate the sincere efforts put in by the officials of the Local Self Government Department Planning wing for materializing this Plan in its present form.

With great pleasure and faith, I present the Master Plan for Alappuzha Town, 2041 herewith. In order to restore the glory of Alappuzha, I actively exhort to implement this Master Plan in its full spirit, which would certainly help Alappuzha Municipality to ascertain its vitality in the region, in the years to come. I also use this opportunity to request the wholehearted cooperation of all the stakeholders, for the successful implementation of this plan.

Alappuzha
Date



K K Jayamma
Chairperson
Alappuzha Municipality

PREFACE

Atal Mission for Rejuvenation and Urban Transformation (AMRUT) scheme, launched by Government of India, focuses on infrastructure creation that has a direct link to provision of better services to the urban citizens. The AMRUT mission mandates a set of 11 reforms which are to be implemented by the States during the Mission period. 'Urban Planning and City level Plans' is one among the 11 reforms. For achieving one of the milestones under this reform viz.'Preparation of Geographical Information System (GIS) based Master Plans', Government of India have launched the 'Scheme of formulation of GIS based Master Plans for AMRUT cities'. The Local Self Government Department Planning was designated as State level Nodal Agency of this Scheme. The Scheme has three components viz. Geo-database creation, Preparation of Master Plans and Capacity building. In the State, Alappuzha is one of the 9 AMRUT cities/towns included under this sub-scheme.

Urban areas have been the driving force in economic and social development. Cities emerged as a focal point of transport, trade, business, education, religion and governance. Unprecedented urbanisation and migration result in multi fold growth of urban areas. The 74th Constitution Amendment Act envisages empowerment of the Urban Local Bodies (ULBs) with planning functions, which are enshrined in the Twelfth Schedule to Article 243 – W of 74th Amendment. The first three functions under the Twelfth Schedule are Urban planning including town planning; Planning of land-use & construction of buildings; and Planning for economic and social development.

Master Plans are expected to give impetus to the development and economic potential of the towns. There were quite a few planning efforts to tackle the developmental issues of Alappuzha Town. Essentially in this Master Plan, the issues that are regarded as very crucial in framing the development proposals to achieve better living and economic conditions in the urban areas, have been considered after carefully weighing the opportunities and constraints offered by the town. The comprehensive efforts have established a framework for physical and socio-economic development and upliftment of the town and its constituent elements and a development policy mechanism by which these goals can be achieved. The Master Plan also attempts to address the hazard, vulnerability, risk associated with Flooding in the town and proposals for mitigation and resilience.

I would like to appreciate the leadership provided by Alappuzha Municipal Council for this endeavour. The contributions of the Master Plan Committee constituted for the preparation

of the Master Plan were significant. I take this opportunity to appreciate the officials of the Alappuzha District office of the Local Self Government Department Planning, especially Sri. Joseph K F, District Town Planner; Smt. Gladis William, Deputy Town Planner; Smt. Hinduja.V. L, Assistant Town Planner; for their sustained efforts in the time bound preparation of this plan. The contributions of Smt. Indu Vijayanath, Former Town Planner, Smt. Nimmy Kurian, Smt. Rahana.H and Smt. Jayasree.V. K, Former Deputy Town Planners is also mentioned at this juncture. I would also like to appreciate Sri. P.N. Rajesh, Additional Chief Town Planner and his team members of the Project Implementation Unit of Program for Results of Rebuild Kerala Initiative by the Kerala Government, for the efforts put forward by them to incorporate risk information in this Master Plan.

Definitely, the Master Plan for Alappuzha Town will provide the necessary framework for the development of this prominent tourism destination. I optimistically look forward to effective implementation of this plan. Certainly, the Master Plan will provide guidance for all stakeholders with an interest in the future development of Town.

Prasanth H
Chief Town Planner (Planning)
Local Self Government Planning

Thiruvananthapuram
Date 27.04.2024



ACKNOWLEDGEMENT

The preparation of Master Plan for Alappuzha Municipality was kicked off as a joint effort of Alappuzha Municipality and district office of Local Self Government Department Planning. The Master Plan delivers a coordinated strategy to guide future development, transport and public utility investments over the next 20 years to ensure our town as safe, attractive and a continued source of pride. The preparation of the Master Plan for Alappuzha Town was initiated as per the resolution number 1 of the Municipal Council on 25/01/2019.

I am sincerely acknowledging the valuable guidance and involvement of Municipal Chairperson Smt. K K Jayamma, Former Chairperson Smt.Soumya Raj, former Municipal Chairmen Sri.Thomas Joseph and Sri.Illickal Kunjumon during the preparation of Master Plan for Alappuzha Municipality. I gratefully acknowledge the contributions of all councilors of the Municipality for their support and advices. The sincere efforts put in by the Secretary and Municipal Engineer needs special mention here.

I express my sincere gratitude to Sri. Prasanth H, Chief Town Planner (Planning), Smt.K.S Girija and Sri. Gigi George, former Chief Town Planners (Planning) for their unmatched support and guidance in bringing out this draft plan. Special thanks also go to all Department persons who gave their valuable support without which the compilation of this vital document would have been difficult to realize. The plan has been prepared in a participatory way having several consultations with Stakeholders at all stages. I offer special thanks to members of Master Plan Committee and other stakeholders for offering their views, comments and recommendations in developing the plan. I would like to extend special thanks to the residents and people of Alappuzha Municipality who provided substantial input that helped to shape the Master Plan vision for future generations to enjoy.

Master Plan preparation is the culmination of several months of dedicated work by the Planning team members. I sincerely appreciate hard work and sincerity of the planning team in the district Town Planning office comprising Deputy Town Planner Smt. Gladis William; Assistant Town Planner Smt. Hinduja V L and Smt. Remya V; First Grade Draftsman Smt. Neeraja Prakash; Second Grade Draftsman Smt. Sruthi Prakash; Planner Associate Smt. Harsha H and GIS Assistant Miss. Namitha Vimal Raj in completing all the works in a time bound and organized manner and bringing out the plan within the stipulated time. I am also indebted to the statistical team of this office, all other members both in the technical and non technical section for all the co- operation and timely action extended. The service of the former Town Planner Smt. Indu Vijayanath; Deputy Town Planners Smt. Nimmy Kurian Smt. Rahana.H, and Smt. Jayasree.V. K and Assistant Town Planner Sri. Jinu V S is remembered with

gratitude on this occasion. Special Mention to Sri. Ajith, former Planner Associate; Smt. Poornima Rajan, Sri. Alan T X and Dr. Akhil, Former GIS Assistants for their continuous and sincere effort during various stages of plan preparation.

Master Plan for Alappuzha is prepared by understanding the hazard profile of the town, analyzing the risk aspects and introducing flood prone zones in land use plan so as to reduce the effects of flood hazard. This was a tedious process and may not have been possible without the help of the Project Implementation unit of Program for results of Rebuild Kerala Initiative by the Kerala Government headed by nodal officer Sri. P N Rajesh, Additional Chief Town Planner, LSGD Planning. The timely advice and efforts of Sri. Ramacandran, Retired Senior Town Planner and Consultant Town Planner of the Project Implementation Unit is also remembered with gratitude. I take this opportunity to appreciate the officials of the Project Implementation Unit for their enthusiastic approach and dedicated effort to complete the work in a time bound manner, especially Smt. Rini Chandra, Town Planner; Smt. Rahana H and Smt. Seema S R Deputy Town Planners of LSGD Planning; Sri. Sriram A, Disaster Management Associate; Devika Hemalatha Devi, Planner Associate and Miss. Poornima Rajan, GIS/Geospatial Analyst of Kerala Institute of Local Administration.

Finally, but not the least, special thanks to all staff of District office for their tireless efforts without which this plan would not have been completed.

Alappuzha
Date

Joseph K F
District Town Planner

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Abbreviations

AMRUT	Atal Mission for Rejuvenation and Urban Transformation
ASC	Agro service centre
BPL	Below Poverty Line
CBD	Central Business District
CCA	Climate Change Adaptation
CDP	City Development Plan
CI	Concentration Index
CPHEEO	Central Public Health and Environmental Engineering Organization
CPS	Centre for Policy Studies
CRDRR	Climate Resilient Disaster Risk Reduction
CRZ	Coastal Regulation Zone
CTARA	Centre for Technology Alternatives for Rural Areas
CWC	Central Water Commission
CWRDM	Centre for Water Resources Development & Management
CZMP	Coastal Zone Management Plan
DDMA	District Disaster Management Authority
DPC	District Planning Committee
DPR	Detailed Project Report
DRR	Disaster Risk Reduction
DTP Scheme	Detailed Town Planning Schemes
DTPC	District Tourism Promotion Centre
DUR	District Urbanization Report
FSTP	Faecal Sludge Treatment Plant
GHG	Green House Gas
GIS	Geographic Information System
HDCK	Handicraft Development Corporation Kerala
IDDP	Integrated District Development Plan
IIT	Indian Institute of Technology
INCCA	Indian Network for Climate Change Assessment
INKEL	Infrastructure Kerala Limited
IPCC	Inter-Governmental Panel on Climate Change
KADCO	Kerala Artisans Development Corporation

KASE	Kerala Academy for Skills Excellence
KCZMA	Kerala Coastal Zone Management Authority
KIIFB	Kerala Infrastructure Investment Fund Board
KILA	Kerala Institute for Local Administration
KSCSTE	Kerala State Council for Science Technology & Environment
KSDMA	Kerala State Disaster Management Authority
KSDMP	Kerala State Disaster Management Plan
KSEB	Kerala State Electricity Board
KSRTC	Kerala State Road Transport Corporation
KWA	Kerala Water Authority
LDP	Local Development Plan
LDMP	Local Disaster Management Plan
LSGD	Local Self Government Department
MGNREGA	Mahathma Gandhi National Rural Employment Guarantee Act
MoEF	Ministry of Environment Forest and Climate Change
MoUD	Ministry of Urban Development
MSME	Micro, Small and Medium Enterprises
NASA	National Aeronautics & Space Administration
NATPAC	National Transportation Planning and Research Centre
NCESS	National Centre for Earth Science Studies
NGO	Non-Governmental Organization
NH	National Highway
NLCP	National Lake Conservation Plan
NMSH	National Mission on Sustainable Habitat
NRSC	National Remote Sensing Centre
NTPC	National Thermal Power Corporation
OHSR	Overhead Storage Tank
PWD	Public Works Department
RKDP	Rebuild Kerala Development Program
RSGP	Registered Seed Growers Program
SH	State Highway
SLIP	Service Level Improvement Plan
SPM	Suspended Particulate matter

SUR	Sate Urbanization Report
SWTD	State Water Transport Department
UA	Urban Agglomeration
UIDSSMT	Urban Infrastructure Development Scheme for Small & Medium Towns
ULB	Urban Local Body
UN	United Nations
UNEP	United Nations Environment Programme
URDPFI	Urban and Regional Development Plans Formulation and Implementation Guidelines
WFPR	Work Force Participation Rate

PART I

STUDY & ANALYSIS

1 INTRODUCTION

1.1 Background of the study

According to Census 2011, India's urban population is 377 million or 31% of the total population. The urban settlements of the country have experienced relatively rapid population growth and the percentage of India's population living in urban areas has more than doubled from 14% at the time of independence to 31.8 % in 2011 (Census of India). This is expected to increase even further to nearly 40% by 2026 and is expected to be more than 50% by 2051.

Most of the urban settlements, especially smaller urban settlements, are characterized by haphazard and unplanned growth, non-conforming land uses, mushrooming unauthorized colonies, and land conversion from agriculture to urban resulting in environmental degradation and poor quality of life. The proper management of urban areas calls for accurate and vital information to be available on a regular basis.

Realizing the need and urgency of guiding the developments of our urban centers, Government of India have introduced a Mission named Atal Mission for Rejuvenation and Urban Transformation (AMRUT) in 2015 as a centrally sponsored scheme with the objectives to (i) ensure that every household has access to a tap with assured supply of water and a sewerage connection; (ii) increase the amenity value of cities by developing greenery and well maintained open spaces (e.g. parks); and (iii) reduce pollution by switching to public transport or constructing facilities for non-motorized transport (e.g. walking and cycling). The scheme aims for providing basic services (e.g. water supply, sewerage, urban transport) to households and build amenities in cities which will improve the quality of life for all, especially the poor and the disadvantaged is a national priority. All these outcomes are valued by citizens, particularly women, and indicators and standards have been prescribed by the Ministry of Urban Development (MoUD) in the form of Service Level Benchmarks (SLBs). The Mission will focus on the following Thrust Areas:

i. Water supply,
ii. Sewerage facilities and septage management,
iii. Storm water drains to reduce flooding,
iv. Pedestrian, non-motorized and public transport facilities, parking spaces, and
v. Enhancing amenity value of cities by creating and upgrading green spaces, parks and recreation centres, especially for children.

One purpose of the Mission is to improve governance through a set of Reforms. During the Mission period, 11 reforms are being implemented. Formulation of GIS-based Master/Development Plans for 500 AMRUT Cities is one of the important reforms under AMRUT, which has been approved as a 100% centrally funded sub - scheme. The major objectives of the sub - scheme are:

- To develop common digital geo-referenced base maps and land use maps using Geographical Information System (GIS) and
- Master Plan Formulation for 500 cities that are selected as AMRUT Cities.

From Kerala, 9 urban local bodies are selected as AMRUT cities for the first phase. The AMRUT cities include Thiruvananthapuram, Kollam, Kochi, Thrissur, Kozhikode and Kannur Corporations and Alappuzha, Palakkad and Guruvayur Municipalities as shown in Figure 1-1.



Figure 1-1: AMRUT cities in Kerala

Master Plan/Development Plan is the major tool for urban land management, providing detailed land use allocation for the sustainable development of city/town. Formulation of Master Plans start with base map preparation, existing land use surveys and collection of socio-economic data necessary for reviewing the existing situation and proposing the future land use plan. With the advances in remote sensing and geographic information system, the plan making process can be expedited with integration of both spatial and attribute data, which enables detailed assessment of spatial growth of towns/cities, land use status, physical infrastructure facilities, etc. in anticipation of the projected population growth. The most crucial information for formulation of Master Plan is an accurate and updated Base Map of the planning area, showing roads and building layouts, spatial extent of development and information on the use of each parcel of land etc. Based on the Design & Standards for the preparation of GIS based masterplan for AMRUT cities, the geo database has been prepared and updated and the detailed study has been conducted to prepare the Master Plan.

1.2 Alappuzha – The Venice of the East

Alappuzha, also known as Alleppey, is a town in Alappuzha District located on the Western coast of Kerala. A town with picturesque canals, backwaters, beaches, and lagoons, it was described as one of the places known as "Venice of the East" by Lord Curson. It is the administrative headquarters of Alappuzha District. The town shows more resemblance with its canal side Dutch Architecture. It is an important tourist destination in India. The backwaters of Alappuzha are one of the most popular tourist attractions in Kerala which attracts millions of domestic and international tourists to the district and employs vast number of locals in the private sector. The world-famous Nehru Trophy Boat Race is conducted every year in Punnamada Lake, which is in Alappuzha Town.

1.3 Earlier Planning Efforts for Alappuzha Town

The earlier planning attempts in the Alappuzha Municipal Area include:

- Development Plan for Alappuzha Town – 2011
- Master Plan of Alappuzha Town – 2031
- 9 Detailed Town Planning Schemes (DTP Scheme) for the different areas of the town
- City Development Plan prepared in connection with Urban Infrastructure Development Scheme for Small & Medium Towns (UIDSSMT) etc.
- Integrated District Development Plan for Alappuzha District

1.3.1 Development Plan for Alappuzha Town – 2011

The first Statutory Master Plan for Alappuzha town prepared by the Department of Town and Country Planning (then the Department of Town Planning) for the time period 1991-2011 was published in the year 1998 by Alappuzha Development Authority under Travancore Town Planning Act 1108. As the Alappuzha Development Authority stopped its functions in December 1999 further processing of the Plan didn't materialize. The implementation of the plan was in a slow pace, due to delay in mobilizing financial resources, acquisition of land and other procedural difficulties. Alappuzha town had an area of 35.18 sqkm. The development plan was formulated based on the following objectives.

- To arrest haphazard development and to encourage compact urban development through the process of intensive land utilization within the developable spaces in the urban area.

- To provide optimum and adequate allocation of land for various land uses.
- To provide employment opportunities for the people in the planning area by making provisions for industrial and commercial development.
- To provide a good functional circulation system that will effectively link the various parts of the town and provide access to the less developed areas and facilitate traffic flow between production points and market.
- To provide a good environmental, community infrastructure of adequate quality at minimum cost and maximum utility.
- To preserve and maintain the cultural heritage of the town.

Table 1-1 shows the comparison of existing and proposed land use as per the development plan 2011 for Alappuzha Town.

Table 1-1: Comparison of Existing (1993) & Proposed Land Use (2011)

	Existing Land Use (1993)			Proposed Land Use (2011)	
Sl. No:	Land Use Category	Area (ha)	% of total area	Area (ha)	% of total area
1	Residential	1834.00	52.13	1223.90	52.19
2	Commercial	19.00	0.54	27.50	1.17
3	Industrial	44.00	1.25	80.80	3.45
4	Mixed Use (Residential/Commercial)	-	-	470.40	20.05
5	Public & Semi Public	153.00	4.35	35.70	1.52
6	Parks & Open Spaces	9.30	0.26	56.90	2.43
7	Roads & Railways/ Transportation zone	168.70	4.80	210.00	8.96
8	Tourism & Recreational Area	-	-	215.40	9.19
9	Green Strip	-	-	24.3	1.04
10	Vacant Land & Sandy Area	43.20	1.23	-	-
11	Water bodies	203.20	5.78	203.20	5.78
12	Paddy Field/Agriculture	1043.60	29.66	692.40	27.36
13	Hazardous Use	-	-	7.50	0.21
	Total Area	3518.00	100	3518.00	100

(Development Plan - 2011, Alappuzha Town)

The major proposals of the development plan are described below:

Proposals in Traffic and Transportation Sector

The Transportation plan of the development plan 2011 mainly aimed at the following:

(i) To promote orderly development of urban land in tune with the land use plan.

(ii) To open up those areas which have poor accessibility.

(iii) To link up all outlying areas and to reduce time and money spent on movements and promote the convenience of users of different modes of transport and

(iv) To improve the convenience and economy of the inhabitants.

Major road proposals include;

- National Highway Bypass: An alternate bye pass road to National Highway was proposed to start from Kommady Jn in the North and run in a South West direction up to Malikamukku Jn and from there Southwards along the Eastern side of the railway line up to Kuthirapanthy and from there in an Eastern direction to meet the present NH47 near the SD college. A minimum width of 45m right of way was proposed for this road. The earlier proposal of National Highway authorities was crossing the railway line at two points one at Malikamukku and the other at Kuthirapanthy.
- Outer Ring Road: This road was proposed to have a width of 24m. This road starts from the Northern side of the NH47 outside the municipal limits and runs in the Eastern direction in order to connect the Thanneermukkam road.
- Existing Alappuzha – Changanasserry road was proposed to be widened to 24m right of way.
- Portions of NH 47 in the town i.e. from Kommady Jn to Kalarkode Jn, was proposed to be widened to a minimum width of 18m and the junctions of the town roads with NH 47 were to be improved to the required standards.
- Portions of Cullen Road from NH 47 at Convent Square upto the proposed NH bypass in the West and that from NH 47 at Pitchu Iyer junctions to Pazhavangadi Jn were proposed to be widened to 18m.
- Mullakkal – Thanneermukkam road which starts from Cullen Road and runs up to the Northern boundary of the town was proposed to have a width of 18m.
- The existing Thathampally road, Malikamukku – Arattuvazhy road and S.L. Puram Road were proposed to be widened to 18m.
- All other major roads were proposed to be widened to 12m.
- In addition to that, 20 main junctions of Alappuzha city were proposed for improvement. About 5 hectares of land was earmarked for KSRTC bus station, near the

NH bypass on the Southern side of Kuthirapanthy road. The existing KSRTC bus stand was suggested to be used as a stand for mofusil buses.

- About 2 hectares of land was earmarked for private bus stand at Alissery road.

New bridges were proposed for the following roads:

1. Railway station road – bridges across Vadai canal and Commercial canal
2. Outer ring road – bridges across Vadai canal, Palace Thodu and Commercial canal
3. Beach road – bridges across Vadai Pozhi, Muthalapozhi and Thumpoly Pozhi
4. Mundrolight road – bridge across Vadai canal

- The existing boat jetty was proposed to be shifted to the opposite side of dock yard, North of Vadai canal. About 1.5 hectares of land is reserved for this.
- An inland water transport terminal was proposed on the Southern side of Vattakayal.

Proposals in Commercial Sector:

- Commercial complex in the municipal bus stand by the side of Alissery road
- Municipal market cum shopping complex on the Northern side of CCNB road
- Municipal market and shopping center near Vazhicherry bridge on the South side of VV & RB road
- Construction of shopping complex near town hall
- Construction of shop cum office complex at Bhattathiri Purayidom on the side of Shedamony Thodu
- Construction of shopping center at Valiyakulam
- Construction of a wholesale vegetable market on the Southern side of N.H Bypass

Other major proposals are:

- One zone was earmarked for cottage industries on the North Eastern side of the town.
- A multistoried office building was proposed in the Taluk office premises for relocating the scattered public offices and administrative institutions in a single centralized complex. In addition to this the existing civil station was proposed to be extended to provide the offices which are functioning in rented buildings.

- A playground and mini stadium in 1.5 ha of land at Bhattathiri Purayidom and construction of a children's park in Avalookunnu were the major proposals in recreation sector.
- There were also proposals for the development of Vadai canal, Commercial Canal and A.C canal and its extension as a complete tourism and recreational zone. Acquisition and development of beach area as a tourist centre was another major proposal in the existing development plan.
- Development of Nehru Trophy area and its surroundings, canal beautification, Maintenance, conservation and preservation of the existing archaeological structure were also important proposals in the existing development plan.

1.3.2 Master Plan for Alappuzha Town – 2031

As the Development Plan for Alappuzha Town - 2011 reached its horizon period, a draft Master Plan for Alappuzha town was published in 2016 and sanctioned vide GO(Ms) No. 5/2022/LSGD dated 15/01/2022 as per section 36(8) of The Kerala Town and Country Planning Act – 2016. Construction free land for road development is ensured through the road development proposals and conversion of paddy and wet land into other use is controlled by enforcing the zoning regulations.

Table 1-2 shows the land use break up. The major objectives of the Master Plan are:

- The economic base of the Alappuzha Municipality shall be enhanced through coir based industries and tourism sector.
- To develop a proper transportation plan by integrating local road network to the regional network and ensuring connectivity between different zones.
- Improve and expand mass and private transport infrastructure
- To conserve the water body and other ecologically sensitive areas of the town and to eradicate environmental pollution
- Viable options for disposal of solid waste and sewerage
- Alappuzha shall be developed with higher order facilities in order to serve the entire district.
- To ensure availability of basic infrastructure to the inhabitants, especially to the socially backward sections.

- To ensure availability of basic housing infrastructure to all the inhabitants.
- To promote agriculture sector through modern techniques.

Table 1-2: Existing (2010) & Proposed Land Use (2031)

		Existing Land Use (2010)	Proposed Land Use (2031)
Sl. No:	Land Use Category	Area (ha)	Area (ha)
1	Residential	1992.80	1685.96
2	Commercial	78.71	91.25
3	Industrial	40.10	30.51
4	Public & Semi Public	193.24	156.73
5	Transportation zone	192.30	241.94
6	Parks & Open Spaces	3.55	4.39
7	Water bodies	451.14	445.88
8	Agriculture	830.68	812.16
9	Beach Area	17.13	16.88
10	Residential Mix Zone	-	176.36
11	Tourism Potential Areas	-	72.12
	Total Area	3799.65	3777.44

(Master Plan for Alappuzha Town - 2031)

The major proposals of the Master Plan are described below:

- Transport development plan includes the following:
  - Improvement of bridges, strengthening and widening of 4 canal roads and widening of roads within the central business area.
  - On street and off-street parking facilities are also proposed to tackle the parking problems.
  - Pedestrian subway or foot overbridges are proposed at District court bridge, power house bridge Kothuvalchavady bridge considering the heavy pedestrian movements.
- Nearly 68.48 hectares of land are earmarked for commercial use near Mullakkal area. Higher order commercial facilities shall be possible at this area. The residential mix zones proposed at Northern end and Southern end of the town are intended for the boosting up of commercial activity. The major proposals for developing commercial facilities include development of higher order commercial centres as per development concept.
- An integrated tourism development is proposed incorporating the following proposals.

- Development of Nehru Trophy Area and its surroundings
- Canal Beautification and Maintenance
- Conservation and preservation of existing Archaeological structure
- Tourism Promotion Zone is envisaged in the plan to capture the tourism potential of the town.

- Port development is proposed with three interdependent facilities such as:
  - Passenger terminal
  - Inland marine system
  - Landside and water based recreation facilities
- Proposals in agriculture sector include the strengthening of group farming activities in paddy lands, supplying high yield variety seeds, adopting new farming techniques etc.
- A separate area is earmarked for industrial use of non-nuisance nature.
- A new market for fish is proposed at Valiyakulam for promoting the fish trade in the Municipality.
- Proposals to tackle the environmental issues include:
  - Introduction of Bio Toilets
  - Canal cleaning through salt water intrusion
  - Proposal for an environmental conservation zone.
  - Conservation of paddy / low lying area.
- Detailed study of drainage and sewerage network and its renovation is suggested.
- The proposals in recreation sector include various projects proposed under the tourism sector. Major tourism activities are concentrated on the Eastern part of the town, especially the back water tourism. A new park is proposed on Eastern side for recreation. The proposed Tourism Promotion Zone provides recreational facility for the tourists. The existing park and other facilities available in beach area are to be improved and the historical structures like pier, light house etc. should be maintained in order to attract tourists.
- The following Special zones are also proposed.
  - Zone 1: Urban Development Promotion Zone

- Zone 2: Proposed KSRTC Bus Terminal
- Zone 3: Proposed Private Bus Stand
- Zone 4: Proposed Truck Terminal
- Zone 5: New Park

1.3.3 Detailed Town Planning (DTP) Schemes for different areas of the town.

There were 9 Detailed Town Planning schemes published for the detailed development of the CBD area of the Municipality. This covered the entire canals of the town and the area between the two main canals. Four of them were published in 1993 and the remaining five in 1998 by the Alappuzha Development Authority. With the sanctioning of the Master Plan in 2022, the provisions of the sanctioned Master Plan prevail over these published Master Plans.

1.3.4 City Development Plan for Alappuzha Town

A City Development Plan for Alappuzha town was prepared under UNDP Project by 'The Institute for Societal Advancement, Thiruvananthapuram, as a Consultant for the Alappuzha Municipal Council in the year 2009. The City Development Plan for Alappuzha town was prepared based on the multi-pronged approach consisting of review of secondary data, stakeholder consultations, visioning and project preparation exercises, internal brainstorming sessions within the consultancy organization and consultation with the experts in the field of the selected project components. This report was rather project oriented, specifically in the service sectors and not prepared on a spatial platform.

1.3.5 Integrated District Development Plan for Alappuzha

A draft Integrated District Development Plan (IDDP) is prepared as a joint exercise of District Planning Committee (DPC) Alappuzha and the School of Planning and Architecture, New Delhi. The role of Alappuzha Town as envisaged in the draft IDDP is considered while formulating this Master Plan.

1.4 Need for the Plan

Alappuzha town is one of the famous tourism destinations in the country, where backwaters are one of the most popular tourist attractions, which generates huge foreign exchange and employment. Even though the tourism activities had encouraged the social and economic development of the town, it also created a lot of problems in the economic, environmental and socio-cultural sectors. Tourism development had resulted in adverse environmental impacts in terms of land, air, water etc. Construction activities led to large scale deforestation and destabilization of natural land forms and encroachment on lakes, rivers and

beaches. Ecologically sensitive areas are destructed due to the arrival of large number of tourists. Due to the growing importance and arrival of tourists visiting the town, it is essential to guide the overall development of the town in well planned manner considering all the planning parameters.

The development plan published in 1997 had crossed the horizon year and the Sanctioned Master Plan is prepared by considering the land use in 2012. The provisions in both the Master Plans should be revised as per the present requirement and by addressing the vulnerability of the town to various disasters that may happen in the future, in light of the flood hazard that occurred in 2018. In a nut shell, the current situation calls for an all-encompassing strategic planning addressing social, economic and physical (including environmental) dimensions of the area. Thus, the Master Plan will facilitate improvement of basic infrastructure including water supply, sewerage, drainage, transportation networks, and provision of parking facilities, green and open spaces. It will help to accommodate systems for traffic flow and management, formulation of effective solid and liquid waste management systems and disaster risk management for a better and bright future of Alappuzha town.

1.5 Delineation of the Planning Area

The first stage in the preparation of Master Plan is the delineation of planning area. It depends on the depth of growth and expansion towards the surrounding area. The planning area is the present Alappuzha Municipality, which comprises five revenue villages such as Pazhaveedu and Alappuzha West villages (full) and portions of Mullakkal and Aryad South and Paravur villages of Ambalappuzha taluk with a population of 1,74,176 (As per 2011Census) and stretches over an area of 35.62 sq.km.

1.6 Methodology

Master Plan will provide all contents necessary for the integral development of area covered by the Plan. Planning process for the preparation of Master Plan is as per the 'guidelines for the preparation of GIS based Master Plan for AMRUT cities' issued by the Government of India. It involves enormous works in collection, compilation, analysis of various primary and secondary data to identify issues and potentials to arrive at formulation of proposals for the horizon period. The resolution to prepare the Master Plan is taken by the Municipal Council and Master Plan Committee is formed in cooperation with the Planning wing of Local Self Government Department. The Figure 1-2 describes the methodology adopted

for preparation of Master Plan. The process of preparation of Master Plan involves the following stages:



- **Data Collection**

The primary data required for the preparation of Master Plan was collected by various surveys such as land use survey, socio-economic survey, traffic survey etc. The land use survey was conducted under the supervision of officers of the department by using the Satellite images of the town obtained from National Remote Sensing Center (NRSC), Hyderabad. Ground trothing and field checking were carried out by surveyors and the geo database has been updated using Geographic Information System Software and the existing land use map of Alappuzha Town is generated. Socioeconomic survey was conducted by a mobile application named ODK (Open Data Kit), the Performa has been prepared at the state level for all AMRUT towns and some necessary changes have done in the proforma by considering the region specificity. The data collection was conducted by the enumerators under the supervision of the Statistical wing of the LSGD Planning office, Alappuzha and verified by the officers of the department. The traffic survey and studies were conducted with the assistance of National Transportation Planning and Research Centre (NATPAC), Thiruvananthapuram.

- **Data Analysis**

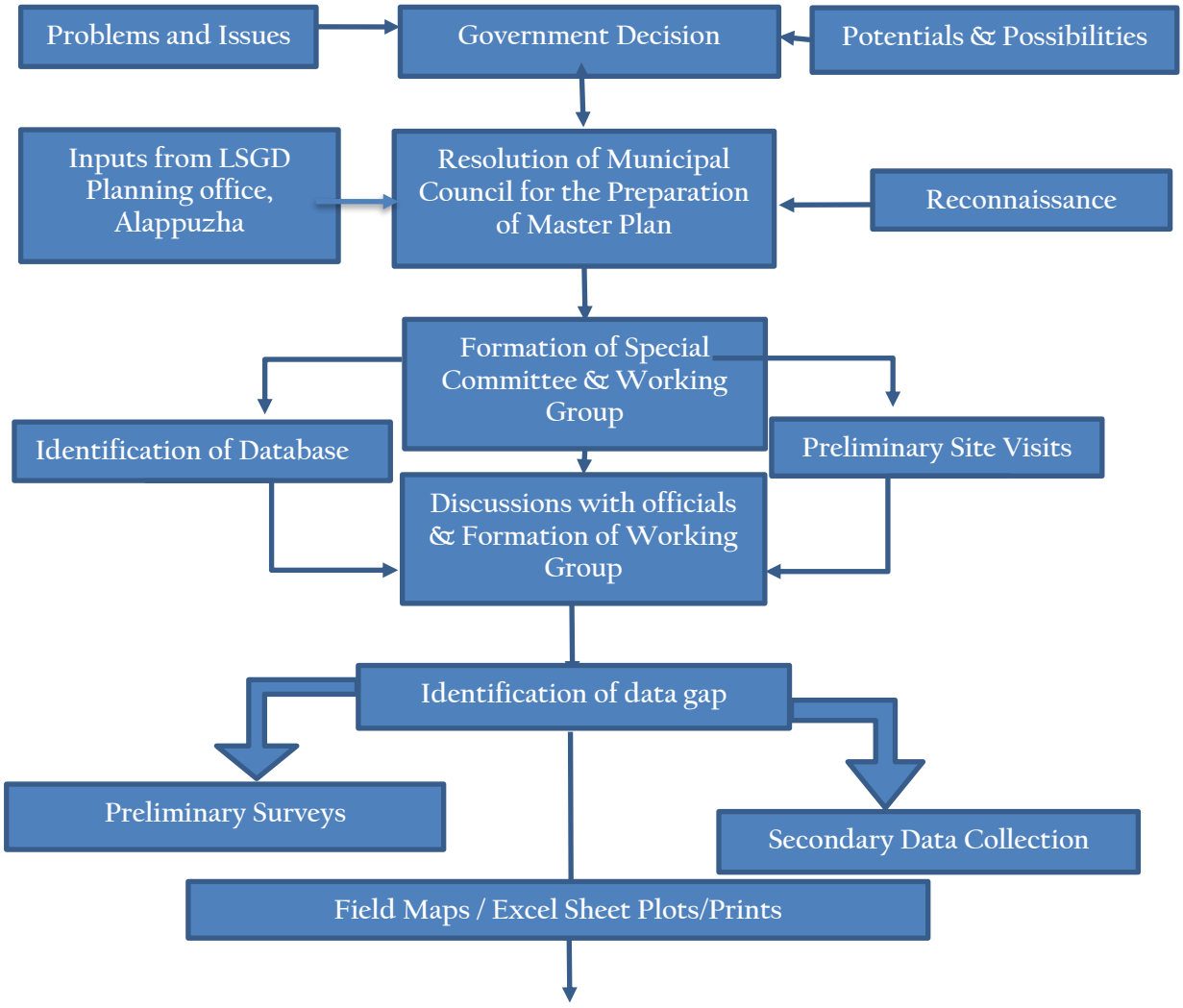
The analysis is done in two stages i.e. Local Level Analysis and Spatial Analysis. The local level analysis focuses on the development trend, its potential and development problems associated with each sector. This includes development aspirations of the people also. The Spatial Committee and working group constituted in the Municipality was responsible for this analysis. The Town Planner of the Local Self Government (Planning) provided technical guidance for the same. The spatial analysis concentrates upon regional setting of the settlement, distribution pattern of activities & population, land use and infrastructure network within the town. The findings of both the analysis and findings from the urbanization study of the district are then integrated to form consolidation of findings in order to facilitate the envisioning process.

- **Envisioning Process**

The envisioning process starts with the identification of development issues from the consolidated findings of the study and proceeds with formulation of development goals and objectives for the town. Once the objectives are identified, development policies and strategies for fulfilling the objectives, be it in the form of land use policy or specific projects for addressing the issues identified, are developed. The detailing of the development plan follows these policies and strategies.

- **Detailing**

The detailing of the Master Plan is done at this stage. The detailing includes preparation of sector level proposals to be taken up during the plan period, a detailed land use plan giving out the land use policy for the town during the plan period, zoning regulations for regulating the land use, costing and phasing of the projects proposed in the development plan and details of implementation and monitoring including the provisions for monitoring of the development plan.



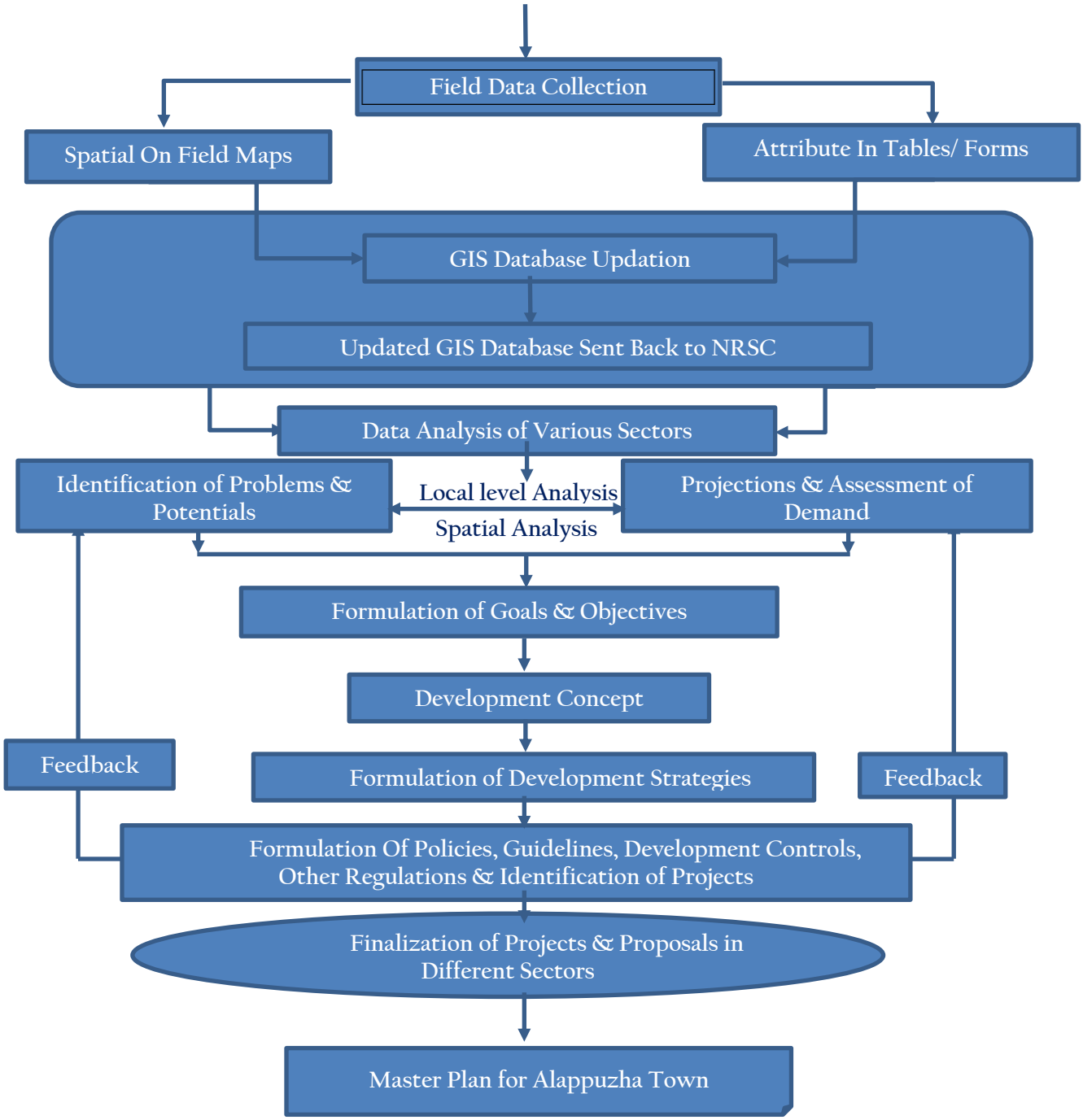


Figure 1-2: Diagrammatic representation of Methodology for the preparation of Master Plan

1.7 Stakeholder Consultation & Community Participation

Master Plan aims to utilize land and resources to best advantage for the use of people. Consultations with local communities are therefore an equally important aspect of preparation of Master Plan. It improves the Local Self Governments relationship with the community and leads to better decisions. It allows people interested in, or affected by, projects to offer their point of view before a decision is made. As per section 34(1) of The Kerala Town and Country Planning Act 2016, the Master Plan shall be prepared through a participatory process. Ensuring

public participation in the process of preparation of Master Plan is entrusted with the Local Self Government Institution as per Section 16(6) of The Kerala Town and Country Planning (Formulation and Sanctioning of Master Plan) Rules.

Even though the world-wide spread pandemic Covid - 19 had affected the process of preparation of Master Plan, data collection and discussions on development needs and identification of issues within the planning area has been done over phone and other mediums with the Municipal Council members, and other stakeholders. Consultations were done by LSGD Planning wing with various line departments, Discussions were carried out with stakeholders, general public and proposals were presented in development seminar in coordination with the Municipal Council.

Questionnaires

A questionnaire survey was conducted among the ward councillors to understand the development issues, development potentials at ward level or Municipal level.

Field Visits

Field visits were carried out by the LSGD Planning team to identify the areas having future development potentials, areas prone to hazards, areas which needs to be provided with basic infrastructure facilities such as colonies etc. with the help of municipal councillors.





Figure 1-3 : Field visits & Data Collection

Stakeholder Meetings

- Discussion of the draft proposals were carried out at the Municipal Council Hall on 08.09.2021. Municipal Chairperson, Vice Chairman and core committee members of the council attended the meeting
- Proposals in the draft Master Plan were presented by the LSGD Planning Team before the honorable MP Adv. A. M. Arif on 18.12.2021 at the Municipal Council Hall.

- Presentation of the Draft Master Plan was held at the Municipal Council Hall on 28.02.2022 at 10.30 am.
- A meeting with Councilors, Licensees, and Municipal office staffs were arranged at the Municipal council hall on 20.05.2022. Proposals in the draft Master Plan were presented. The invitees actively involved in understanding the various proposals, Proposed Land Use Map, Zoning Regulations etc.



Figure 1-4 Stakeholder Meeting at Municipal Council Hall on 20.05.2022 at 11 am

- A meeting was arranged at the Municipal Council Hall to discuss about incorporating Risk Information in Master Plan on 18.07.2022. LSGD Planning Team presented the identified hazard prone areas within the Municipality. Vice Chairman, Special Committee members, Councilors, Officials from various departments, Working Group Members etc. attended the meeting. The importance of incorporating Risk Information in Master Plan was explained by the officials from the Project Implementation Unit for the preparation of Risk Informed Master Plan. The reason for flooding, problems faced during the flood of 2018, Mitigation measures adopted by Local Self Government and various departments, Mitigation measures to be adopted to become resilient against future flooding etc. were discussed in the meeting.

Cluster/Ward level Meetings

52 wards were categorized into 6 clusters and cluster level meetings were arranged at suitable locations on 20.06.2022 and 21.06.2022 by the Municipality to discuss the draft proposals with the general public. Later, meetings of three clusters were cancelled by the Municipality itself. Meeting of Cluster 5 (12,13,31,25,8,9,26,27) was held at the Municipal Town hall on 20.06.2022 at 2 pm. Fourteen People attended the meeting and their views on

future development for the town were shared with the planning team and suggestions were given to improve the situations at ward level.



Figure 1-5 Discussion at Municipal Council Hall on 18.07.2022



Figure 1-6: Meeting of Cluster 5 at Municipal Town Hall on 20.06.2022 at 2Pm

Meeting of Cluster 6 (28,29,38,40,39,41,10,11,30) was held at the Temple of English Medium School on 20.06.2022 at 4 pm. Twenty-two persons attended the meeting and they actively involved in understanding the future development proposals.



Figure 1-7 Meeting of Cluster 6 at Temple of English Medium School on 20.06.2022 at 4Pm

Meeting of Cluster 1 (1,2,49,45,46,47,50,51,52) was held at OLF Vellappally School on 21.06.2022 at 4 pm. Twenty peoples attended the meeting and they suggested some proposals for the improvement of tourism sector, development of basic amenities, development of colonies etc.



Figure 1-8: Meeting of Cluster 1 at OLF Vellappally School on 21.06.2022 at 4Pm

Discussions with Various Department Officials

Discussion of the proposals in the draft Master Plan were carried out with various line Departments during the process of preparation of the Master Plan. The problems faced in various sectors, future development potential of the town etc. were identified during the discussions.

Development Seminar

LSGD Planning wing presented the draft Master Plan in the development seminar at Municipal Town Hall hosted by the Municipality on 30.06.2022 at 2pm. Municipal Chairperson, Vice chairman, Municipal Secretary, Council Members, Standing Committee Members, Working Group Members, Various department officials, Municipality staffs and the General Public attended the meeting. A synopsis of the draft proposals prepared by the LSGD Planning wing has been distributed to the invitees and their suggestions has been collected in written format.



Figure 1-9: Development Seminar held at Municipal Town Hall on 30.06.2022, 2pm

2 PROFILE OF THE TOWN

2.1 Location & Linkages

Described as the "Venice of the East", Alappuzha is one of the important towns on the Western coast of Kerala. It is one of the 6 Municipalities in Alappuzha District, which acquired Municipal status in the year 1906. The town lies between 09°28'00" and 09°33'00" North Latitude and 76°19'00" and 76°24'00" East Longitude. Alappuzha town is the headquarters of Alappuzha district and Ambalappuzha taluk. The Alappuzha Town is bounded by Aryad, Mannancherry and Mararikkulam South Grama panchayats on the Northern side and Punnapra North Grama panchayath on the Southern side. Pallathuruthy River is flowing through the Eastern side of the town which is bordered by Kainakary Grama Panchayat and on the Western side is Arabian Sea as shown in Figure 2-1.

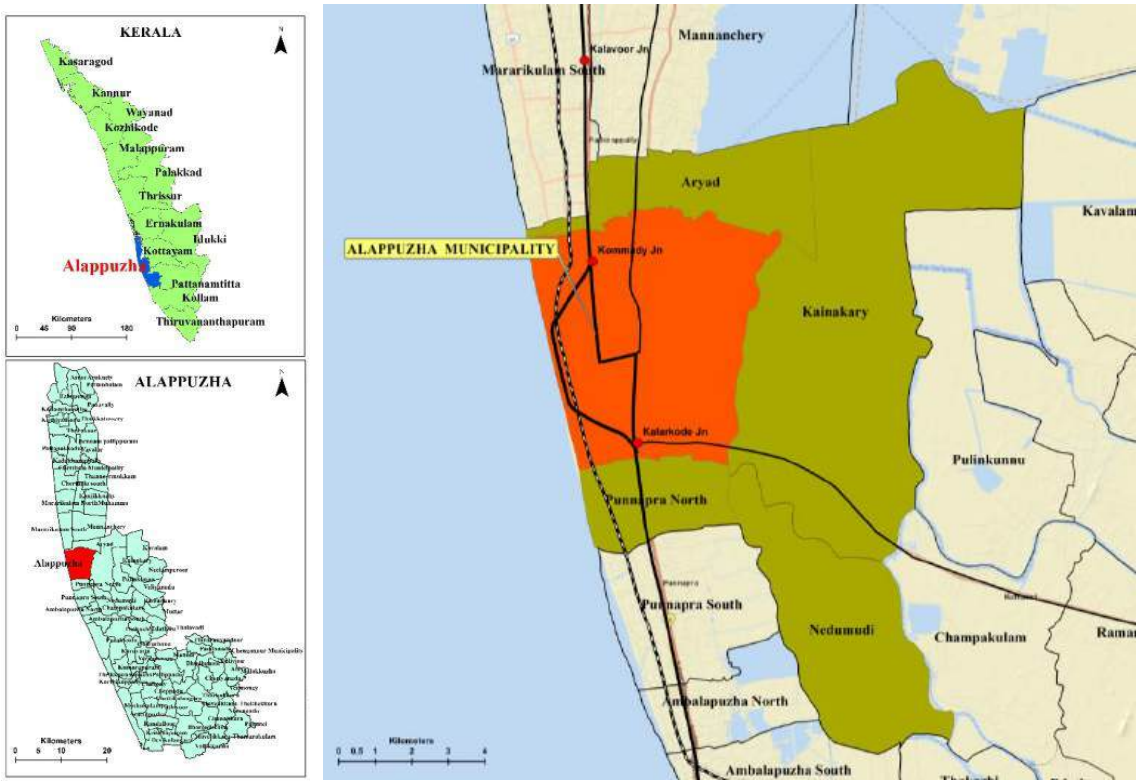


Figure 2-1: Map showing location & surrounding panchayats of Alappuzha Municipality (Generated from database)

The Alappuzha town is well connected to other towns through road and rail networks. National Highway 66 (Panavel to Kanyakumari) and two State Highways (SH 40 Alappuzha - Madurai) & SH 11 (Alappuzha - Changanassery) passes through the town. Alappuzha railway station is located nearer to the town center. The Ernakulam - Alappuzha railway line (51km) was commissioned in 1989 and an interconnecting rail link with a length of 43 km from

Alappuzha to Kayamkulam giving rail connectivity to the State headquarters was opened in 1992. With these two landmark developments the district as well as the town in particular, is well connected by railway network raising Alappuzha district to the main stream of industrial development and transport with the rest of the state.

Water transport network is yet another highlight of this region. Alappuzha has a well-connected network of artificial and natural canals within the municipal town and these interlinked canals are connected to the Vembanad Lake, having potential for developing an integrated water transport system.

The major nearest city is Kochi, located at a distance of 62 Km from Alappuzha town. The nearest airport is Cochin International airport at Nedumbassery at a distance of 85Km from the town. The National Waterway III also connects Alappuzha to Kollam and Eranakulam. On the Eastern side Alappuzha is connected to Kottayam town through roads and waterways. The 27 km long Alappuzha Changanasserry Road (opened for traffic in 1958) and 37 km long Thanneermukkom bund road provides good road connectivity between Alappuzha and Kottayam and the other Eastern side towns and mountainous regions beyond Vembanad backwaters.

2.2 Area & Population

The area of the town is 35.62 Sq.Km, which is about 3.3% of the total area of the district. The town comprises of Pazhaveedu, Alappuzha West village, Mullakkal village (full) and portions of Aryad South village and Paravur village of Ambalappuzha taluk (Figure 2-2). Alappuzha Municipality consists of 52 wards.

2.3 Climate

The climate is generally hot and humid. The divisional variation of temperature is small, seldom exceeding 10^0C. The average monthly temperature is between 32^0C and 34^0C. July is the coldest month, with temperatures averaging 25.9 °C. The dry season lasts from December to February. It is characterized by moderate humidity and occasional rains. The days are fairly hot but the nights are chill. The hot season lasts from March to May. Fairly high temperature, occasional showers and thunder storms are the characteristics of these months. The heat is moderated by the sea breeze.

The South-West monsoon begins in June and lasts till September. The driest month is January, with 28 mm of rainfall. Most of the precipitation here falls in June, averaging 689 mm. The sky is cloudy, the air is dry and humid and there is heavy rain with quests and equals of

varying intensity. The month of maximum rain fall is June. The monsoon weakens about the middle of August. The retreating of North-West monsoon takes place in the months of October and November. During this season, the rains are generally preceded by thunderstorms. By the beginning of December, the rain becomes less frequent and dry weather sets in.

Humidity of atmosphere is very high and the relative humidity variation rarely goes below 70%. Humidity is high in the months of June and July (about 90%) and low in the months of November, December and January (about 70%).

Winds are generally light to moderate with some increase in force in summer and monsoon seasons. In the period of January to May winds strengthen in the afternoon. During South West monsoon season winds are mainly Westerly or North Easterly. During the rest of the year wind blow from South to West and North to West in the afternoons and mainly Westerly or North Easterly in the mornings.

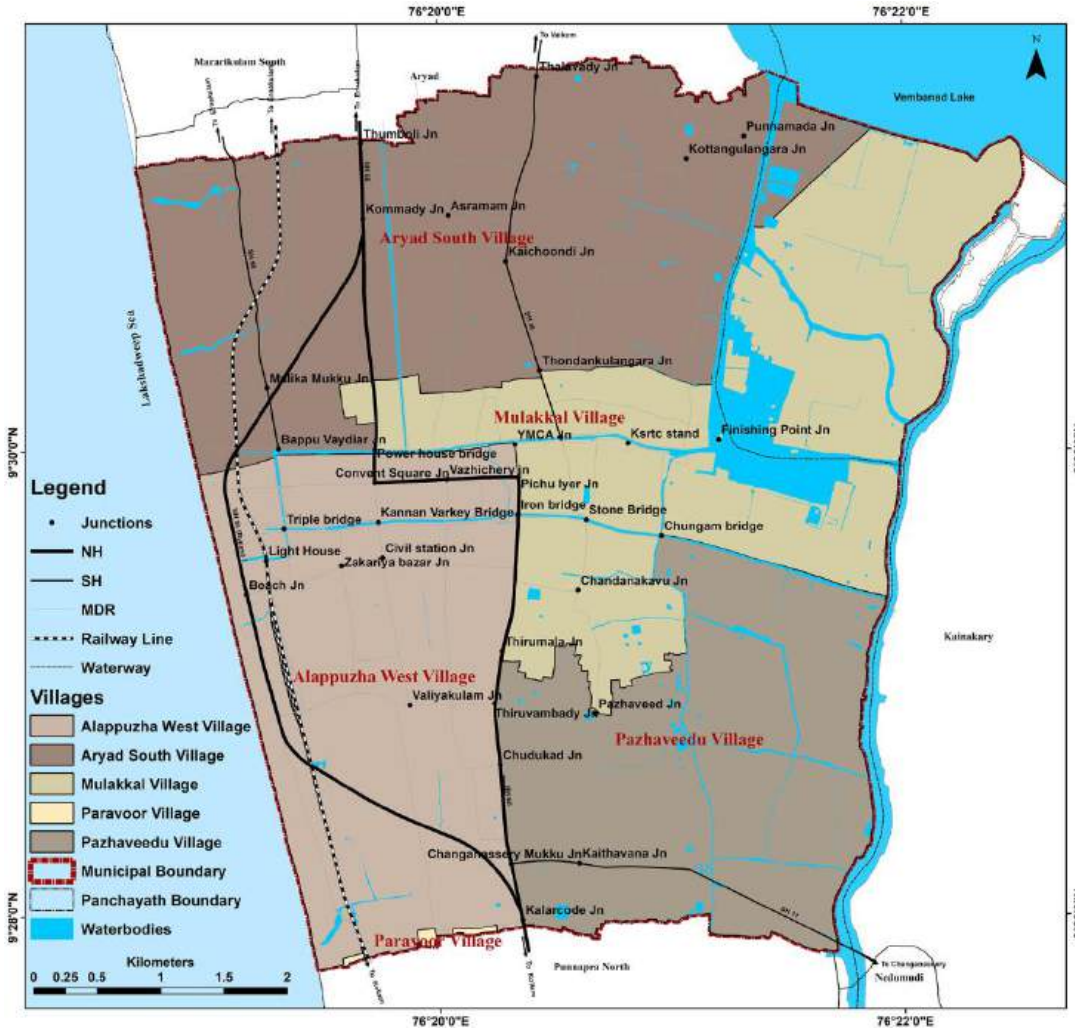


Figure 2-2: Map showing villages in Alappuzha Municipality (Generated from database)

2.4 Physiography

The geographic location of Alappuzha town is very significant. It forms part of the sandy strip of land of Alappuzha district and is intercepted by lagoons and canals. The narrow strip of land crisscrossed by canals and bridges is sandwiched between the two large water bodies - the sea and the Vembanad Lake. A singular characteristic of Alappuzha is a region called Kuttanad lying just on the suburbs of Alappuzha town. The deltaic formation of four rivers converging into the Vembanad Lake; Kuttanad lies 0.60 to 2.20 m below mean sea level.

There are neither mountains nor hills in Alappuzha town nor within the urban agglomeration. The Alappuzha town has relatively flat topography. The slope of ground falls in the category of 'level to nearly level' and 'gently sloping'. The slope of ground is in the range of 0-15%. Maximum slope in the town is 15 %. The water table is at 3 meters below the ground.

Sandy soil is seen in the coastal belt of Cherthala and Ambalappuzha taluks (North and East of Alappuzha town). Alappuzha town falls in the same zone. The characteristics of sandy soil allow rainwater to percolate to ground water. It proves to be good soil for strong foundations. The depth of soil is greater than 100 cm. This characteristic is favorable for agriculture. The soil found here is classified as sandy, peaty or 'kari', alluvial and laterite. The sandy loam to pure sand along the coast, the texture is highly porous having very little water retention capacity. The main components of this soil are silica and quartz. As the content of organic matter in this soil is not very high, chemically it is more alkaline in nature.

In contrast, in the Kuttanadu region, which lies on the Eastern part of Alappuzha, the soil is alluvial. The Kari soil (black soil) found here is highly acidic (pH 3-4 under dry conditions) having high content of organic matter but acidity decreases with continuous submergence. This type of soil is heavy textured, poorly drained and distributed in flat areas lying 1 to 2 m below sea level. During June-November, for about 6 months, the soils are continuously submerged in rainwater. Rice is the main cultivation in this region. Rich remnants of lime shells have also been found scattered in this area which is organically very rich. The region, other than these two, consists of marshy land where the soil is comparatively lesser in terms of its richness and high in acidity.

Alappuzha district has an unbroken seacoast of 82 km length, which is 13.90 percent of the total coastal line of the state. An interesting phenomenon seen along the coast here during the onset of South-West monsoon is the mud banks. Sandbars appear around the onset of the monsoons due to tidal action and collection of sediments that are displaced during the

monsoons. This periodic shifting of the mud bank zones popularly known as 'Chaakara" takes place within a range of 25 km of Alappuzha – Purakkad coast. During this period very calm sea conditions prevail in these zones due to hydraulic pressure when the level of backwater rises during the South-West monsoon.

2.5 History / Evolution & Growth of Alappuzha Town

Formerly Alappuzha was a part of the Chembakassery Kingdom with its capital at Ambalappuzha. This was annexed to Travancore state by King Marthandavarma.

History of Alappuzha town starts with the Dewanship of Raja Kesava Das. Prior to that, Purakkad was the most important place with a small harbour and was the scene of many fights between the forces of Travancore, Cochin and the Zamorins. In about 1762, Raja Kesava Das cleared the jungle-country on the coast at Alappuzha and paved the foundation for Alappuzha town. Raja Kesavadas was a statesman with a vision and he could envisage the significance of developing a port town to trade with the countries across the world, far ahead of his time. The construction of a port at Alappuzha began in 1762 and as the fulfillment to his farsightedness; the first ship embarked at Alappuzha in 1786.

Raja Kesavadas invited business magnates from as far away as Bombay, Gujarat, and Kutch and encouraged them to settle here and establish business enterprises. Infrastructure facilities were generously offered. Roads and canals were constructed to improve communication and he built warehouses and depots to facilitate easy trade. Two parallel canals, Commercial canal and Vadai canal with the ramifying system of waterways were built for easy transportation of goods to the port and from there to the countries abroad.



Figure 2-3: Commercial Canal in 1971

He stayed in Purakkad and Alappuzha and tirelessly worked to make these places the leading port towns of the day. Thachil Mathutharakan a trusted lieutenant of Raja Kesavadas gave him unstinted support in his efforts and gradually the Diwan handed over the responsibility of trade and commercial activities of Alappuzha to Mathutharakan. He succeeded in attracting leading traders from Coimbatore, Kozhikode, Madurai,



Figure 2-4: Bazar in 1960s

etc. to this port town. The names of Chekkuttivadakan who came from Kozhikode and Venkiteswara Pai who made his home at Alappuzha coming from Purakkadu are worth mentioning.



Figure 2-5: Canal side Buildings

In order to enhance the interests of trade and commerce, a canal was cut open from Pallathuruthy to the Beach, under the leadership of Mathutharakan. This canal later came to be called Commercial canal (Kachavada thodu). Such developmental activities gave rise to trade centers on either side of the canal.

Navraoji Kawasji, a Parsi family was the first among the daring and enterprising traders who reached Alappuzha and made it their home. The place where they lived is still known as Navraoji Estate. Leading merchants like Vallabha Das Kanchi and others made Alappuzha as their second native place. For improving foreign trade, Raja Kesavadas invited shipping companies like Scindia Steam Ship Navigation to start cargo centers here. James Darragh and Henry Smail established the first modern factory for coir mats and mattings here in 1859. Alappuzha attained legendary progress and became the financial capital of Travancore at the time of Raja Kesavadas. Before long, Alappuzha gained the coveted slot in the International Trade map. With a geographical indicator of its own in the form of 'Alleppey Coir' and the developments initiated by Kesavadas, the city had earned several accolades that few other cities could boast of.



Figure 2-6: Vallabhdas Kanchi



Figure 2-7: Port Office

With the increase in spice trade, the economy and income through foreign trade also increased considerably. In fact, Travancore was able to repay the huge debt accrued as a result of loan taken from the English traders for their war with Mysore, from the income that came from the

Port. Its importance as a money-making center of Travancore was such an established fact that the town was considered as a 'milch cow' of the State.



Figure 2-8: Godowns at Beach

The history of Alappuzha would not be complete without the mention of Veluthampi Dalava (Commander in Chief), a contemporary of Balaramavarma Maharaja, yet another historical figure, who played a very significant role in developing the town as a great center of commerce and trade. He succeeded in bringing the entire Pathiramanal, an island situated in the Vembanad Lake, under coconut cultivation and the large tracts under paddy. He established the market in Changanasserry (popularly called the Changanasserry Chantha) for trading of the commodities, especially spices that came from the Eastern sector. Veluthampi Dalava contributed greatly for the development of waterways, which enabled Alappuzha to become a commercial hub. a number of waterways in his effort to make Alappuzha a commercial center. He established a Sachivalay (administrative office) and salt pandakashala (godown) near the beach.

Alappuzha with its smooth mud bank afforded facilities for shipping operations throughout the year. A light house was built here in 1862 under the supervision of Captain Facriford. This 28 mtrs high circular masonry tower (red and white bands) stands 33 meters above mean sea level and 4 Km away from the town. It flashes light every 15 seconds and its range is 25 nautical miles.



Figure 2-9: Light House

The 1270 feet pier at the Alappuzha beach that extends into the sea was the outcome of long and tireless efforts and dates back to 1862. The pier is one of the most important landmarks of Alappuzha, as it was the Gateway to all its glory. It was constructed by Captain Huge Crawford and served as a platform that provided access and protection to ships and boats. Built by the Commercial department of Travancore, it was only a wooden bridge during the period 1871-72 and used for loading and unloading goods on a very small scale from

commercial boats. The Bridge did not stand for long and it fell apart by 1875. In spite of repairs that were done, it fell apart once again in the cyclone of 1879. Afterwards an Iron Screw Pile Pier was built in 1880 A.D. Owing to the recession of the sea in 1892 A.D. it became necessary to repair and extend the old pier further. A further recession of the sea later on necessitated the construction of the new existing pier in 1910 A.D. This was subsequently extended further in 1933.

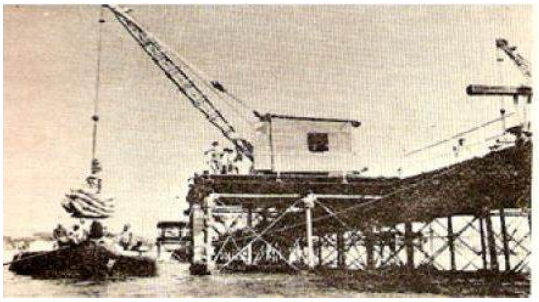


Figure 2-10: Pier in the Past

Alappuzha had been a thriving port city till the late 1960s. Although a major port for the export of cashew nut, coir, copra and spices among others for a long time, the absence of container handling facilities and the commissioning of an all-weather port in Kochi in 1935 hit the seasonal Alappuzha port hard. The development of Cochin harbour during the second quarter of the century marks the beginning of the decline of Alappuzha market and port. The business community found better prospects in Kochi and a large number of them moved to Kochi. Within a span of 150 years the golden age of this commercial metropolis declined and the political developments as well as the development of Kochi Port finally sealed its fate. The credit of having the first post office and first telegraph office in the erstwhile Travancore state goes to this town. The first Telegraph office of Travancore was established in Alappuzha in 1863. Initially telegraphic messages were sent up to Kochi but later it got extended to Tuticorin. As the town progressed and trade advanced, it became necessary to establish trade relations with other countries of the world. The Post Office, to receive and distribute letters, similar to the Post Office in Britain, was set up in 1857.



Figure 2-11: Port in the Past



Figure 2-12: Old Post Box

Later, this centre became part of the Anchal (postal) Department of Travancore. It is a reflection on its importance as a leading town in Travancore that all these facilities were bestowed on Alappuzha at a time when even the capital city of Thiruvananthapuram did not have one. Alappuzha was also witness to progressive concepts like the Town Improvement Committee, which was set up in 1894 with Repli Mackay, being its first President.

2.5.1 Spatial Development of the Town

Before 1760s - Blacksmith canal & Chungam Area

Evolution of Activity in Alappuzha begins with the port and the canals which breathed life into the place, before which it was known to be tropical jungle. Until 1762 the hamlet Alappuzha at the dead end of small stream on the Western outskirts of the backwaters, seemed the only inhabited place in the area. Hamlet consisted probably of a few Konkani traders and some artisans, among them apparently some blacksmiths who according to one interpretation, coined the name of the settlement. While the artisans lived along the stream, Konkani merchants occupied the area directly North of it: Thirumala. The trade activities took place along the blacksmith canal and chungam area. (ArchitectureBatch, 2016) (H.Schenk, 1986).

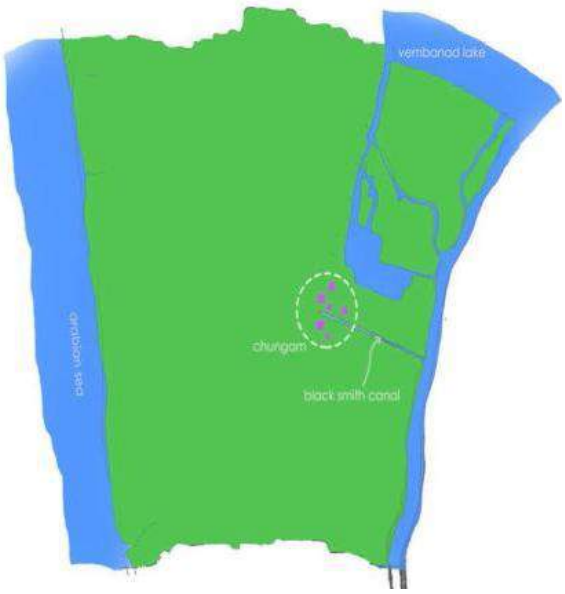


Figure 2-13: Settlement before 1760

1760 – 1800 - Construction of Commercial Canal

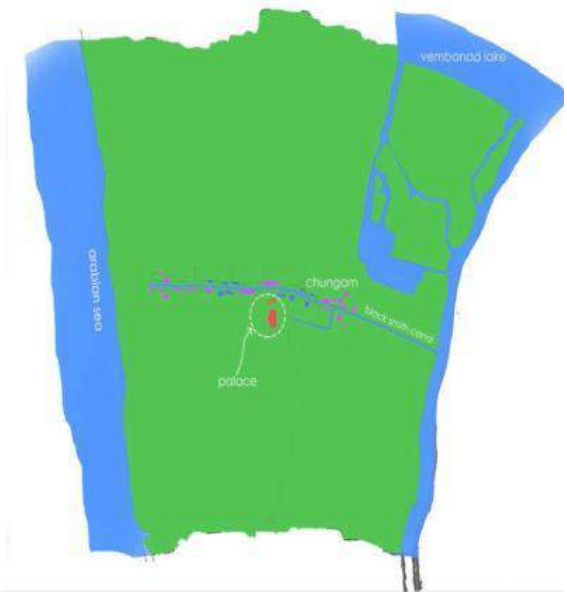


Figure 2-14: Town Between 1760 and 1800

Commercial canal was dug or rather extended from Alappuzha hamlet and stream to beach in order to bring merchandise by boat close to the sea, while on its banks go-downs and an office of state commercial department (cutcherry) were built. The only dominant spatial expression of the character of Alappuzha as it developed from 1762 onwards is its main canal – Commercial canal. This canal was the lifeline of the town and the very heart of it. Commercial canal was divided into 5 sections by four bridges connecting Northern side with Southern side of the canal. Commercial activity evolved with Godowns built on both sides for storing spices for trade. Palace was also

constructed near Commercial canal for governing trade activities. Commercial canal extended towards the palace for ease of transportation. Commercial canal was of course the main and almost only transport artery, and on its banks godowns, business offices, residences of traders and similar buildings were constructed (ArchitectureBatch, 2016) (H.Schenk, 1986).

1800 – 1815 - Flourishment of Trade

Commercial canal culminated at its dead end – a few hundred metres from the sea – where it widens somewhat to make for more manoeuvring space for the vallams and where the godowns are concentrated. Traders who were invited by minister settled as community. Muslims stayed South of commercial canal, Christians North of it. Konkani brahmins had their nucleus in the East, in Tirumala and later also near the palace of maharaja in the South East. Namboodiris stayed West of Tirumala around the present Mullakkal area. Gujarathis - possibly including Kutchis, Sindhis and Parsis – concentrated in the West close to the beach, where there is even now a Gujarathi street can be seen. It demonstrates the importance of North Indian trading communities in the original social structure of the town (ArchitectureBatch, 2016) (H.Schenk, 1986).

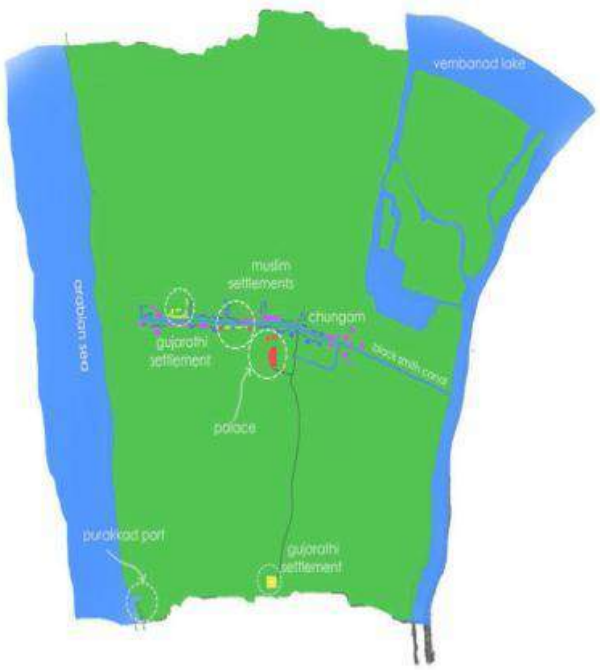


Figure 2-15: Town Between 1800 and 1815

1815 – 1900 - Construction of Parallel canals & Port

Physical planning in the 19th and early 20th centuries included the digging of a parallel canal – Vadai canal – 4 furlongs North of commercial canal, 2 short canals connecting the main canals in the Western and Eastern sections of the town. Spatial filling of the area between the canals by a regular chequer board type road pattern, and a gradual extension of urban space built up South and North of 2 canals. This period saw the colonial rule in Kerala and focused on the construction of port facilities. Wooden pier was replaced by iron pier. This period marked glory in the history of Alappuzha (ArchitectureBatch, 2016) (H.Schenk, 1986).

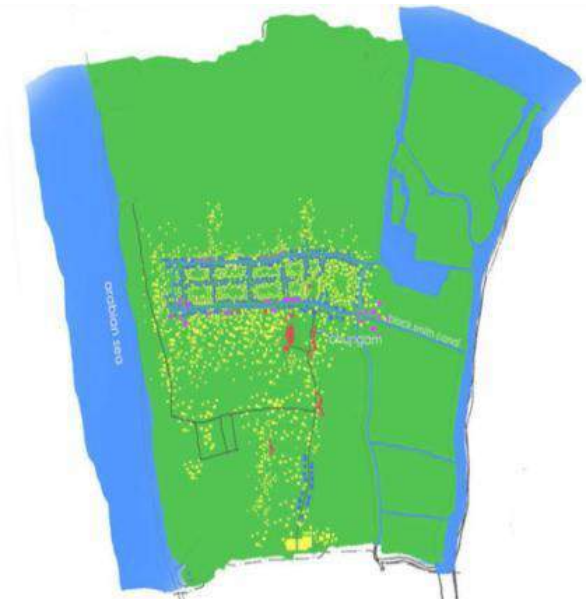


Figure 2-16: Town Between 1815 and 1900

This period saw the establishment of various religious institutions like the first colonial church and educational institutions such as first primary school established by Colonel Norton. First angelical church, CSI and St. Mary's Forane church were established by Dutch. First higher secondary school, Leo XIII was founded in 1889 by a Portuguese Bishop (H.Schenk, 1986).

1900 – 1947 - Decline of Port, Emergence of Coir Industry

The early 1900s saw the development of surface transport. After reaching the highest point of prosperity in trade in the late 1800s, Alappuzha as a trade centre began to decline due to the development of Kochi port in 1920s. Coir industry continued to grow with Europeans setting up coir factories along the canal which led to the origin of New Bazaar and the coir industry reached its zenith. Character of Alleppey changed from a trade dominance to an industrial dominance, commercial canal kept its central role in the urban economy, assisted by Vadai canal. Commercial canal carried the vallams bringing coir yarn from the backwater villages to the factories along its banks. There small jetties, quays and stairs bear witness to the transshipment of coir yarn from small boats into the factory premises of William Goodacre, Darragh Smail, Aspinwall and so many others. From there the occasional roads to the South and North brought workers from the surrounding villages to the factories. The market remained hidden by the waterfront structures and the

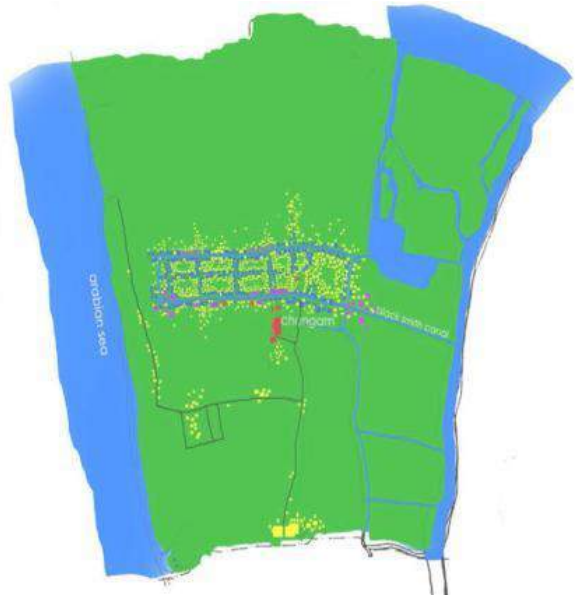


Figure 2-17: Town Between 1900 and 1947

New Bazaar just added to the dominance of commercial canal. After IInd World War coir trade declined. Economy of Alappuzha collapsed (H.Schenk, 1986) (ArchitectureBatch, 2016).

1947 – Present - Decline of Coir Industry, Emergence of Tourism

After independence, Alappuzha's identity shifted from an industrial town to predominantly administrative due to decline in port activity and coir trade. Government offices and civic amenities were setup. Change of occupation from trade & commerce to administration and services resulted in the decline of activities linked with the canal. The downfall of economic base of Alappuzha brought decay of the town and this is most visible at Commercial Canal and its immediate surroundings. The decline of port led to the migration of the ethnic communities to other places resulting in the loss of cultural diversity. Due to the development of road transportation, residential buildings developed away from canal. Settlement spread out in grid iron pattern. Port became nonfunctional. Railway line developed during this period. Tourism emerged as a new economic base (ArchitectureBatch, 2016) (H.Schenk, 1986).

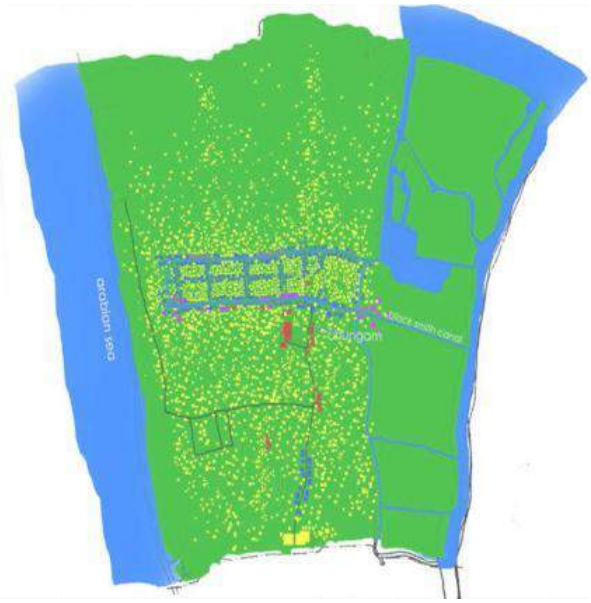


Figure 2-18: Town After 1947

2.6 Biodiversity

The Vembanadu kol Wet-land borders the Eastern side of the Municipal area. Vembanad Lake is the most important waterbody of the West Coast Canal System. It is the largest waterbody in the state. It spreads over a vast area stretching from Alappuzha to Kochi. Five rivers originating in the Western Ghats, Pampa, Achankovil, Manimala, Meenachil and Moovattupuzha rivers drain into this waterbody in addition to the numerous canals and river branches draining to this. Vembanad Lake is ecologically and environmentally highly sensitive. The significance and relevance of preserving the identity and character of this wetland is not given due consideration in the present-day developments. The waterbody is decreasing in area due to encroachments and is getting polluted by activities in and around the lake. The aquatic life is seriously affected. The area of the lake has shrunk from 36,329 hectares in 1834, to 12,504

hectares in 1984 and the water holding capacity consequently declined from 2.449 cubic km to 0.559 cubic km. The lake is reduced to 37 % of its original area, as a result of large scale land reclamation. The uncontrolled mining of shells from the lakebed is also posing threat to the ecosystem. The sewage effluents and the heavy load of organic and toxic industrial waste released from the neighbouring areas is let into the water and are responsible for the decrease in dissolved oxygen content in the water in the lake.

The fish, reptile and the molluscs in the lake face threat to their very existence. Though reduced of late, coconut husk retting also contributes to deterioration of the water quality. High organic content, high BOD, low oxygen, and high sulphide content of retting zones are found to be devastating for the bottom fauna in the lake. The construction of Thanneermukkam barrage in the year 1976 caused water quality problems such as reduction of the flushing action in the waterbodies and thereby led to proliferated growth of weeds and water hyacinth in the water body.

During the peak South-West monsoon period (July-August), the outbreak of a severe fish disease among the fresh water fish was reported. It is also reported that the incidence of cancer is on the rise in certain grama panchayats bordering the backwater. These indicate the deterioration and degradation in the ecosystem.

Considering the fragile ecosystem of the wetland, deterioration of water quality and consequent damage to aquatic organisms and the shrinkage of Vembanad Lake, this wetland system was included in the National Lake Conservation Plan (NLCP) in 2003 by the National River Conservation Authority, chaired by the Prime Minister under the Ministry of Environment and Forest. Government sanctioned Pampa Action Plan under the NLCP, but the project did not meet the expectations.

Vembanad-Kol Wetland of area 1512.5 sqkm is included in the Ramsar list of Wetlands of International Importance on 19/08/02. The Ramsar Convention (The Convention on Wetlands of International Importance, especially as Waterfowl Habitat) is an international treaty for the conservation and sustainable utilization of wetlands, i.e. to stem the progressive encroachment on and loss of wetlands now and in the future, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific and recreational value. In spite of all these, scant attention is paid to generate awareness among the common people and the stakeholders in the tourism industry.

2.7 Inferences

Alappuzha is a famous tourism destination, which is having an area of 35.62 sq.km with 52 wards having a population of 1,74,176 as per 2011 Census. Alappuzha Town lies entirely in the low land belt. The town is well connected by road and rail networks. Occasional rainfall, warm humidity, of atmosphere and a fairly uniform temperature throughout the year are the characteristic climatic features of the town. Alappuzha town forms part of the sandy strip of land of Alappuzha district and is intercepted by lagoons and canals. The soil found here is classified as sandy, peaty or "Kari", alluvial and laterite.

The town boasts a rich historical and cultural past. Presently the town as a whole represents only a shadow of its former splendor. Gradually over a few decades' economic importance of the town declined without any attempt from any quarters to arrest its decline till recent years. Presently Alappuzha has become an internationally renowned destination for leisure tourism, especially with regard to waterfront tourism in the state.

3 REGIONAL SETTING

3.1 Regional Significance

The regional setting of a town can be arrived from the Regional Plan which spells out hierarchy of the town in the District Scenario, the activity of the town has to perform and its connectivity with different settlements. Detailed regional setting studies were carried out in the state and Alappuzha district in connection with the Scheme of Preparation of Development Plans for Municipalities, which has been documented as the Sate Urbanization Report (SUR) and District Urbanization Report (DUR) respectively. In addition, draft Integrated District Development Plan (IDDP) for Alappuzha District is prepared through a joint exercise for the purpose carried out by the District Planning Committee, Alappuzha and the School of Planning and Architecture New Delhi. The regional setting of Alappuzha Town has been brought out with clarity in SUR, DUR and IDDP and is explained hereunder.

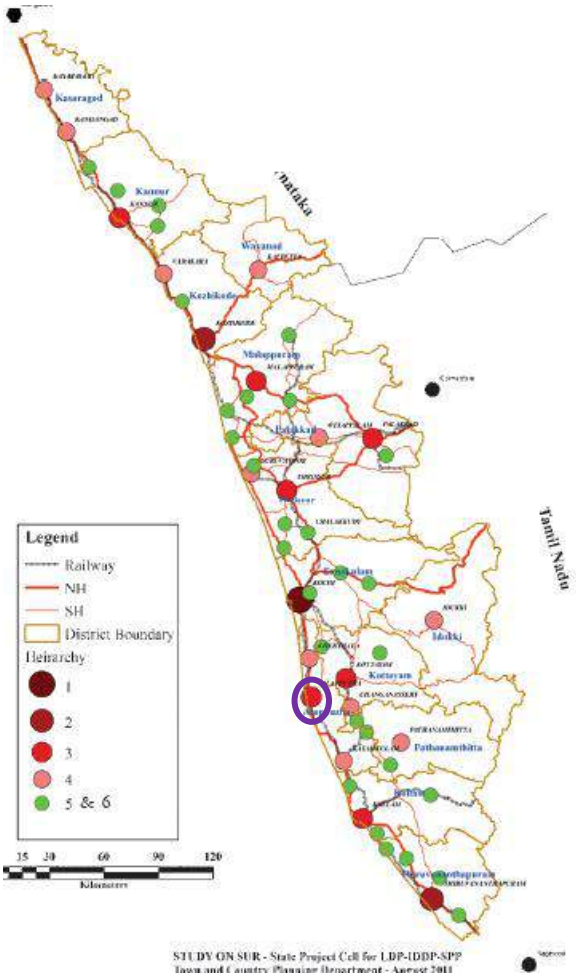


Figure 3-1: Spatial distribution of urban centres with hierarchy

As per the State Urbanization Report of Kerala published in 2012, Alappuzha urban agglomeration which includes Alappuzha Municipality, Kalarkode Out Growth, Punnapra Out Growth and Komalapuram Census Town, is envisaged as a 3rd order hierarchy urban center, where corridor type peri - urban development can be expected. Figure 3-1 shows the urban centers in Kerala and Figure 3-2 shows the service zones of these urban centers. Kochi UA is the only first order urban center in the state. There are only two second order urban centers in the state. They are Kozhikode UA and Thiruvananthapuram UA. There are seven third order urban centers in the state and Alappuzha UA is one among them. The third order urban centers other than Alappuzha are Kannur, Malappuram, Palakkad, Thrissur, Kottayam and Kollam. The comparison of population and population

density in these third order urban centers are shown in Figure 3-3 and Figure 3-4. Comparing the population of Alappuzha UA with other third order urban centers it is seen that Alappuzha UA has the lowest population. But in population density Alappuzha UA has third position among the seven third order urban centers. Table 3-1 shows the service population of third order urban centers. As a third order urban settlement in the state, the estimated service population of Alappuzha is 1204800. The service area and service population of Alappuzha town is comparatively lower than the corresponding values of other third order urban centers. But since the urban content as well as urbanization pace of Alappuzha District is noted high, Alappuzha UA is retained as a third order urban center as per the delineated urban profile in the State Urbanization Report.

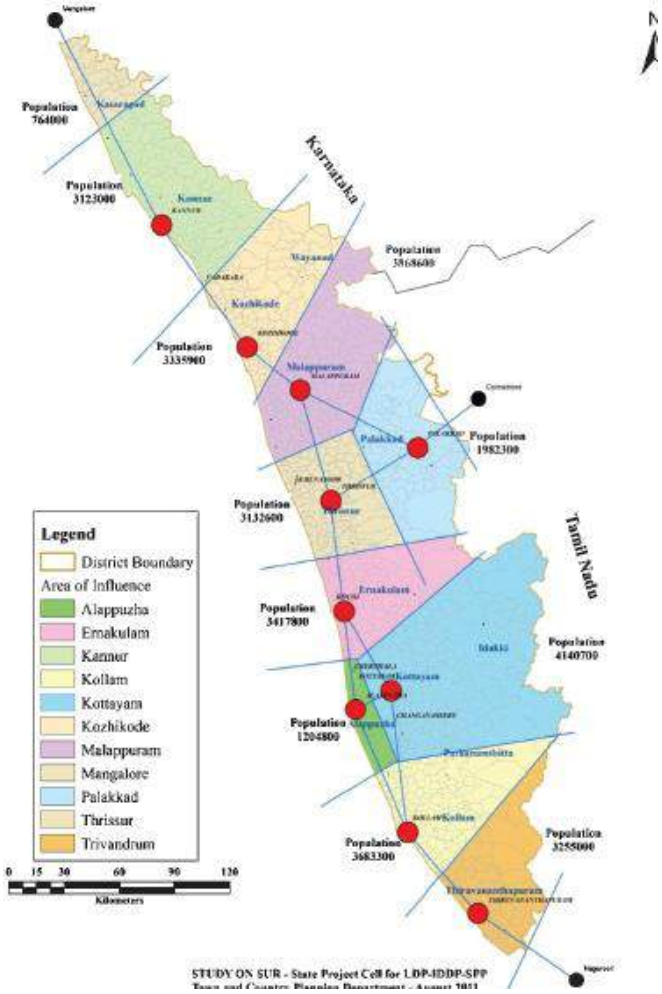


Figure 3-2: 3rd order urban centers with service zones

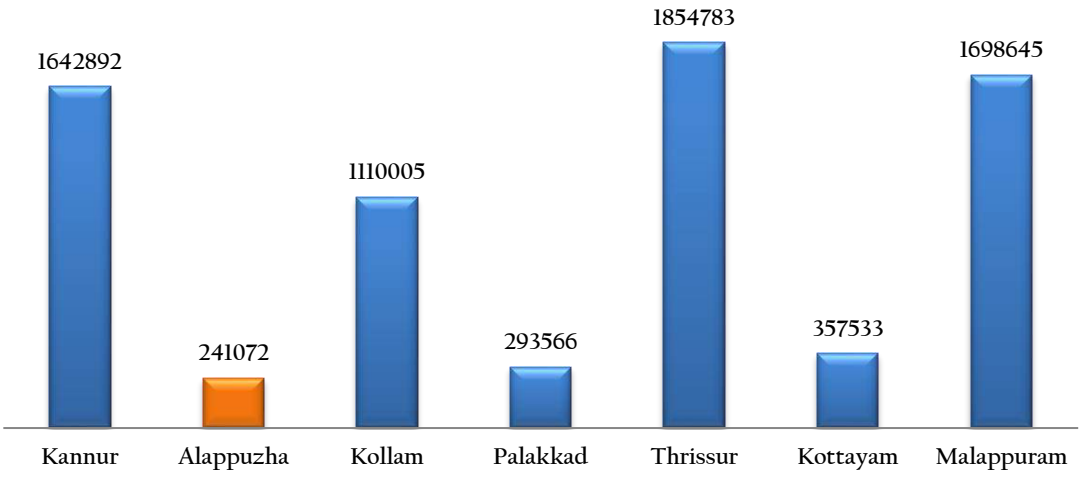


Figure 3-3: Population of 3rd order urban centers

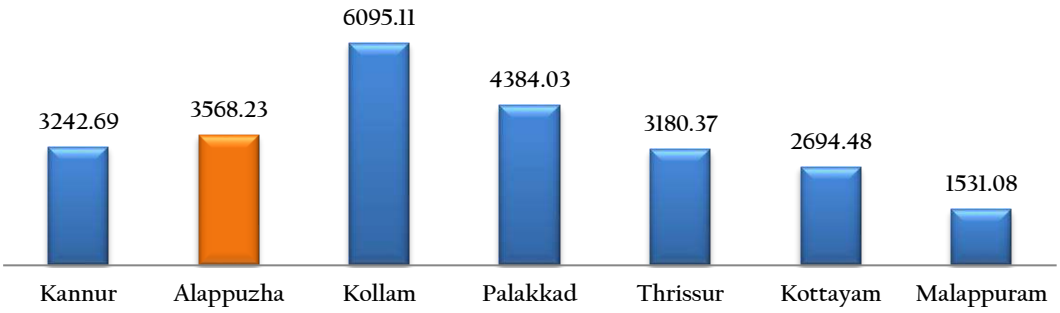


Figure 3-4: Population Density of 3rd order urban centers

Table 3-1: Service population of urban centers

3rd order urban center	Service population
Kannur	3123000
Kozhikode	3335900
Malappuram	3868600
Palakkad	19282300
Thrissur	3132600
Kochi	3417800
Alappuzha	**1204800**
Kottayam	4140700
Kollam	3683300
Thiruvananthapuram	3255000

(State Urbanization Report, Kerala, 2012)

Analyzing the category of workers in the urban centers of the state as per SUR it is stated that "The analysis of the tenfold category of workers unequivocally reveals that the workers in the Municipal Corporations of Kerala are not engaged in agricultural activity whatsoever (except in Alappuzha and Palakkad Municipal Councils), but a small portion of them are engaged in livestock and fisheries activities etc. But in the case of the two Municipalities under study viz Palakkad and Alappuzha, comparatively more share of workers is seen in agricultural pursuits."

According to the census 2011, Alappuzha town forms part of the Alappuzha Urban Agglomeration. As per the future urbanisation trend delineated in the State Urbanisation Report, in 2021 Alappuzha UA forms part of the Alappuzha Urban cluster which in turn in 2031 forms part of the Alappuzha – Ernakulam-Thrissur- Palakkad Urban Corridor. Urban Profile 2021 & 2031 are shown in Figure 3-5 & Figure 3-6 respectively.

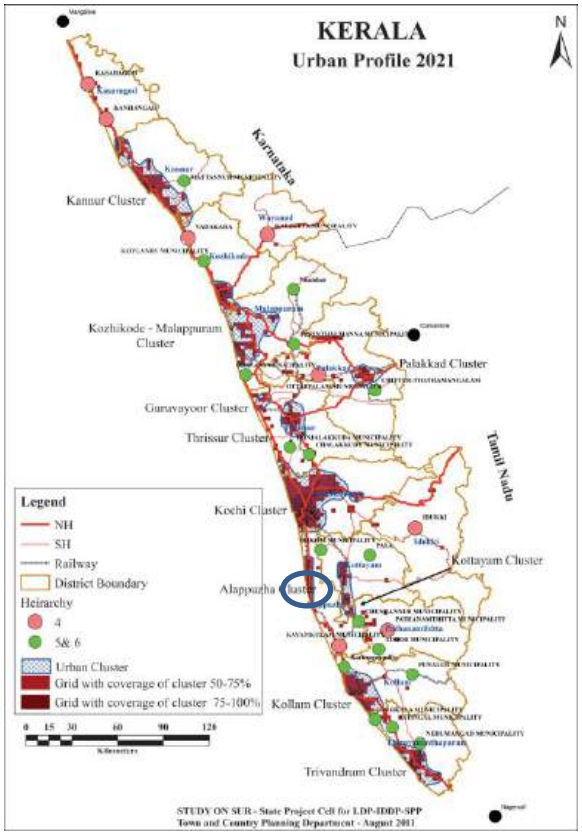


Figure 3-5: Urban Profile 2021

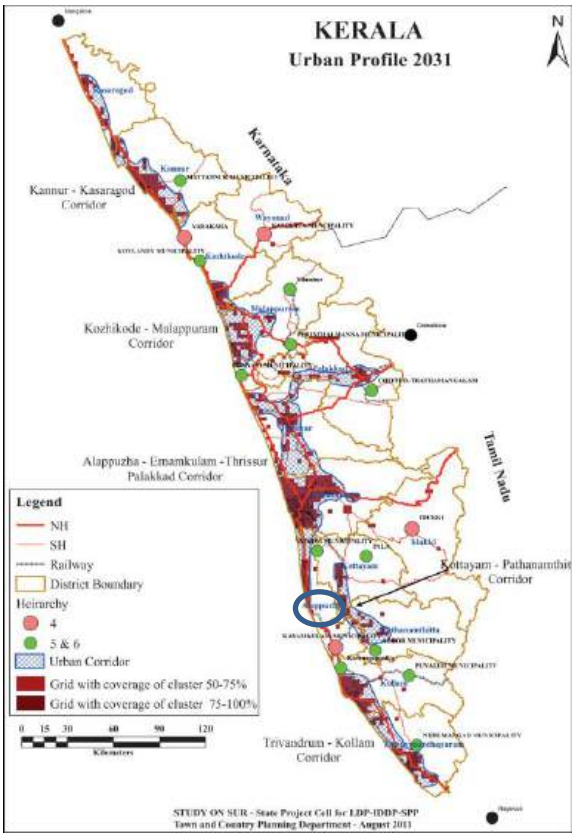


Figure 3-6: Urban Profile 2031

3.2 Spatial Structure of the District and the Role of Alappuzha Town

Spatial structure of the district is a derivative of the inputs from the analysis on settlement hierarchy, connectivity and activity pattern of the district. Activity pattern of the district is evolved from land use concentration pattern, functional character and future urban profile. Functional character is determined from population distribution and land use, urban profile is derived considering occupational structure and hierarchy of settlements and the land use concentration pattern is evolved from the land use analysis and real ground scenario. The various findings from the analyses on each of these aspects are overlaid to evolve the spatial structure of the district. The spatial structure of the district

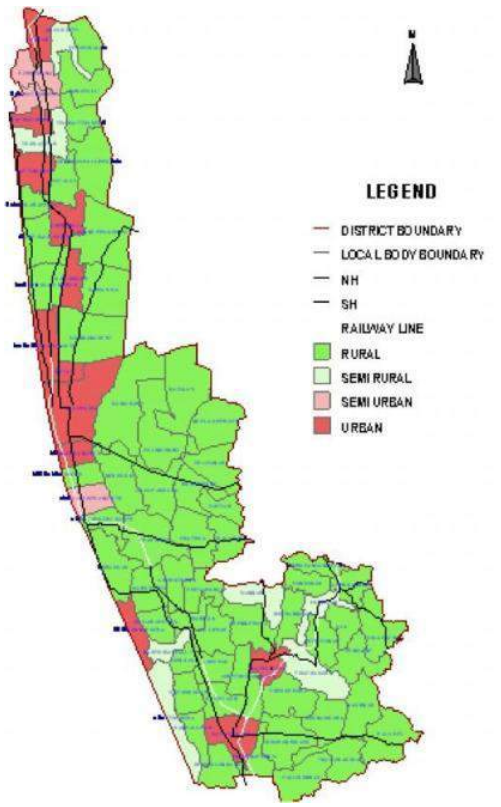


Figure 3-7: Spatial Structure of Alappuzha District

thus evolved in the District Urbanization Report is represented in Figure 3-7.

Alappuzha Municipality is the first order settlement within the district. The connectivity patterns show that Alappuzha town, being the administrative headquarters and commercial center serving the entire district acts as the first order node. The higher order nodes and settlements are well connected by existing National Highway, State Highway and other district roads. Teritiary activity is predominant in Alappuzha Municipality. In the DUR for Alappuzha the major function of settlements is determined by studying the major land use and the average plot size in the settlement. According to this study Alappuzha Municipality exhibits an urban character. The functional character of the district is shown in Figure 3-8. This indicates that the character of Alappuzha town is urban as per urban profile, non-agricultural as per land use concentration and urban as per functional classification.

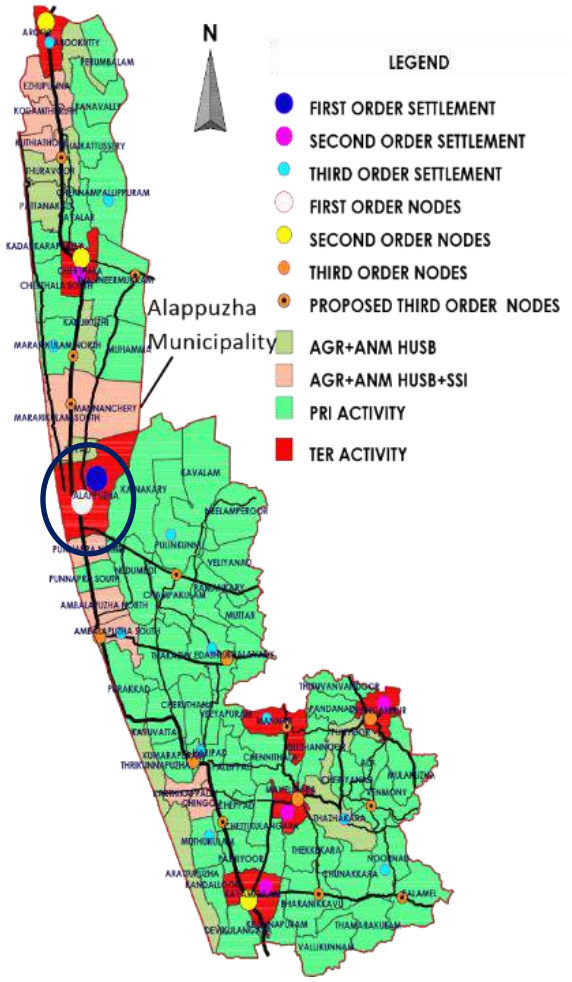


Figure 3-8: Functional Character of Settlements in Alappuzha

Source: (District Urbanisation Report, Alappuzha, 2011)

3.3 Regional Connectivity

Connectivity is a term to denote how well an area is connected to other regions (inter regional) or within the region (intra-regional). This may be by air, road, rail or water. The regional/ district level connectivity network as per the District Urbanization Report is shown in Figure 3-. Figure 3- depicts the major regional connectivity networks of Alappuzha town.

Alappuzha town is well connected with the major urban centers of the state through road, rail and waterways. The existing major road network comprises mainly of the national Highway-NH66 and State Highway viz. Alappuzha Changanacherry Road SH 11, Alappuzha Madurai Road SH40 and Alappuzha Chellanam Road SH66. With the commissioning of the coastal railway line in 1992 Alappuzha merged with the main stream of industrial development

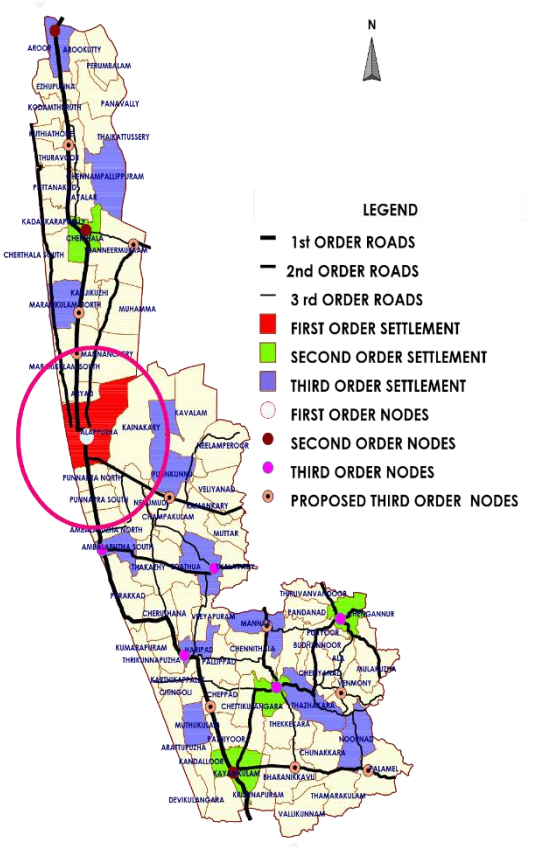


Figure 3-9: Transportation network, Alappuzha District

Source: (District Urbanisation Report, Alappuzha, 2011)

transport. Its importance is recognized especially in the context of water front tourism developments gaining more importance by virtue of the potentials in this sector.

Alappuzha town is the only First Order settlement in the district as per the District Urbanization Report. In the case of nodes also Alappuzha is First order with a weightage of 28. Being a first order center in the district, the town caters to the entire population of the district. The service area of Alappuzha Municipality when considered as a third order settlement includes the neighbouring LSGIs like Aryad, Nedumudi, and rail transport with the rest of the state. Earlier waterways played an important role in the transportation system of the town. The interconnected perennial water bodies provide an ideal platform for inland water transport. The public transport system operated by the State Water Transport Department with its headquarters at Alappuzha. The department has boat stations, both within the district and outside the district under its control. The National Water Way 3 passes through the town and a terminal is located within the municipal limits. It is likely to boost up the transportation of goods by waterways. Waterways being more environment friendly and economical have unique advantages over other modes of



Figure 3-10: Transportation network – Alappuzha Town

Mannancherry, Kainakary and Punnapra North. Service area and service population of the Municipality as a third order settlement is listed in the Table 3-2.

Table 3-2: Service area of urban centers

Sl. No	Local governments served	Service Area (sq km)	Population	Density p/sq km	Population Growth Rate
1	Alappuzha Municipality	46.71	174176	3729	-1.61
2	Aryad (P)	6.87	32265	4696	14.86
3	Nedumudy(P)	16.47	19701	1196	45.91
4	Mannancherry(P)	34.52	50990	1477	7.45
5	Kainakary(P)	33.05	19094	578	-8.55
6	Punnapra North(P)	11.06	28749	2599	6.62

(Census Data, 2011)

3.4 Inferences

Alappuzha town is the only First Order settlement in the district. State Urbanization Report of Kerala 2012 envisages that Alappuzha Urban Agglomeration will form a part of the Alappuzha urban cluster in 2021 and which in turn 2031 forms part of the Alappuzha – Ernakulam-Thrissur- Palakkad Urban Corridor. Also it is envisaged as a 3rd order hierarchy urban center, where corridor type peri - urban development can be expected. The distribution of the third order urban centers shows that the service area and service population of Alappuzha district is comparatively lower than those of the other third order urban centers in the state. Population and density of Alappuzha town are remarkably higher than nearby local bodies. The connectivity patterns show that Alappuzha town, being the administrative headquarters and commercial center serving the entire district acts as the first order node. The higher order nodes and settlements are well connected by existing National Highway, State Highway and other district roads. Teritiary activity is predominant in Alappuzha Municipality. Functional character of Alappuzha Municipality shows that it exhibits an urban character. Alappuzha is the commercial hub of adjacent local bodies. On physical verification, it is clear that nearby local bodies exhibit rural nature. Hence the planning area for Alappuzha town is delineated as Alappuzha Municipal Area itself. However, studies reveal that LSG's of Aryad, Mannanchery, Mararikulam South and Punnapra North shall be added in the planning area at a later stage since these local bodies will attain urban nature in the near future. The town is well connected to the other parts of the district and State. The water bodies have leashed a new breath of life to the economy of the town by way of developments in waterfront tourism and related activities.

4 DEMOGRAPHY

Planning is essentially a tool in achieving the justifiable wants and equitable distribution of the requirements of the population. People are the ultimate beneficiaries in any development endeavor. Planning is aimed at providing maximum good for the maximum number of people. Hence, it is imperative to analyze the characteristics of population by studying the various parameters such as population size, growth rate, population density, population concentration pattern, migration details and assessment of future population etc.

4.1 Population

Total population of Alappuzha district as per 2011 Census is 21,27,789 which is 6.37 % of total population of the state and the district is placed at the 9th position as far as population size is considered. Alappuzha is the smallest district in the state in terms of area (3.64% of area of the state).

As per 2011 census, the total population of Alappuzha Municipality is 1,74,176. This is 8.19% of the total district population of Alappuzha and 50.09% of the total urban population of Alappuzha district. The decadal variation of population from 1971 to 2011 of the district and Alappuzha Municipality is shown in Figure 4-1. Table 4-1 shows the ward wise population of Alappuzha Municipality.

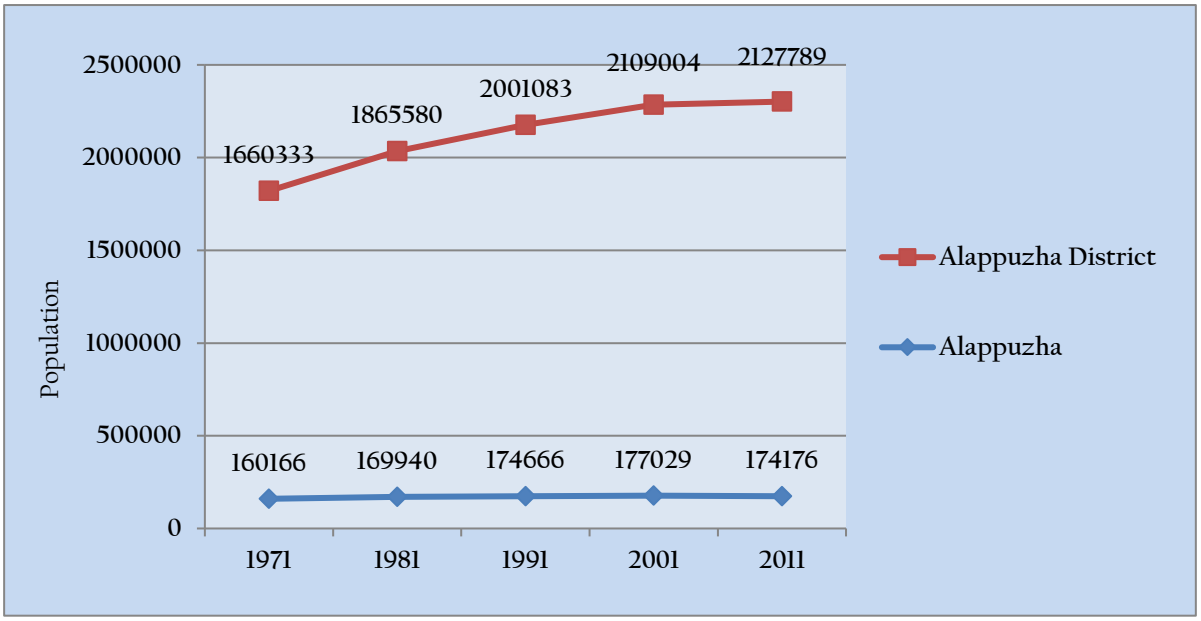


Figure 4-1: Decadal Variation of Population
(Census Data, 2011)

Table 4-1: Ward wise population of Alappuzha Municipality

Sl.No:	Ward Name	Population	Sl.No:	Ward Name	Population
1	THUMBOLY	3869	27	THIRUVAMPADY	2125
2	KOMMADY	2500	28	HOUSING COLONY	2484
3	POONTHOPPU	2691	29	SANATHANAPURAM	2485
4	KALATH	3558	30	ERAVUKADU	3262
5	KOTTAMKULANGARA	3791	31	MULLATHUVALAPPU	3948
6	PUNNAMADA	3530	32	VALIYAMARAM	3375
7	NEHRU TROPHY	2573	33	MUNICIPAL STADIUM	3761
8	THIRUMALA	3107	34	ALISSERY	1253
9	PALLATHURUTHY	3705	35	LAJNATH	3606
10	KALARKODE	2032	36	VALIYAKULAM	2443
11	KAITHAVANA	2762	37	VATTAYAL	2569
12	PAZHAVEEDU	4429	38	KUTHIRAPANTHI	2399
13	PALACE	2715	39	GURUMANDIRAM	3743
14	MULLACKAL	2816	40	VADACKANAL	2741
15	DISTRICT COURT	3560	41	BEACH	3165
16	THATHAMPALLY	2044	42	RAILWAY STATION	7814
17	KARALAKAM	3576	43	ZACHARIAH BAZAR	3271
18	AVALUKUNNU	3480	44	CIVIL STATION	2638
19	KARUKAYIL	3714	45	SEA VIEW	6997
20	THONDANKULANGARA	2343	46	VADACKAL	2503
21	ASRAMAM	6821	47	POWER HOUSE	3907
22	MANNATH	2600	48	CHATHANADU	2416
23	KIDANGANPARAMBU	3341	49	ARATTUVAZHI	4172
24	VAZHICHERRY	1547	50	KANJIRAMCHIRA	5320
25	MUNICIPAL OFFICE	2479	51	KALAPPURA	4286
26	A N PURAM	5079	52	MANGALAM	2834

(Census Data, 2011)

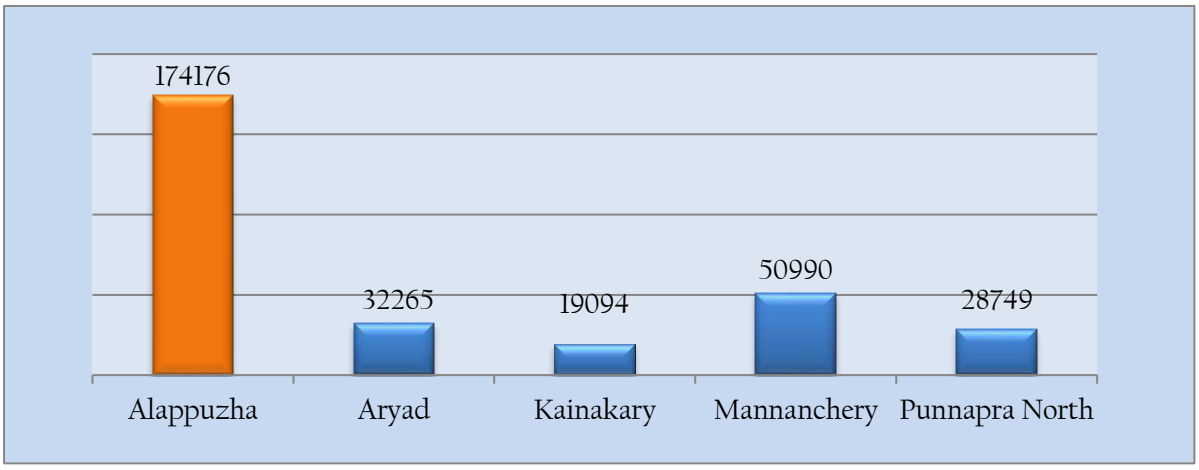


Figure 4-2: Comparison of Population with surrounding LSGIs

Compared to the neighboring LSGIs and other urban centers of the district, Alappuzha Municipality has the highest population as shown in Figure 4-2 and Figure 4-3 respectively. Comparing with the other third order urban centers of the State, Alappuzha town is in third position next to Kollam and Thrissur as shown in Figure 4-4. Kollam and Thrissur are municipal corporations. Alappuzha has the highest population among third order municipalities in the State as per 2011 census.

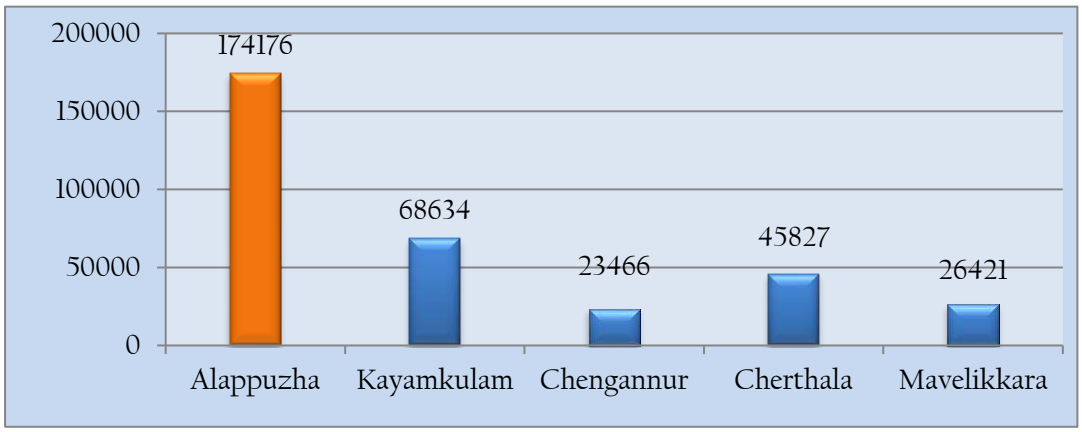


Figure 4-3: Comparison of Population with other urban centers in the district

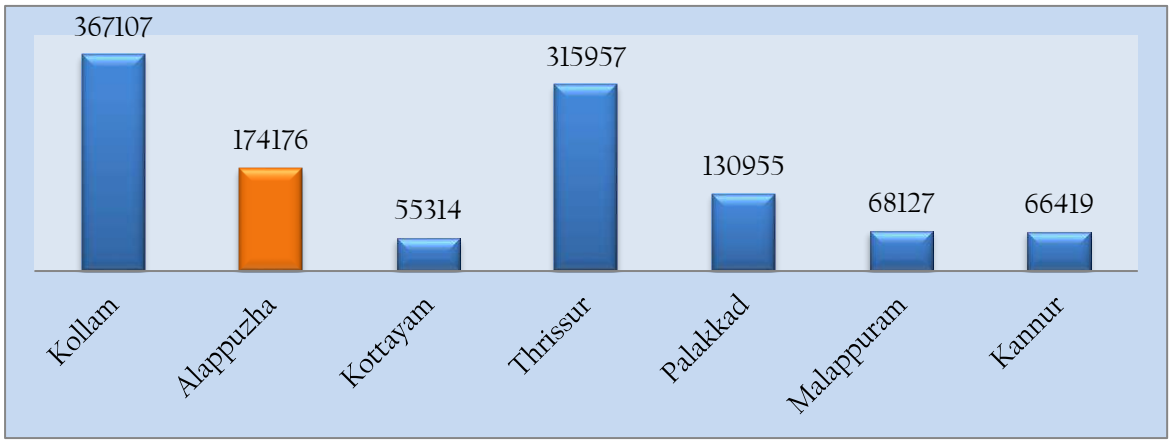


Figure 4-4: Comparison of Population with other 3rd order urban centers of the state (Census Data, 2011)

4.2 Population Growth Rate

The temporal variation of population growth rate of the Alappuzha town and the district is shown in Figure 4-5 . It shows that the population growth rate of the town as well as the district is gradually declining and the town shows a negative growth rate in 2011 ie. -1.61. Compared to the neighboring LSGIs, the town has very low population growth rate except for Kainakary Panchayat as shown in Figure 4-6. As per the socio-economic survey data analysis there is negligible immigrants' to the town. Nearly 3% of the total families surveyed have at least one out migrant in the family. Absence of economic activities attracting the workforce

may be the reason for this outmigration and this could be the reason for the decreasing growth rate of population of the town.

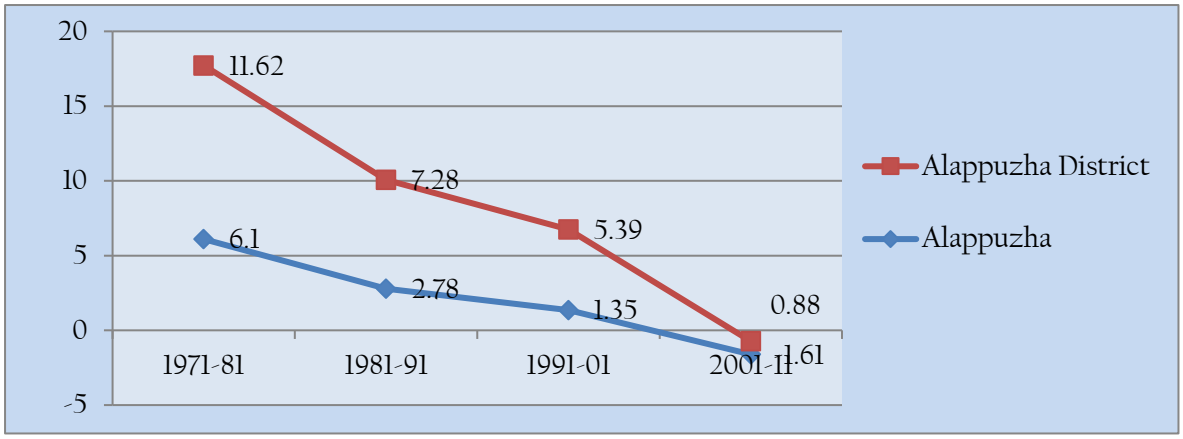


Figure 4-5: Comparison of Population Growth Rate of Alappuzha District & Municipality

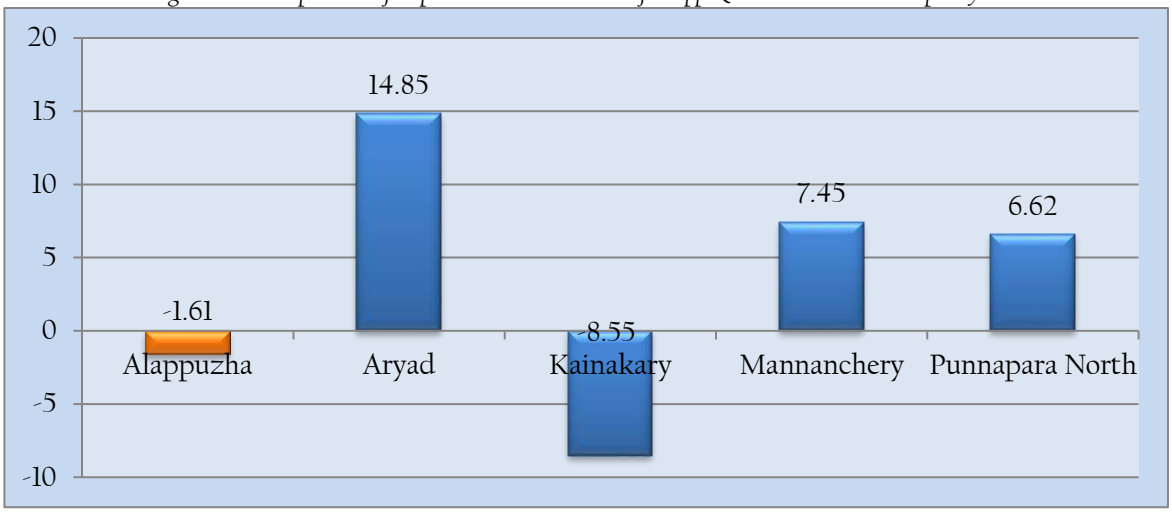


Figure 4-6: Comparison of Population Growth Rate of Alappuzha Municipality with surrounding LSGIs

Comparing with other urban centres of the district the growth rate of the town is lesser than that of Cherthala and Kayamkulam as shown in Figure 4-7.

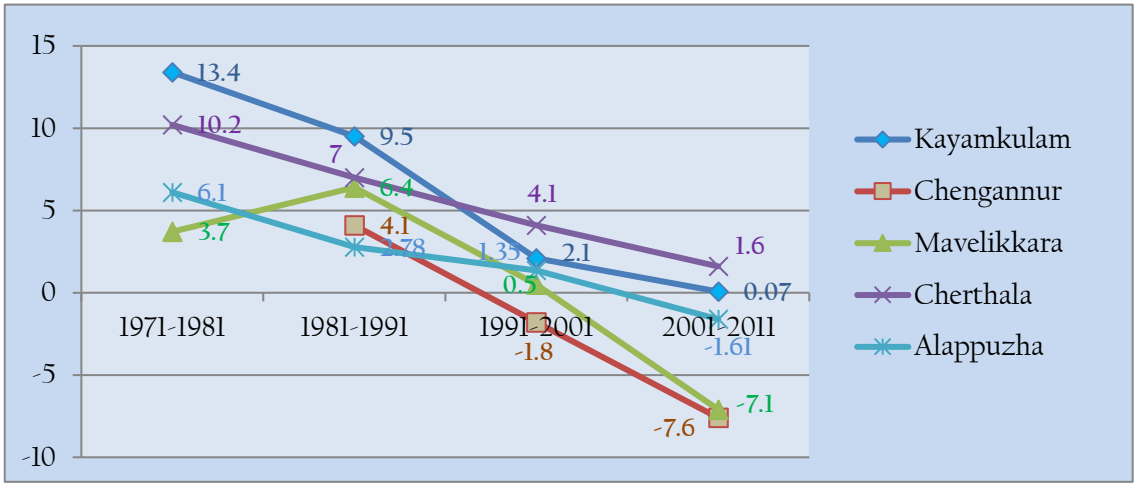


Figure 4-7: Comparison of Population Growth Rate of Alappuzha Municipality with other urban centers in the district

Compared to the other third order urban centers of the State, the growth rate of Alappuzha Municipality is very low except for Kottayam as shown in Figure 4-8 .

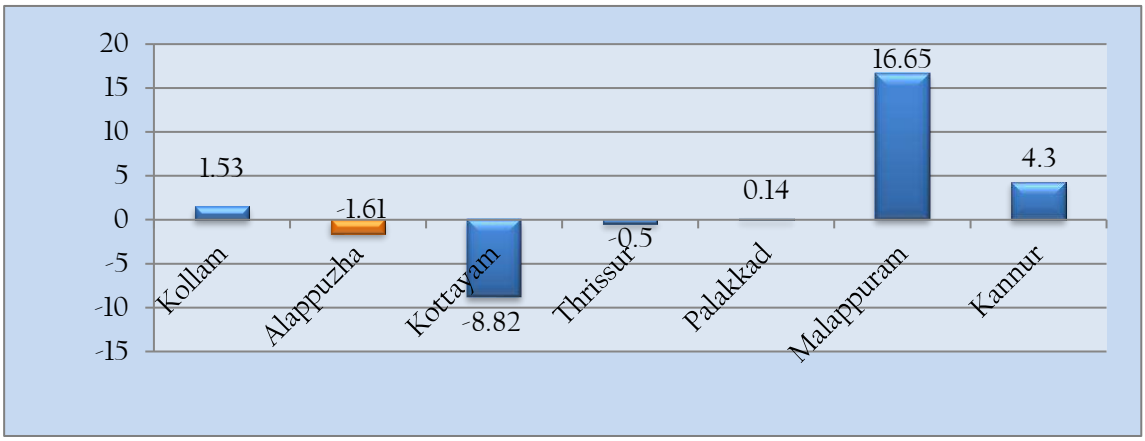


Figure 4-8: Comparison of Population Growth Rate of Alappuzha Municipality with 3rd order urban centers in the state (Census Data, 2011)

4.3 Population Density

Comparing with State, State Urban, District & District Urban, Alappuzha Municipality has the highest population density as per Census 2011 (Figure 4-9). The gross population density of urban areas of Alappuzha district is 2384 persons per sqkm which is nearly double the average density of the district (1492).

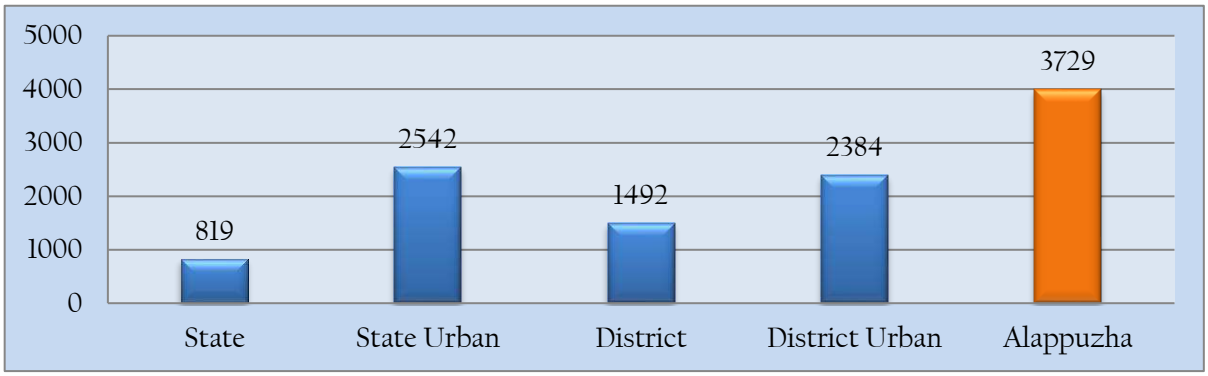


Figure 4-9: Comparison of Population Density - 2011

Compared to the surrounding LSGIs the town has the second highest gross density, the neighboring gram panchayat Aryad with the highest gross density of 4697 (Figure 4-10).

The gross density of population in Alappuzha town is 3729 which is highest among the urban centers of the district (Figure 4-11). Compared to the other third order urban centers of the State, town has 4th position (Figure 4-12). Other third order urban centers with population density greater than Alappuzha are Kollam, Kannur and Palakkad. One third of the municipal area being waterbody the net density of the town is taken which is 5410 persons/sqkm.

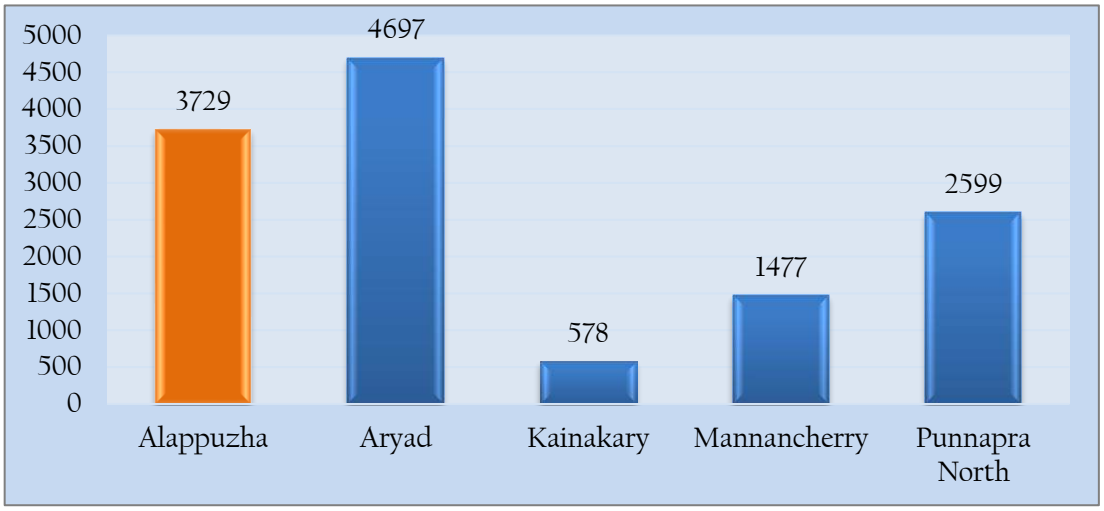


Figure 4-10 Comparison of Population Density with surrounding LSGIs- 2011

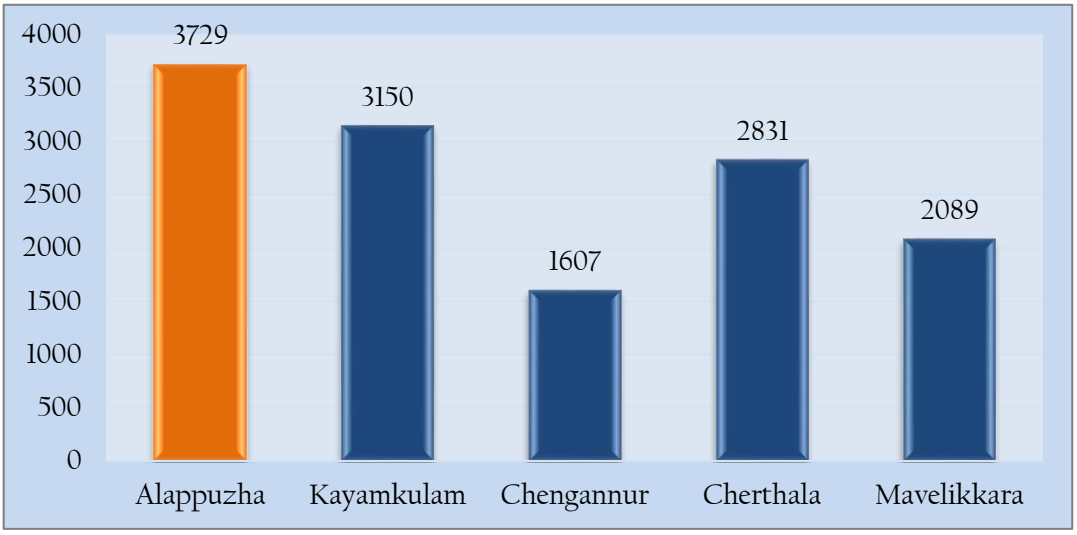


Figure 4-11: Comparison of Population Density with other urban centers in the district- 2011

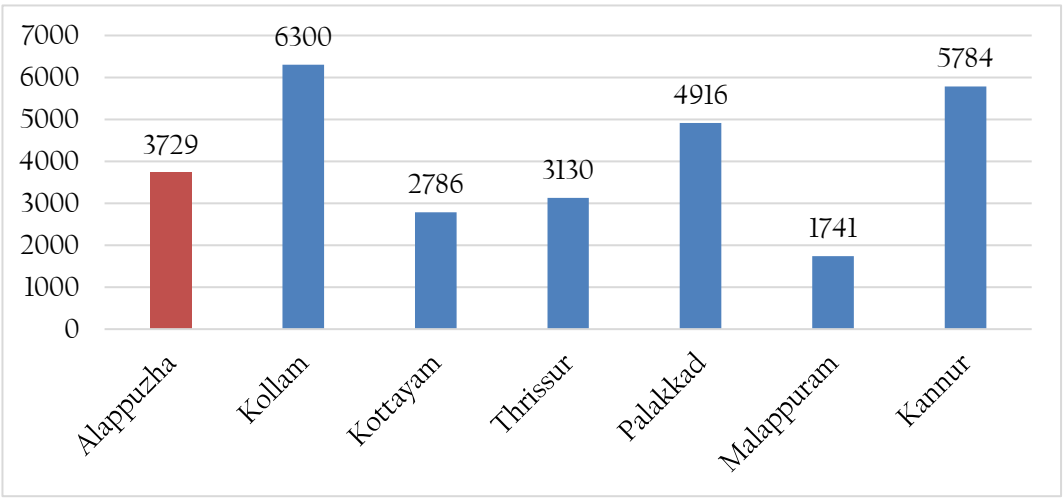


Figure 4-12: Comparison of Population Density with other 3rd order urban Centers- 2011

4.4 Spatial Distribution of Population

The municipal area has been divided into 52 electoral wards as per the ward division in 2010. According to the 2005 division there were 50 wards and census 2011 is based on these 50 wards. The population in census 2011 is distributed among the 52 wards. The ward wise distribution of population is shown in Table 4-1. It ranges from 1253 to 7814 persons. Railway Station (42), Sea View (45), Asramam (21) are the most populous wards. The ward wise distribution of population is shown in Figure 4-13.

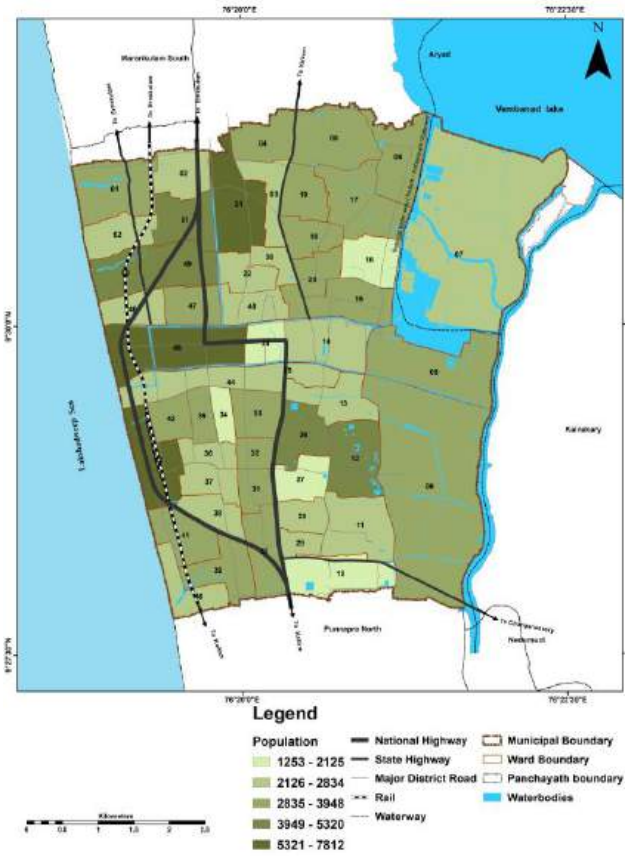


Figure 4-13: Ward wise distribution of Population

Density of population is an indicator of pressure of population on land which in turn is influenced by factors like accessibility, proximity to facilities etc. Higher population density puts more pressure on infrastructure and environment but reduces the per capita costs of supply of public goods and services. The ward wise density varies from 517 to 14719 persons/sq.km. Thondankulangara (20), Sanathanapuram (29), Mullathuvalappu (31), Valiyamaram (32), Lajnath (35) and Railway Station (42) are the wards with highest density. The ward wise distribution of population density is shown in Figure 4-14. From the figure it is seen that the wards with high density are located adjacent to the major transport corridors.

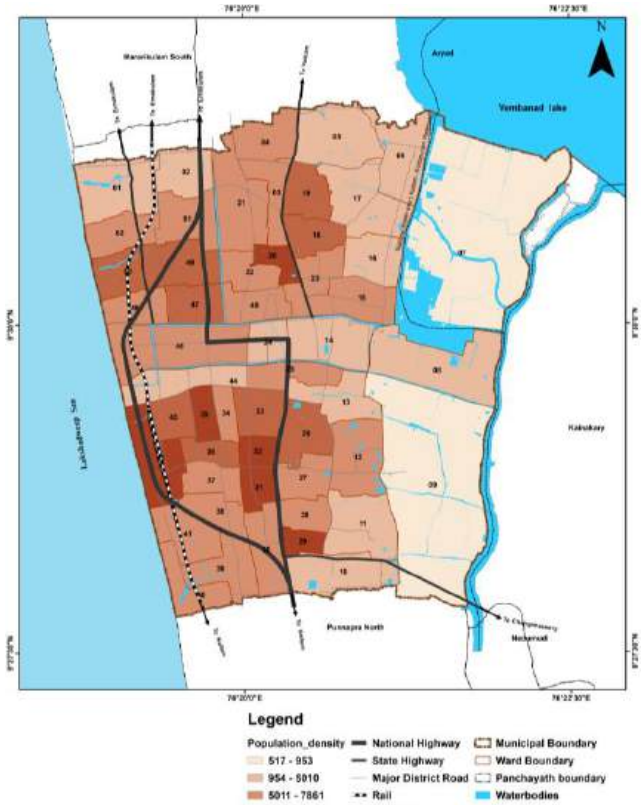


Figure 4-14: Ward wise Distribution of Population Density

4.5 Population Concentration Pattern

Population concentration maps help in identifying the areas where population is more concentrated and divert the population growth to some other region. Population concentration of the Municipality is shown in Figure 4-15 .

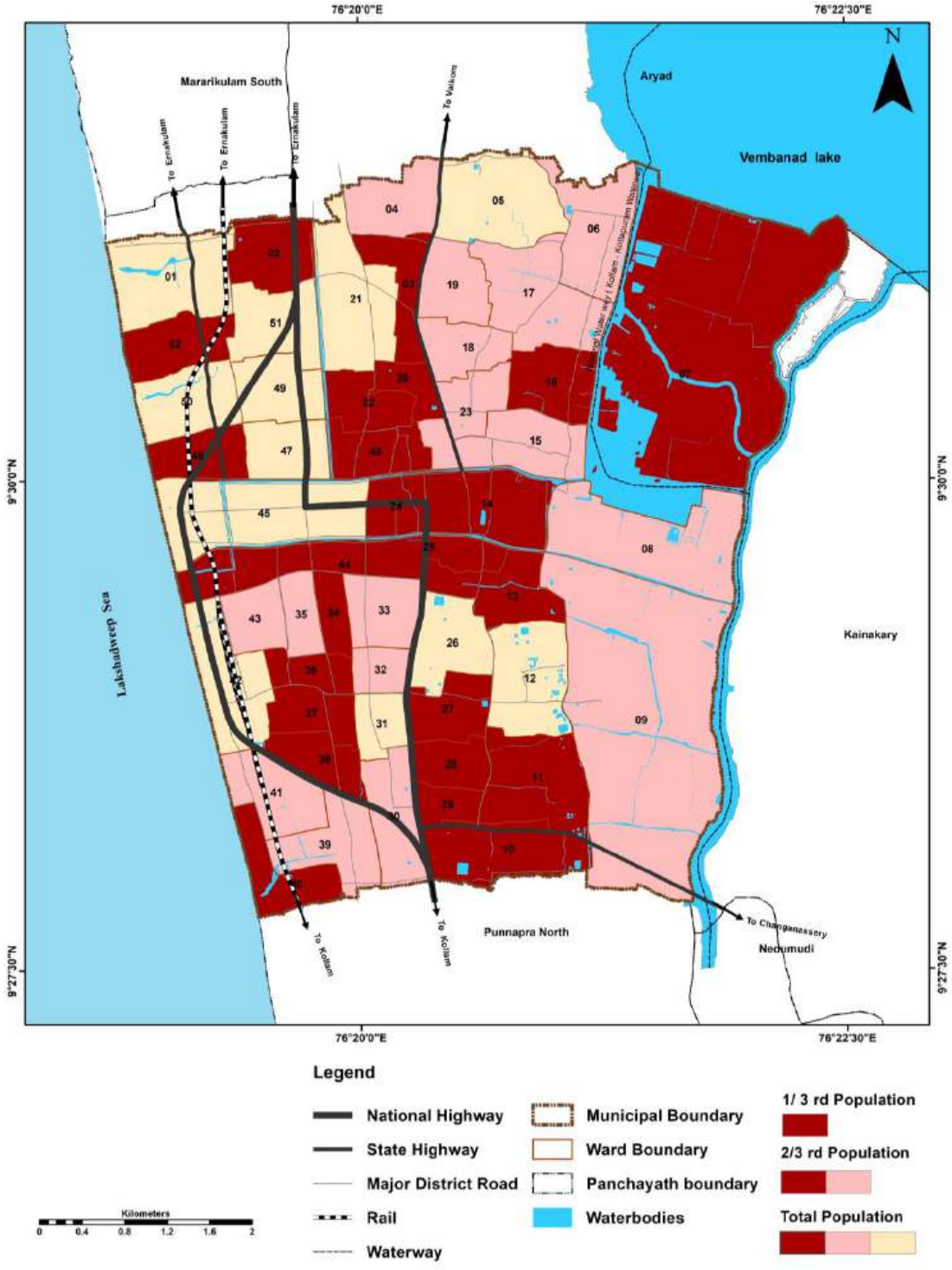


Figure 4-15: Population Concentration Pattern of Alappuzha Municipality

4.6 Sex Ratio

Sex ratio is a social indicator for measuring the extent of equity prevailing between males and females at a given point of time. It is counted for number of females per 1000 males. Kerala is the only female surplus state compared with rest of India. In the past decade, all districts of Kerala have shown improvement in the sex ratio. According to 2011 census, sex ratio of Alappuzha Municipality is 1077; whereas the sex ratio of the district is 1100. Figure 4-16 shows the decadal variation of sex ratio of Alappuzha Municipality. It shows that sex ratio is gradually increasing over the last four decades.

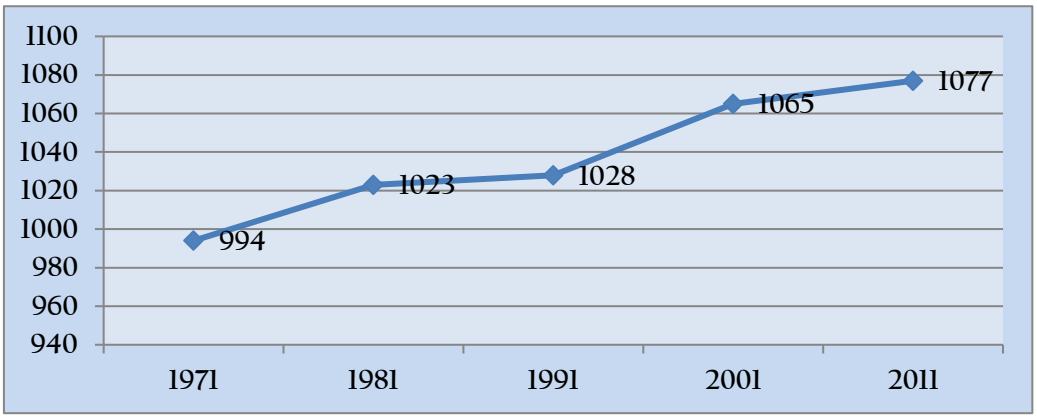


Figure 4-16: Decadal variation of sex ratio of Alappuzha Municipality

Figure 4-17 shows the comparison of sex ratio with surrounding LSGIs and Figure 4-18 shows the comparison with other urban areas in the District. Sex ratio of Alappuzha Municipality is higher than that of Cherthala and Kayamkulam Municipality and lower than that of Chengannur and Mavelikkara Municipalities. Comparing with other third order urban centres of the State, Alappuzha town have 2nd position in sex ratio as shown in Figure 4-19.

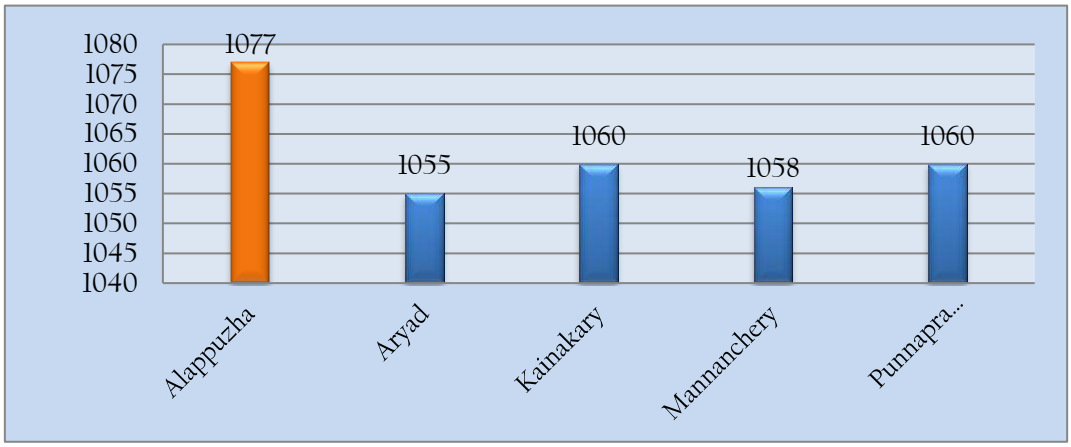


Figure 4-17: Comparison of sex ratio with surrounding LSGIs

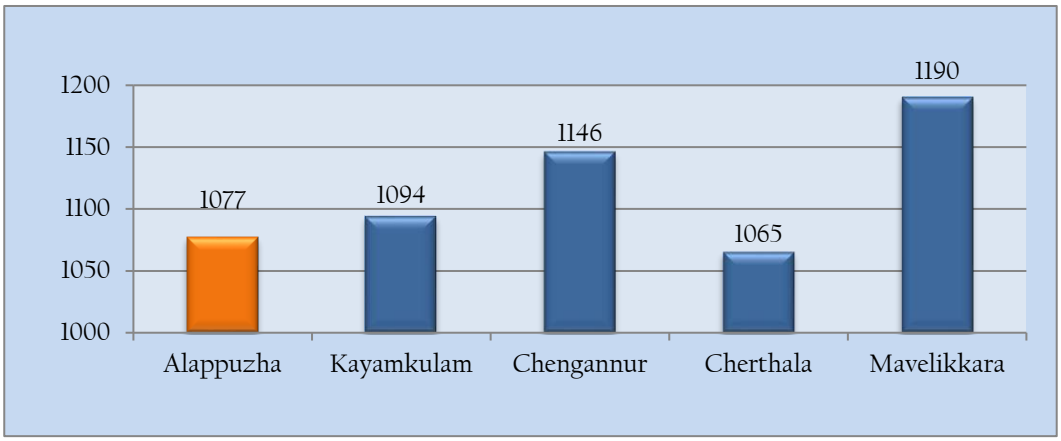


Figure 4-18: Comparison of sex ratio with other urban areas in the district

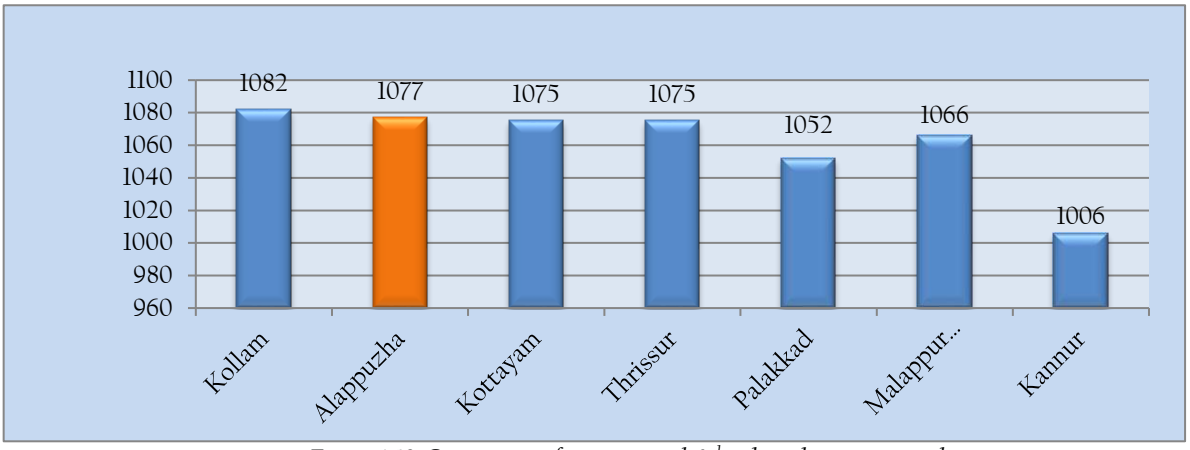


Figure 4-19: Comparison of sex ratio with 3rd order urban centers in the state

4.7 Age Sex Pyramid

A population pyramid, also called as age pyramid or age picture is a graphical illustration that shows the distribution of various age groups in a population, which forms the

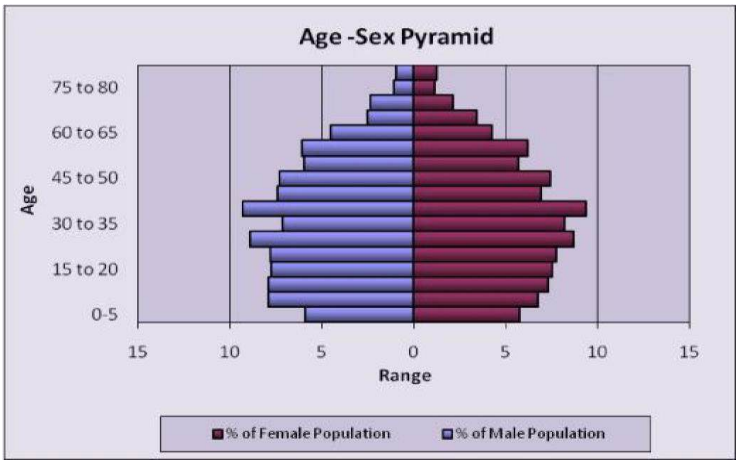


Figure 4-20: Age Sex Pyramid

shape of a pyramid when the population is growing. Figure 4-20 shows the age structure of the people in the Municipality.

4.8 Literacy

Literacy is one of the important social characteristics. Children in the age group of 0-6 are considered illiterate and are excluded from the calculation of literacy rate. Kerala is the most literate state in the country. Figure 4-21 shows the decadal variation of literacy rates of Alappuzha district and Municipality. The literacy rate of Alappuzha Municipality is 96.20 as per census 2011. The male literacy rate is 97.61% and female literacy rate is 94.91%. The literacy rate has increased over the past years.

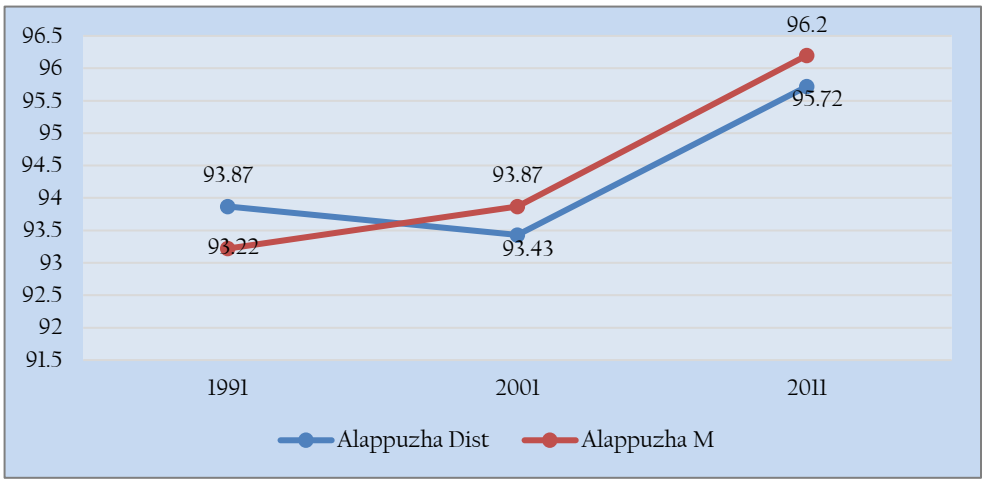


Figure 4-21: Comparison of decadal variation of literacy rate

4.9 Household size

Another important component of demography is size of household. Understanding the household size helps us to understand the ongoing trend of families being joint or nuclear. Total number of households in Alappuzha Municipality in 2011 is 41655. The total population being 1,74,176, the average house hold size is 4.19. This is lower than the state average, but higher than the average household size for the district which is 3.97 as shown in Figure 4-22.

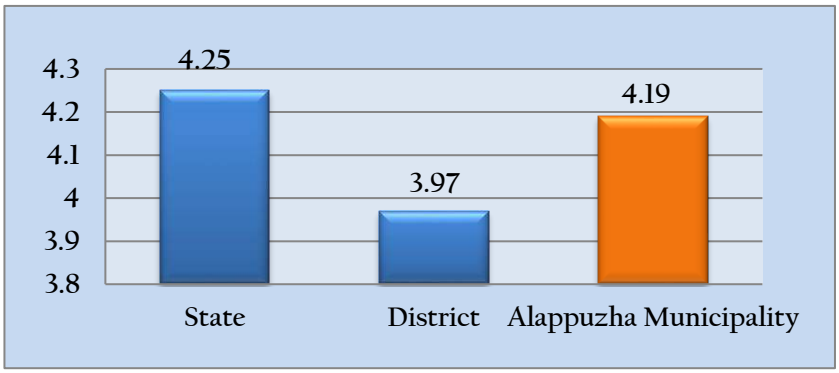


Figure 4-22: Comparison of Household size with State & District

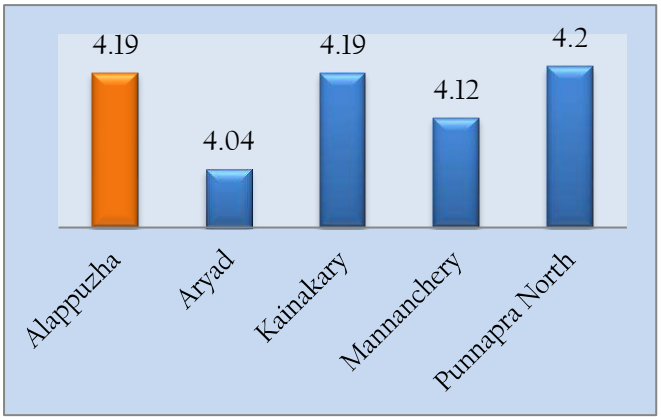


Figure 4-23: Comparison of Household size with surrounding LSGIs

The nearby LSGIs has a lower household size than the Municipal town except for Kainakary and Punnapra North which has an almost similar value (Figure 4-23). House hold size of other municipal towns except Kayamkulam in the district is lower than Alappuzha Municipality (Figure 4-24).

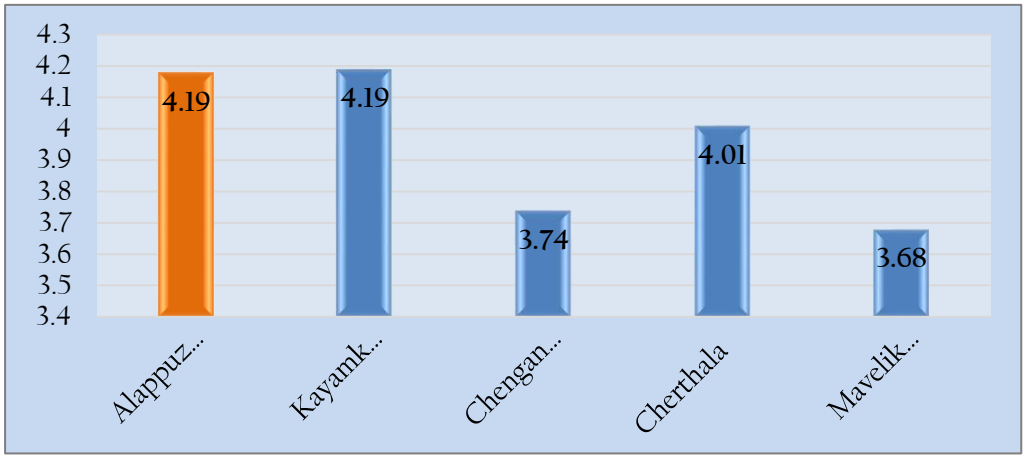


Figure 4-24: Comparison of Household size with other urban areas in the district

4.10 Inferences

The total population of Alappuzha Municipality is 1,74,176 which is about 8.19% of the total district population of Alappuzha. Compared to the neighboring LSGIs and other urban centers of the district, Alappuzha Municipality has the highest population. Comparing with the other third order urban centers of the State, Alappuzha town is in third position. Population growth rate of the town as well as the district is gradually declining. Alappuzha was one of the port towns of erstwhile Travancore, economic importance of the town has gradually declined and at present sufficient job opportunities are not created to attract people which have resulted in negative growth rate of population of the Municipal town. The town lost its importance due to the deterioration of the trade and industries with the activities of the port being abandoned. Comparing with State, State Urban, District & District Urban, Alappuzha Municipality has the highest population density. According to 2011 census, sex ratio of Alappuzha Municipality is 1077. The literacy rate is higher than the state average and district average. The household size is lower than the state average, but higher than the district average.

5 EMPLOYMENT

In this chapter, the economic base of Alappuzha Town is analyzed to assess the major economic activities in the district and also to identify how people and resources are geographically distributed with regard to these economic activities. This helps in identifying the economic sectors which can be taken as activity sectors where attention is to be focused to enhance local economy. Moreover, it helps in estimating the underutilization or overutilization of resources in various economic activities as well as the demand for facilities and services required for these economic activities. Hence within the framework of the study, the analysis of economic base has a significant role.

5.1 Number of Workers

The percentage of population engaged in economic activities is an indicator of the economic development and urbanization in an area. The total number of workers in Alappuzha Town as per 2011 census is 59232. The total workers are further divided into main and marginal workers. As per census those who are engaged in economic productive activity for the major part of the reference period (i.e.6 months or more in a year) are termed as main workers while marginal workers work for less than 6 months in a year. A person who did not work during the reference period is termed as non-worker. As per 2011 Census, the main and marginal workers constitute 28.68% and 5.3% of the total population respectively as shown in Figure 5-1. Table 5-1 shows the decadal variation of workers in the Municipality. Figure 5-2 shows the decadal variation of Total, Main and Marginal workers in the Municipality.

Table 5-1: Decadal Variation of Workers in Alappuzha Municipality

Year	Population	Total Workers	Main Workers	Marginal Workers	Non - Workers
1981	169940	46252	38566	7686	123688
1991	174666	51790	48568	3222	122876
2001	177029	56118	47800	8318	120911
2011	174176	59232	49961	9271	114944

(Census Data, 2011)

There is a significant increase in the total number of workers from 1981 to 2011. However, there is a slight decrease in the number of main workers from 1991 to 2001 but the figure has increased in 2011. This slight decrease of main workers in 2001 may be due to the decrease in the number of cultivators and agricultural laborers.

Another fact to be noted is the significant share of workers from other states like Tamil Nadu, Orissa, Bengal etc. in the tertiary sector, which is not included in the census data. More than 20% of the workers in this sector are from this group, but no clear-cut statistics is available to substantiate this. The share of female workers is also very low in Alappuzha. There is a clear dominance of male in all the sectors. According to census 2011, the male workers constitute 77.03% of the total workers.

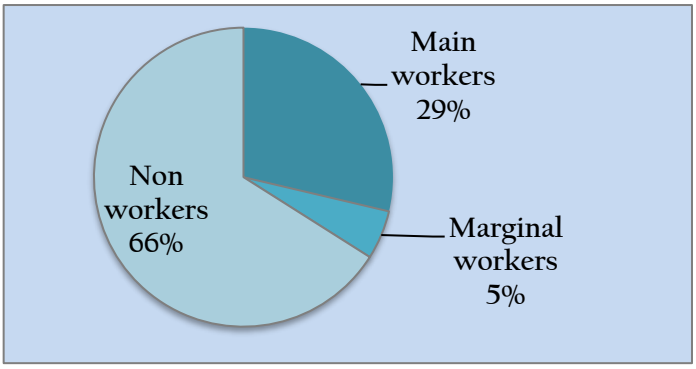


Figure 5-1: % of workers – 2011

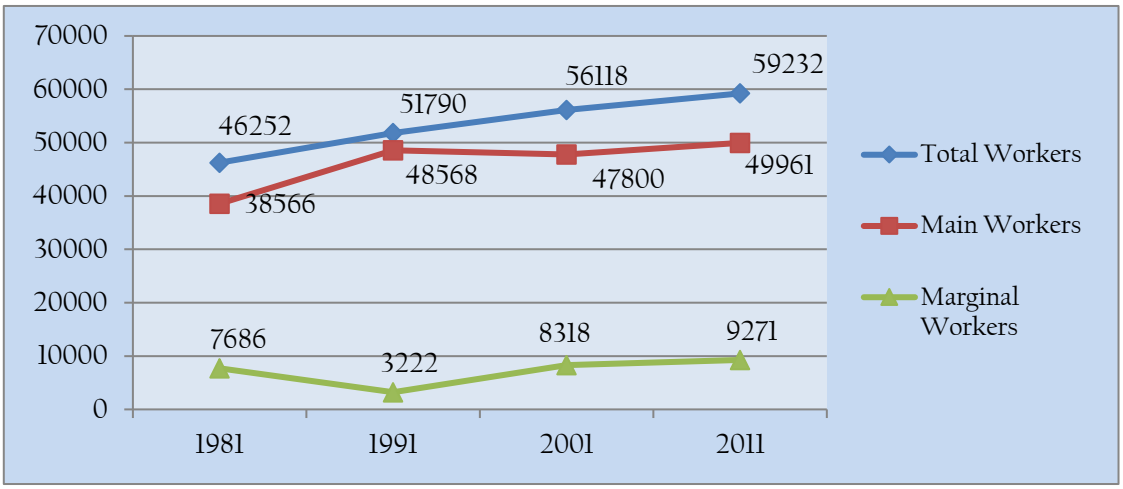


Figure 5-2: Decadal variation of Total, Main and Marginal workers of Alappuzha Municipality

5.2 Work force participation rate

The Work Force Participation Rate (WFPR) is a measure of the active portion of the economy's labor force. It refers to number of people who are either employed or are actively looking for work. The participation rate is an important metric to use when analyzing unemployment data because it reflects the number of people who are participating in the work force. Figure 5-3 shows the comparison of decadal variation of WFPR of state, district and Alappuzha Municipality. The work force participation rate of Alappuzha district (37.8%) is

higher than that of the state (34.78%) in 2011. The WFPR of Alappuzha Town (34.01%) is lower than that of district and state.

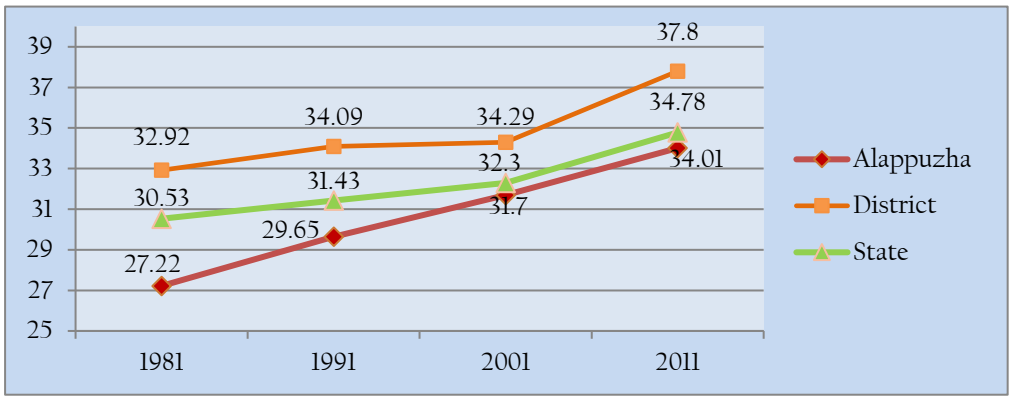


Figure 5-3: Decadal variation of WFPR – State, District & Municipality

Compared to the nearby local bodies, WFPR of Alappuzha Municipality is lower as shown in Figure 5-4. Alappuzha Municipality is in the 2nd position compared to the WFPR of other urban local bodies in the district and 4th position compared to other third order urban centers in the state as shown in Figure 5-5 and Figure 5-7 respectively.

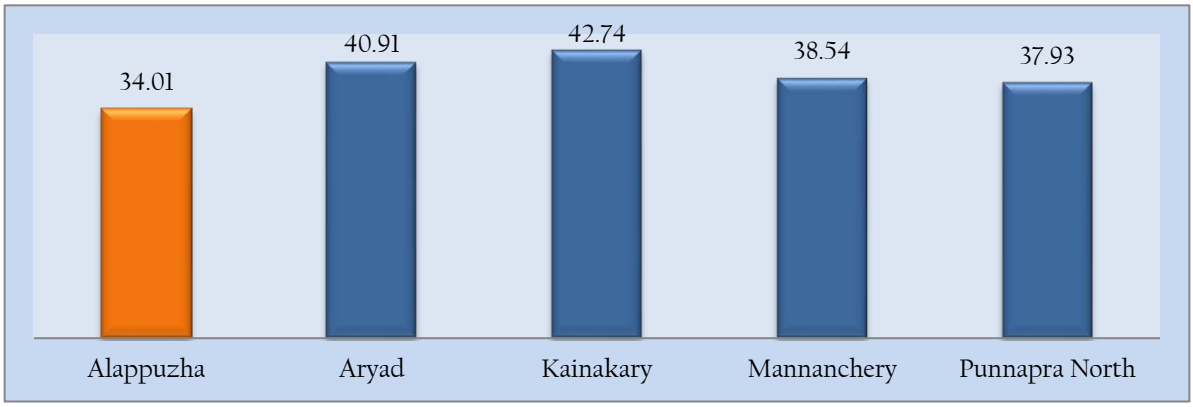


Figure 5-4: Comparison of WFPR with surrounding local bodies

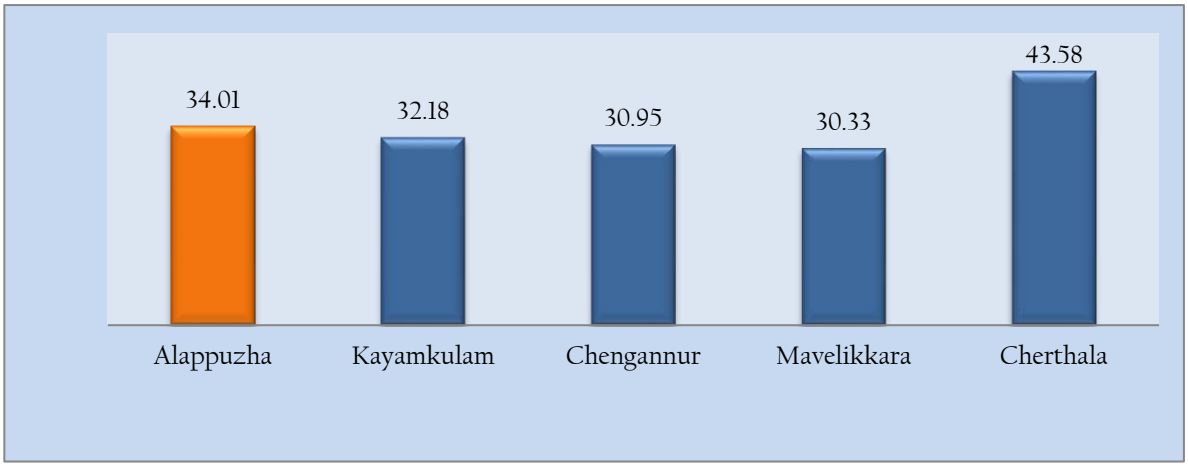


Figure 5-5: Comparison of WFPR with urban local bodies in the district

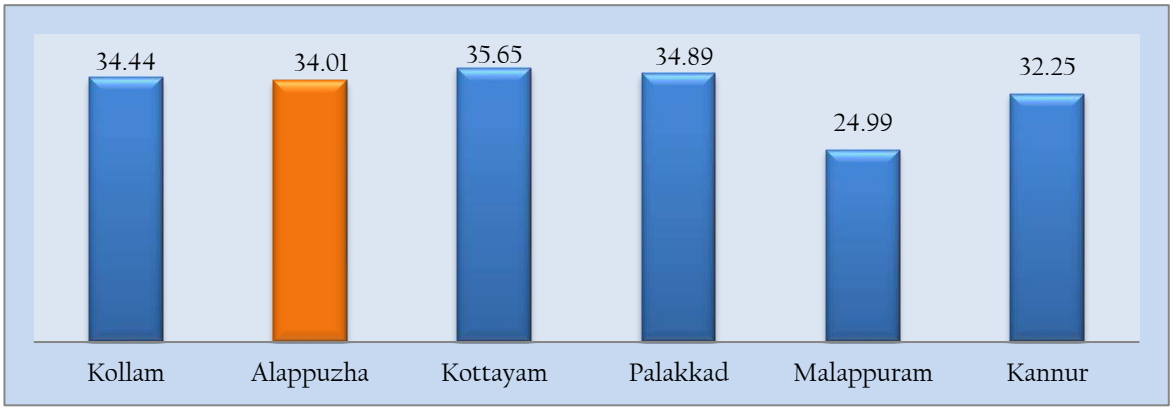


Figure 5-6: Comparison of WFPR with 3rd order urban centers in the state

5.3 Male & Female Work force participation rate

Table 5-2 shows the decadal variation of male and female work force participation rate as per Census Data (2011). It shows gradual increase from the previous decade.

Table 5-2: Decadal Variation of Male & Female WFPR in Alappuzha Municipality

Year	1981	1991	2001	2011
Male WFPR	41.8	46.06	50.49	53.40
Female WFPR	12.96	13.85	14.06	16

(Census Data, 2011)

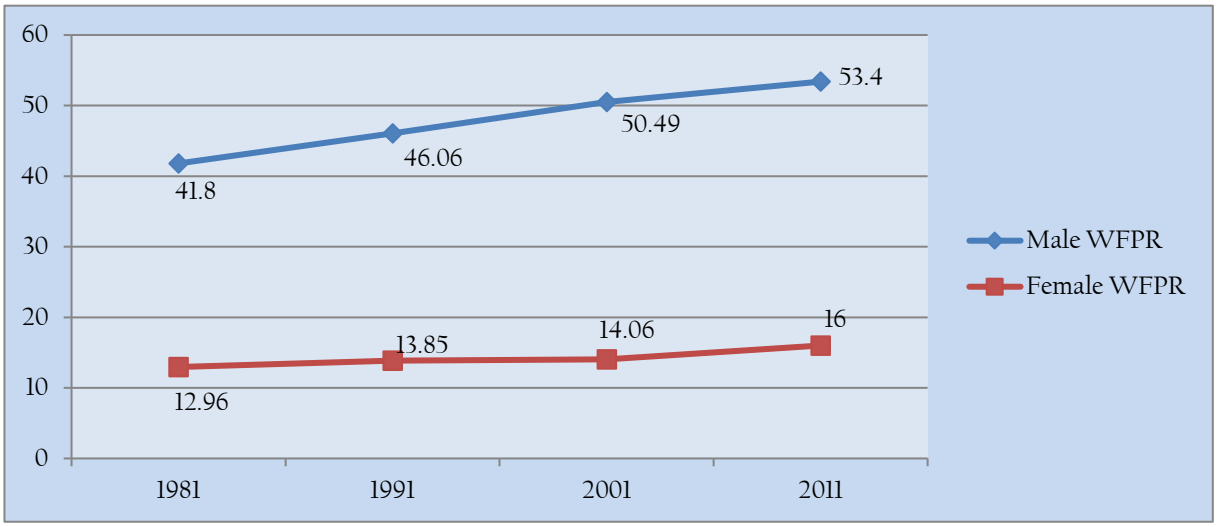


Figure 5-7: Decadal variation of male and female WFPR in Alappuzha Municipality

5.4 Four – Fold Classification of Workers

As per Census, workers are classified into cultivators, agricultural laborers, household industry workers and other workers. Table 5-3 shows the number of workers in each category from 1981 to 2011 and Figure 5-8 shows the decadal variation of four – fold classification of workers.

Table 5-3: Decadal Variation of Workers in Alappuzha Municipality

Cultivators				Agricultural labourers				HH industrial workers				Other workers			
1981	1991	2001	2011	1981	1991	2001	2011	1981	1991	2001	2011	1981	1991	2001	2011
237	487	141	221	2150	4137	1923	1488	1775	1614	1801	1334	34404	42330	43935	46918

Majority of the workers are coming under 'Others' category and their number is increasing at a constant rate. The number of Agricultural labourers is showing a sudden decline after 1991 and the trend continues in 2011 also. The number of cultivators has slightly increased in 2011. Agricultural labourers and Cultivators constitute 3.42% of the total workers as per 2011 census, where as other workers constitute about 93.91% of total workers. This shows an inclination of people towards service sector. In the case of Alappuzha district, the share of other workers is 83.49% and Agricultural labourers and Cultivators is approximately 12.05% of total workers. Household industrial workers in the municipal area constitute 2.25% of the total workforce which is also lesser than the district average.

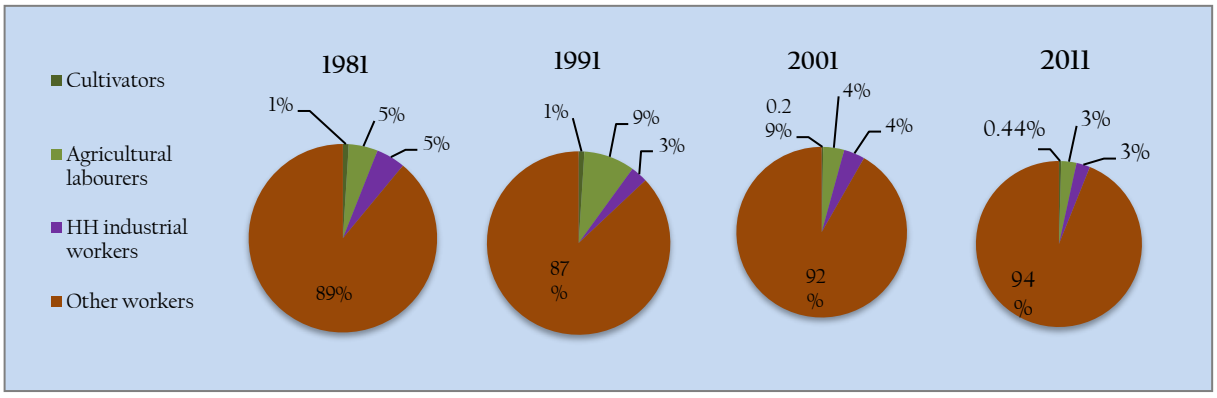


Figure 5-8: Decadal variation of four – fold classification of workers

Workers are also classified into Primary, Secondary and Tertiary workers. The workers in others category can be considered as tertiary workers, therefore the increase in the total number of workers is due to an increase in the number of tertiary workers. Primary occupations include all those essential activities such as agriculture and allied activities like animal husbandry, forestry, fishery, poultry farming etc. Secondary activities include manufacturing industries composed of both large and small scale and mining. Tertiary activities include all other activities like transport, communication, banking, insurance, trade etc. Classification of primary, secondary and tertiary workers as per census 2011 is shown in Figure 5-9. Majority of the workers are engaged in tertiary sector activities.

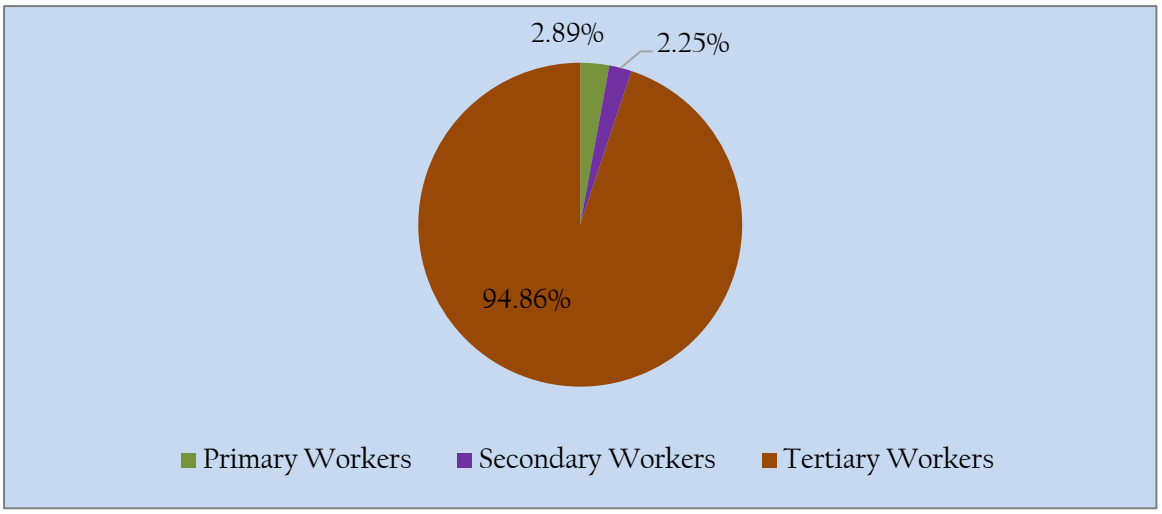


Figure 5-9: Classification of workers as per Census 2011

5.5 Spatial Distribution of Workers

The distribution of agriculture land as obtained from land use survey is shown in Figure 5-10. Figure 5-11 & Figure 5-12 gives the ward wise concentration of cultivators and agricultural laborers. The maximum concentration of cultivators is seen in Eravukard ward and agriculture laborers are mostly concentrated in the wards of Alisserry (34), Eravukad (30) and Beach (41). The agricultural land is distributed more or less in the same or nearby wards where there is a high concentration of cultivators and agricultural workers.

Figure 5-13 & Figure 5-14 gives the ward wise concentration of household industrial workers and other workers respectively. HH industrial laborers constitute only 2.25% of the total workers. This concentration is more in the wards of Karalakam (17) and Vattayal (37). The other workers are evenly distributed in majority of the wards.

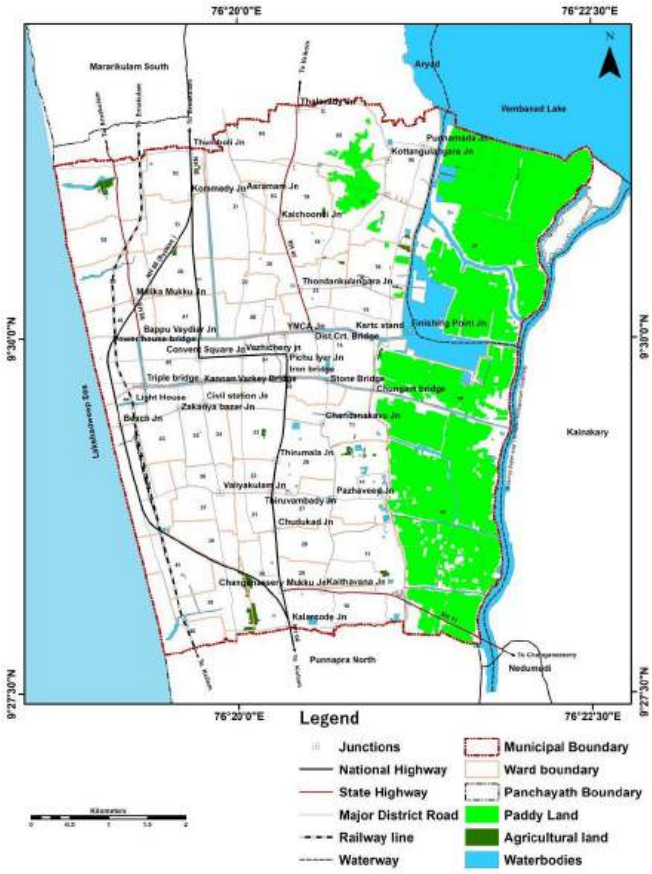


Figure 5-10: Spatial distribution of Agriculture Land Use

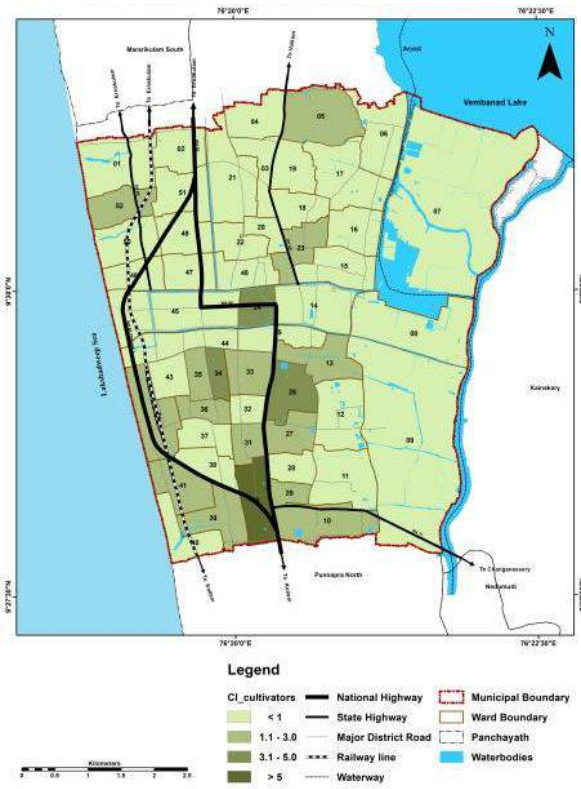


Figure 5-11: Ward wise concentration of cultivators

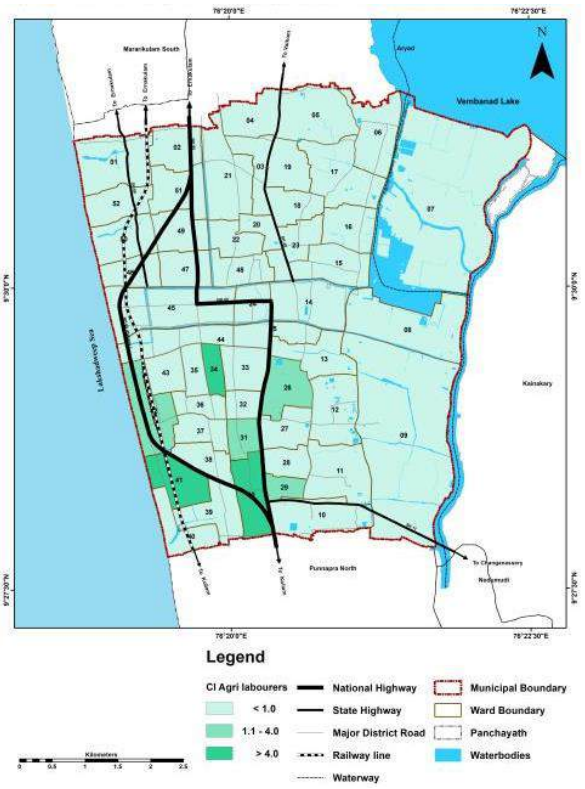


Figure 5-12: Ward wise concentration of Agricultural Laborers

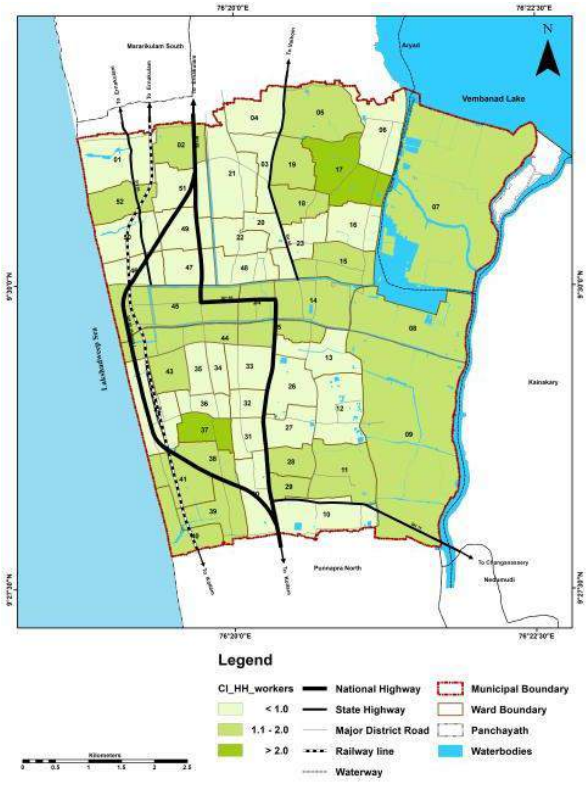


Figure 5-13: Ward wise concentration of HHI Workers

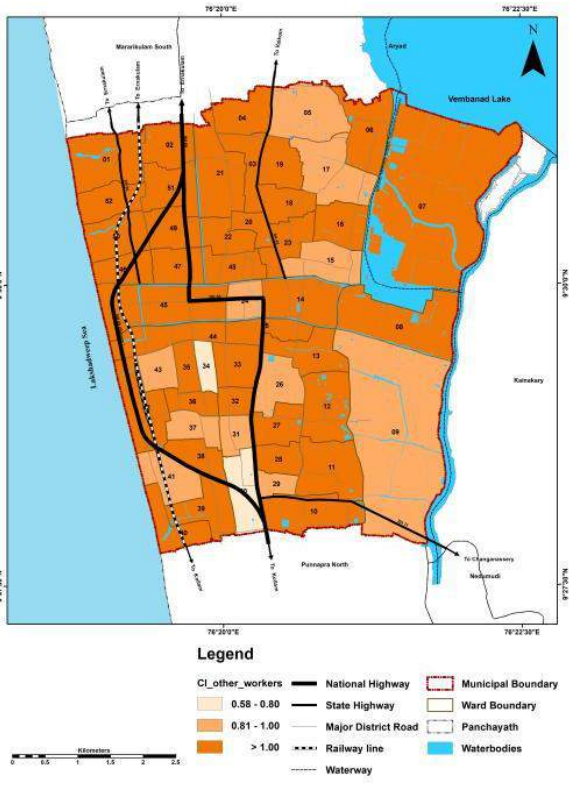


Figure 5-14: Ward wise concentration of Other Workers

5.6 Dependency Ratio

The dependency ratio is an age population ratio of those typically not in the labour force (the dependent part) and those typically in the labour force (the productive part). It is used to measure the pressure on productive population. Dependency ratio of Alappuzha Municipality is 1.94, which is higher than that of state and district as shown in Figure 5-135.

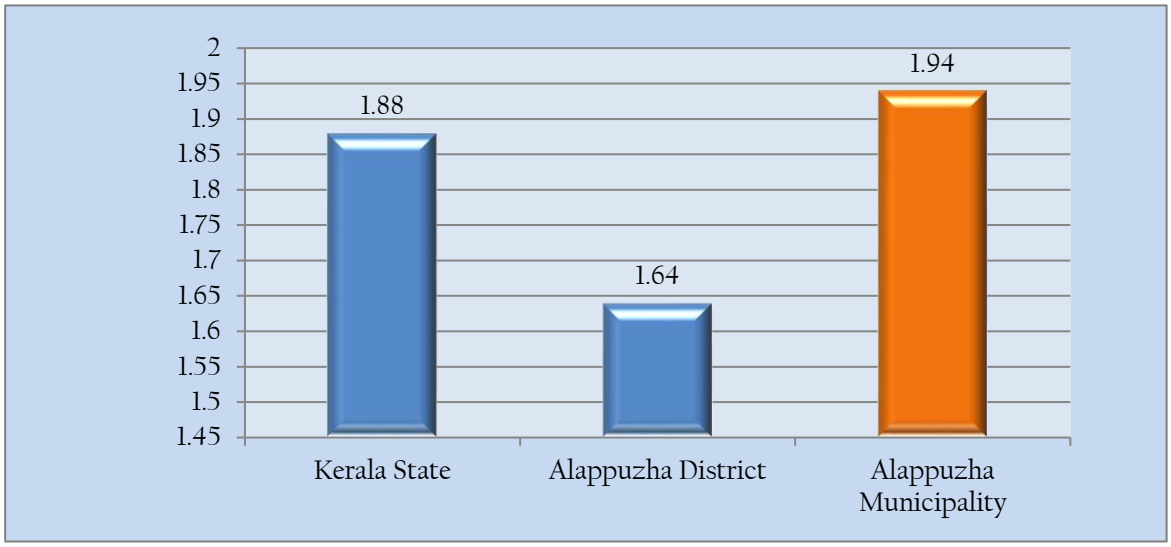


Figure 5-135: Comparison of Dependency Ratio

5.7 Inferences

The backbone of the economy of any region is the production sector. The analysis of the occupational structure of the town depicts a not so bright picture of the economic base of the town. The total number of workers in Alappuzha Municipality shows an increasing trend over the last decades. The work force participation rate is also increasing gradually. The production sector including agriculture and industrial sectors shows declining trends of growth. The service sector which is to supplement the production sector shows growth. The number of workers in tertiary sectors is increasing throughout the decades. Majority of the urban population depends on the service sector for their livelihood. The shift in occupational structure is conspicuous.

6 LAND USE

Land and use thereon form a major determinant in spatial planning. The entire process of planning is focused finally at preservation or regulated change in land use of the constituent parcel of land in the area for which planning is conceived. To understand the existing situation and to plan for the future, the exact share of the land to which each of the predominant activity (use) such as agriculture, residential, commercial, etc. are put to, has to be determined. The analysis of the existing land use is inevitable in understanding the predominant economic activities of an area as well as the likely availability of land for future economic activities.

6.1 Existing Land Use

Figure 6-1shows the existing land use of Alappuzha Town, which covers the geographical area of 35.62 sq.km. The land use breakup in terms of area is shown in Table 6-1.

Table 6-1: Land use Breakup

Land Use	Area	Percentage
Residential	17.86	50.15
Commercial	0.97	2.73
Public& Semi-public	0.14	0.38
Public Utilities	0.01	0.04
Educational	0.39	1.10
Health Services	0.11	0.31
Religious	0.39	1.10
Central Govt. Property	0.02	0.07
State Govt. Property	0.23	0.64
Communication	0.00	0.00
Solid Waste Management	0.01	0.02
Industrial	0.40	1.11
Mixed	0.22	0.62
Transportation	0.15	0.42
Traffic related	0.02	0.04
Railway Property	0.06	0.17
Road	1.88	5.27
Agricultural Land	7.63	21.42
Recreational	0.19	0.54
Green Areas	0.72	2.04
Vacant Land	1.43	4.02
Wastelands	0.18	0.51
Wetlands	0.40	1.13
Water Bodies	1.75	4.90
Others	0.45	1.27
Total	35.62	100

Source: Land Use Survey, 2019

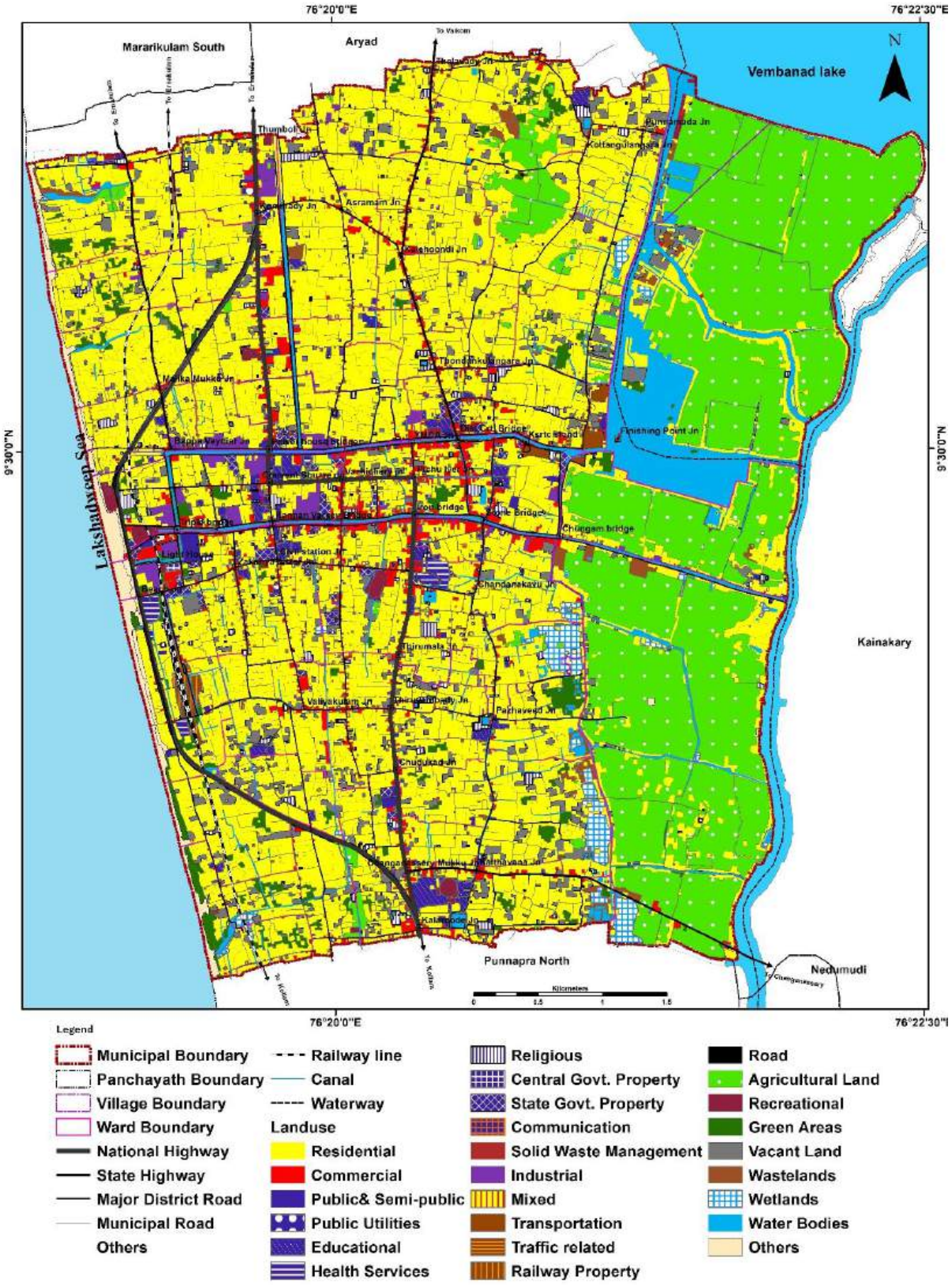


Figure 6-1: Existing Land Use – Alappuzha Municipality

Source: Land Use Survey, 2019

6.2 General Analysis of Land Use

For analysis purpose the public & semipublic, public utilities, educational, health services, religious, central and state government property, communication and solid waste management has been grouped as one category; i.e.: public & semipublic. Transportation, traffic related, railway property and road are categorized as Transportation. Since the major agriculture land use is paddy, it has been shown as separate symbology; i.e.: paddy land. Also, waste land is grouped into Wetlands, since most of them are marshy areas and beach area is shown separately. Figure 6-2 shows the existing land use of Alappuzha Town as per the above-mentioned symbology. The land use breakup in terms of area and the pie chart of percentage with respect to total area is shown in Table 6-2 and Figure 6-3 respectively.

Existing land use pattern of the town shows that the major share of the geographical area is covered by residential area (50.15%). The next major land use is paddy land which covers an area of 7.46 sq.km (20.96%). Waterbodies constitutes 4.9% of the total area. About 4.48% of the land is lying vacant in the town. Recreational land use is about 0.54%.

Table 6-2: Land Use breakup of Alappuzha Town

Land Use	Area (Sq.Km)	Gross Percentage
Residential	17.86	50.15
Commercial	0.97	2.73
Industrial	0.40	1.11
Mixed	0.22	0.62
Public & Semi-public	1.30	3.66
Transportation	2.10	5.90
Agricultural Land	0.17	0.47
Paddy Land	7.46	20.96
Recreational	0.19	0.54
Beach	0.41	1.16
Green Areas	0.73	2.04
Vacant land	1.60	4.48
Wetlands	0.42	1.18
Waterbodies	1.75	4.90
Others	0.04	0.11
Total	35.62	100

Source: Land Use Survey, 2019

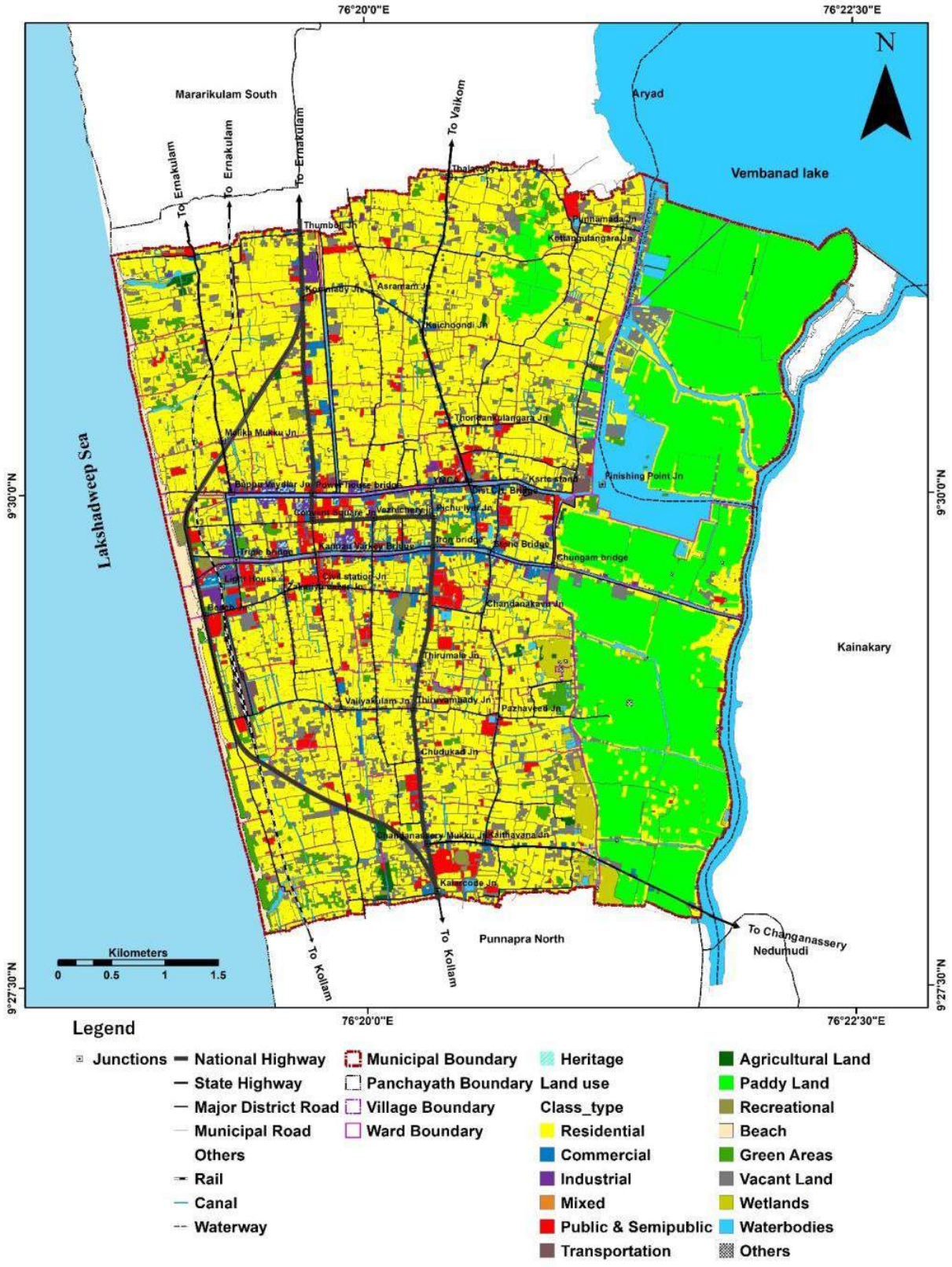


Figure 6-2: Existing Land Use- Alappuzha Municipality - 2019

Source: Land Use Survey, 2019

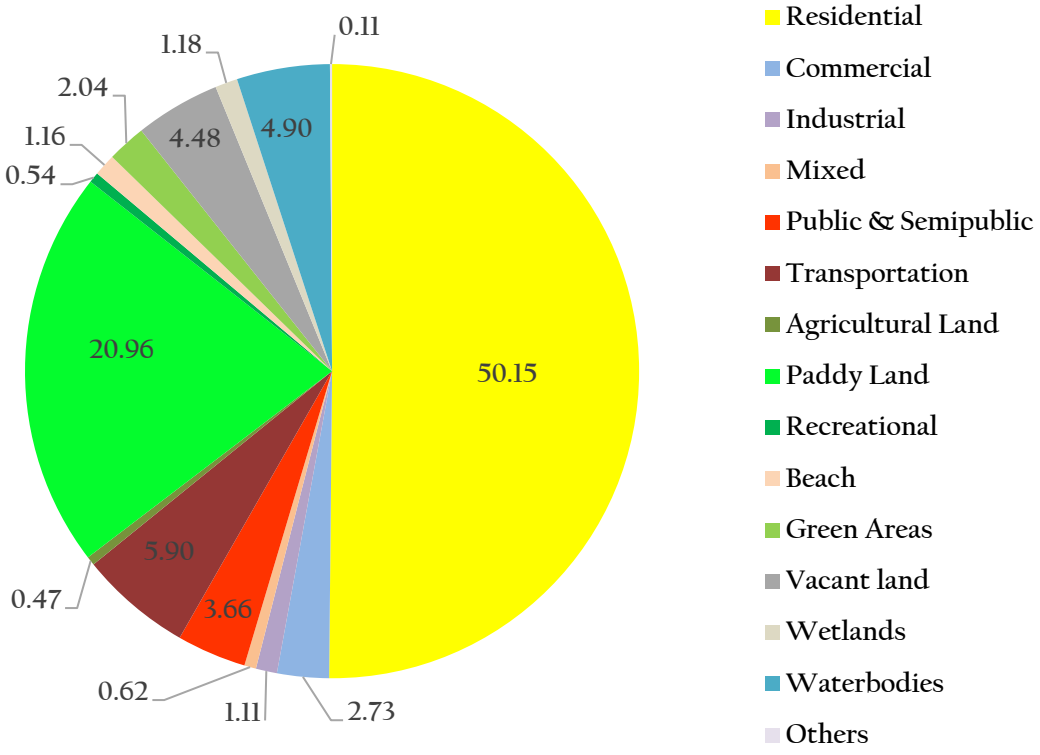


Figure 6-3: Existing Land Use Breakup of Alappuzha Town, 2019

Source: Land Use Survey, 2019

6.3 Comparison of Land uses with URDPFI Guidelines

Table 6-3 shows the comparison of land use of Alappuzha Municipality with URDPFI guidelines. Percentage of residential land use is more than the URDPFI norms, whereas all other land uses are less than the norms.

Table 6-3: Comparison of Land Use with URDPFI Guidelines

Land Use	Area (Sq.Km)	% of developable area	URDPFI Standards
Residential	17.86	69.84	43-48%
Commercial	0.97	3.80	4-6%
Industrial	0.40	1.55	7-9%
Mixed	0.22	0.86	
Public & Semi-public	1.30	5.09	6-8%
Transportation	2.10	8.21	10-12%
Agricultural Land	0.17	0.65	Balance
Paddy Land	7.46		Balance
Recreational	0.19	0.76	12-14%
Beach	0.41		
Green Areas	0.73	2.84	

Vacant land	1.60	6.24	
Wetlands	0.42		
Waterbodies	1.75		Balance
Others	0.04	0.15	
Total	35.62		

Source: Land Use Survey, 2019

6.4 Spatial Distribution & Concentration Pattern of Land Use

In order to arrive at a reasonable picture of the distribution of the various land uses and their intensities, and to compare these on a platform, the concept of concentration index is made use of. The concentration index helps in evaluating the relative intensities of various land use among the various local governments in the district. The concentration index (CI) quantifies the extent of concentration of a particular land use in a ward.

The Concentration Index of a particular land use in a ward = (Area of land use in a ward / Total area of ward)/ (Area of Land use in the Municipality/Total area of Municipality).

The concentration pattern of a land use gives a clear picture on the relative density and concentration of the particular land use among the wards within the town. Concentration Index can be less than one, equal to one or greater than one. CI less than one indicates that there is no concentration of that particular land use in that ward. But CI equal to or greater than one indicates that the intensity of land use under consideration is on the higher side in the ward when compared to other wards in the district.

Using the above concept, concentration indices of major categories of land use are analyzed and are detailed here.

6.4.1 Residential Land Use

Residential Land Use constitutes 50.15% of the Municipal area. Figure 6-4 shows the spatial distribution and the concentration index of residential land use. The density in the already developed residential areas is not high providing scope for accommodating more population. The land value poses restriction on this forcing people to seek other options such as shifting to nearby LSGIs. While analysing the concentration pattern of residential land use, higher concentration is seen in majority of the wards.

6.4.2 Commercial Land Use

Commercial area constitutes only 2.73% of the total Municipal area. The spatial distribution and concentration pattern of commercial land use is shown in Figure 6-5. It shows

that the commercial nodes are concentrated in the central area of the town. Most important commercial nodes are Mullakkal, District Court Jn, Vazhichery and General Hospital Junction.

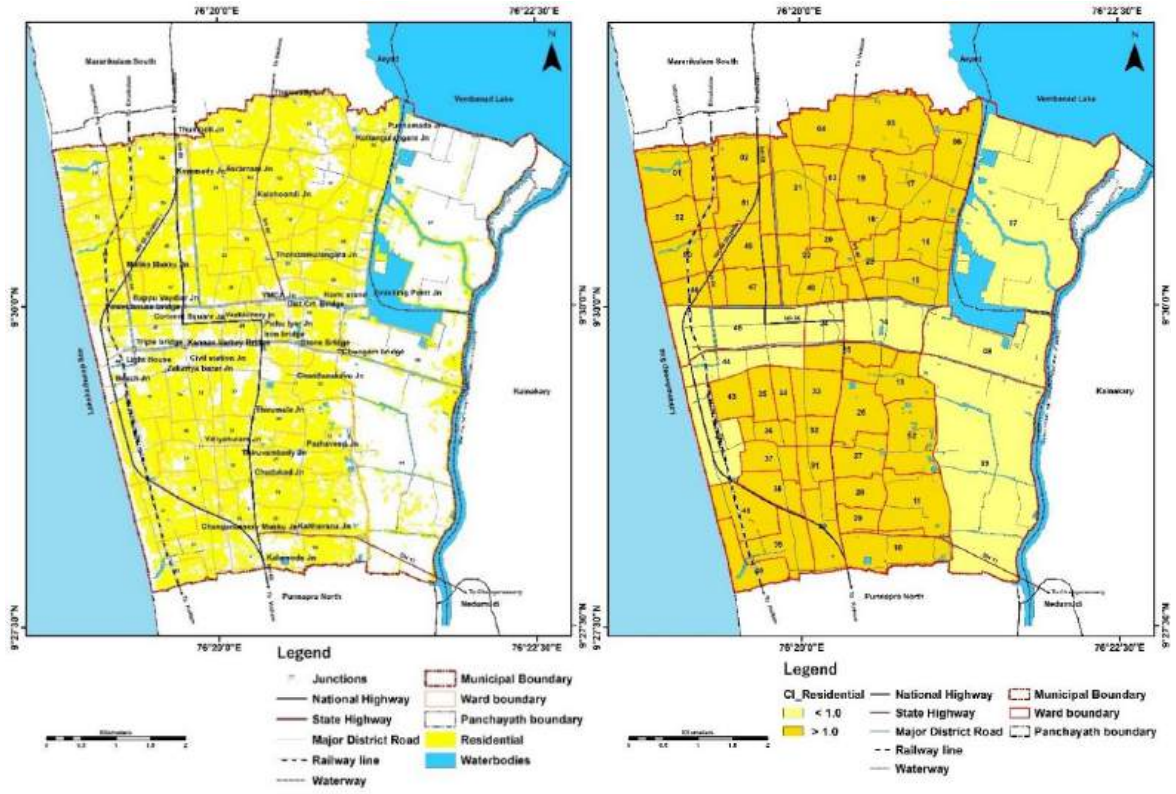


Figure 6-4: Spatial Distribution & Concentration Pattern of Residential Land Use

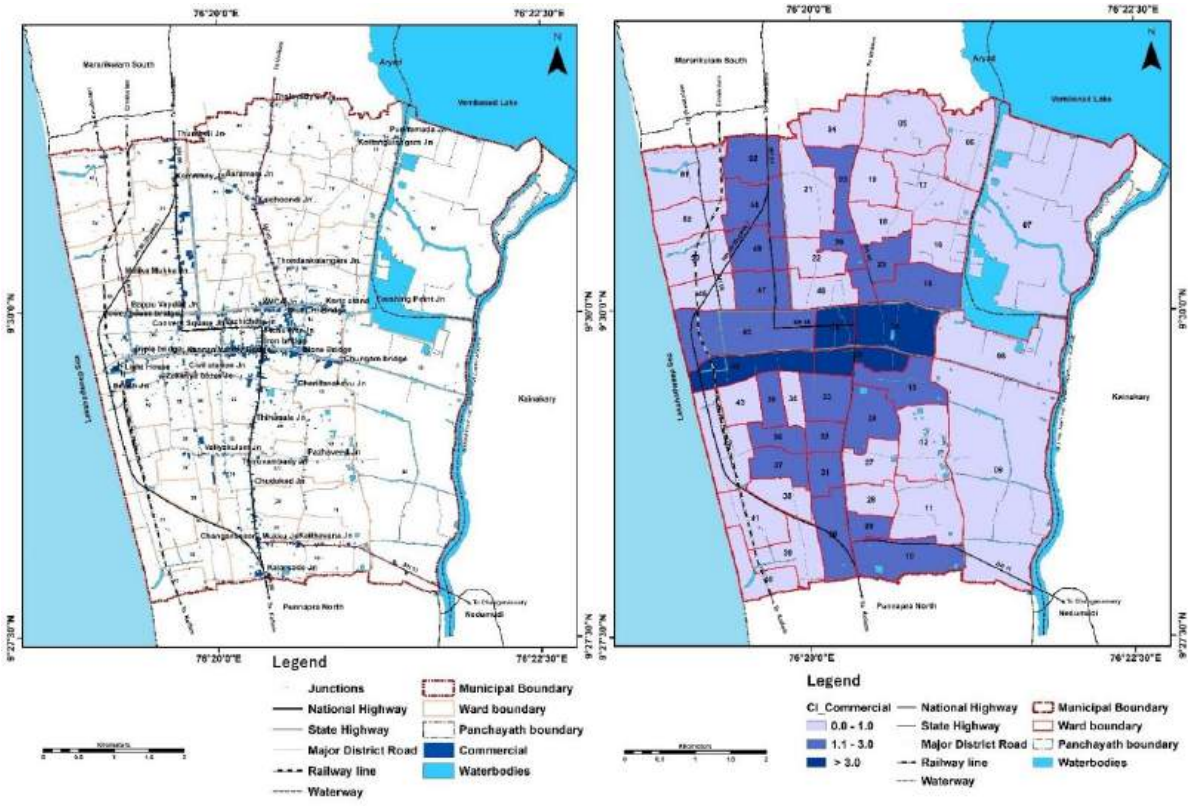


Figure 6-5: Spatial Distribution & Concentration Pattern of Commercial Land Use

6.4.3 Industrial Land Use

Industrial land constitutes only 1.11% of the Municipal area. The large-scale industries are primarily coir based and most of them are more than 100 years old. The spatial distribution of industrial land use and its concentration pattern are shown in Figure 6-7. The higher concentration is seen in Kommady (2), Vazhichery (24), Sea View (43) and Power House (47) and Civil Station (44) wards.

6.4.4 Mixed Land Use

Mixed use constitutes 0.62% of the total Municipal area. Mixed use is predominant in wards Chathanadu (48), Vazhicherry (24), Municipal Office (25), Civil Station (44), Zacharia Bazaar (43), Lajaneth (35), Alisserry (34), Municipal Stadium (33) and Valiyamaram (32).

6.4.5 Public & Semi Public Land Use

public & semi public, public utilities, educational, Health services, religious, central and state government property, communication and solid waste management are grouped under this category. There is a large number of government offices concentrated in the central area due to the location of Civil Station (Figure 6-9). The total extent of land occupied by public and semipublic use comes to 3.66% of the Municipal area.

6.4.6 Recreational Land Use

Recreational use constitutes about 0.54% of the total Municipal area. Municipal stadium is the only stadium in Alappuzha Municipality which is meant for sports and other cultural activities. All the recreation facilities are concentrated in and around the town centre.

6.4.7 Transportation Land Use

The area covered by transportation network comes to about 5.90%. The study area is served by public transport system consisting both KSRTC and private buses. KSRTC bus station is located within the town area, by the side of the canal where the intercity boat terminal is located. The private buses are operated from the private bus stand situated at District Court Bridge junction on VCSB road.

6.4.8 Agriculture & Paddy Land

Agriculture (0.17 Sq.Km) and Paddy land (7.46 Sq.Km) together constitutes 21.43% of the total area of the town. Paddy land exists mainly in Nehru Trophy, Thirumala and Pallathuruthi wards. The spatial distribution and the concentration pattern of agriculture and paddy lands are shown in Figure 6-6.

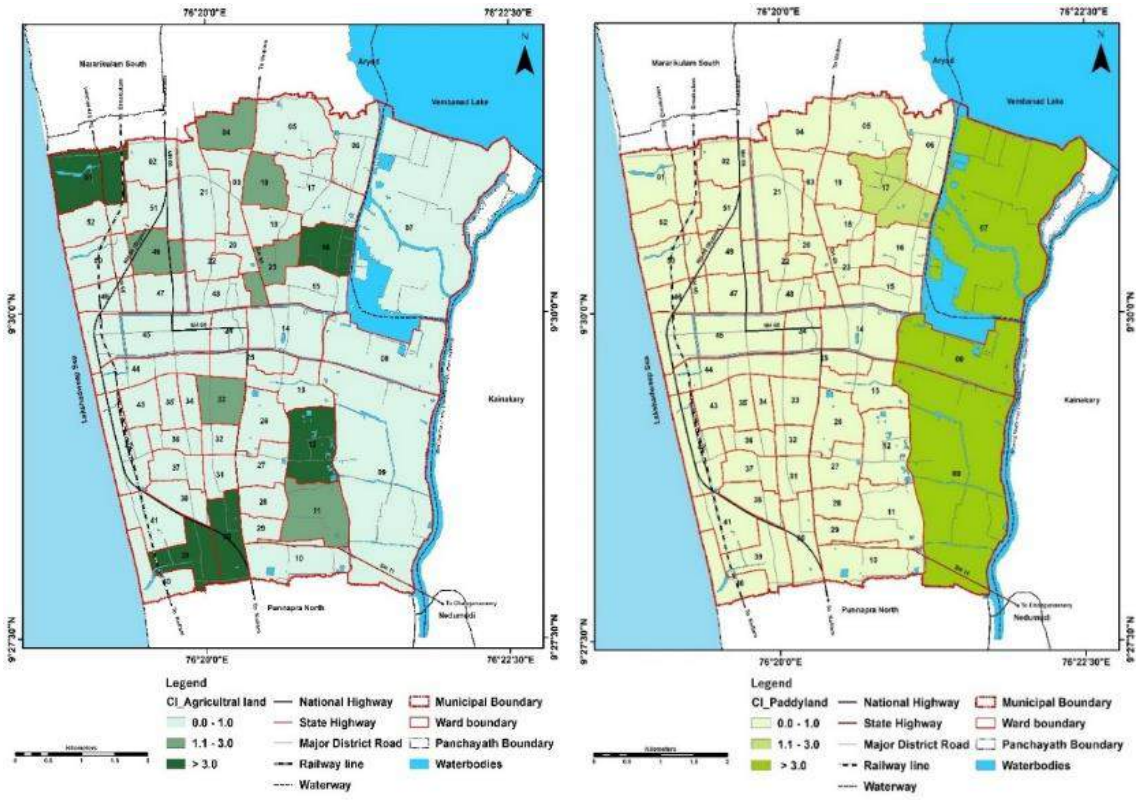


Figure 6-6: Spatial distribution and Concentration pattern of Agriculture and Paddy land

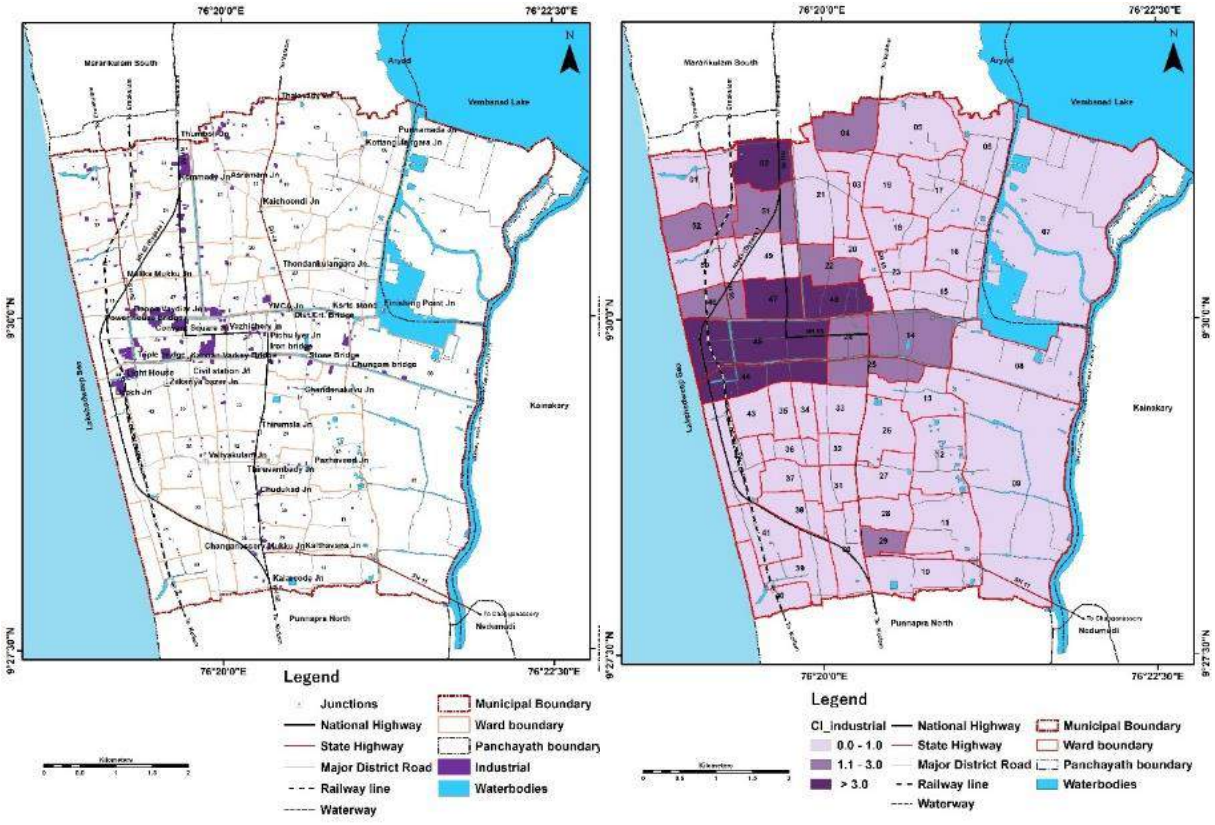


Figure 6-7: Spatial Distribution & Concentration Pattern of Industrial Land Use

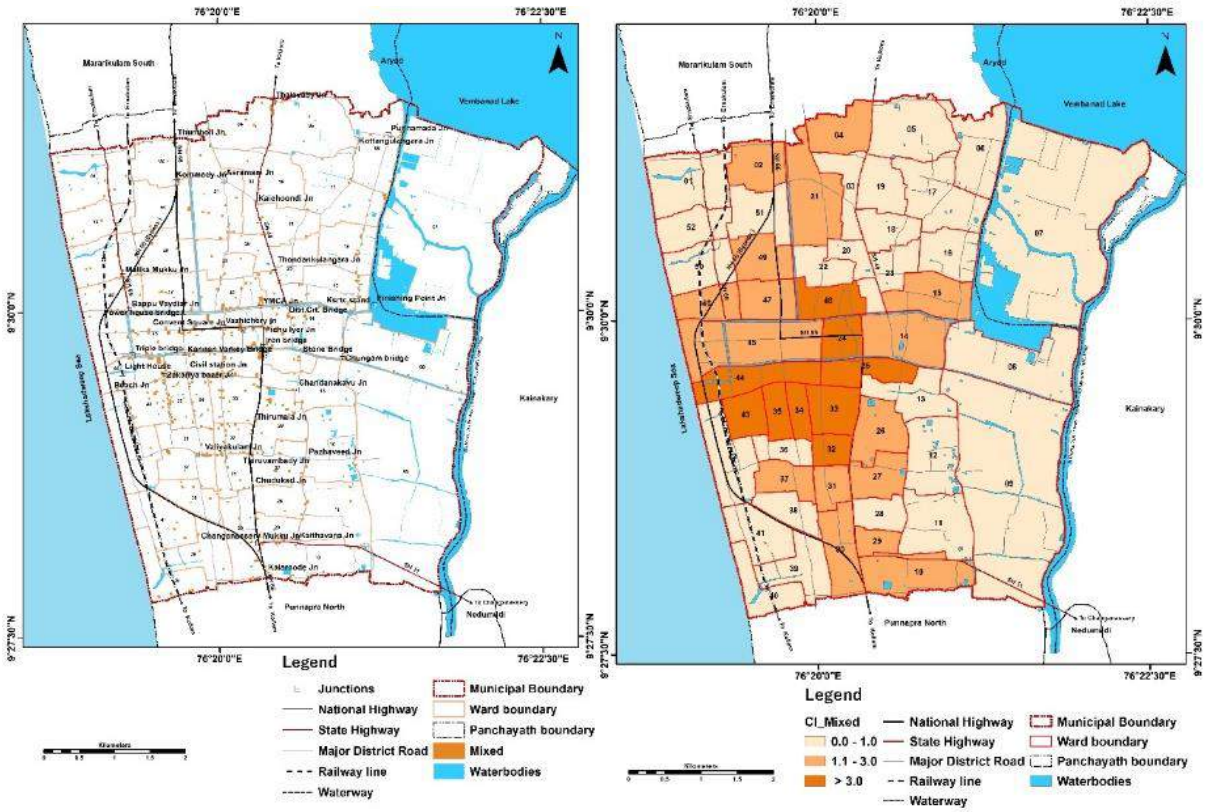


Figure 6-8: Spatial Distribution & Concentration Pattern of Mixed Land Use

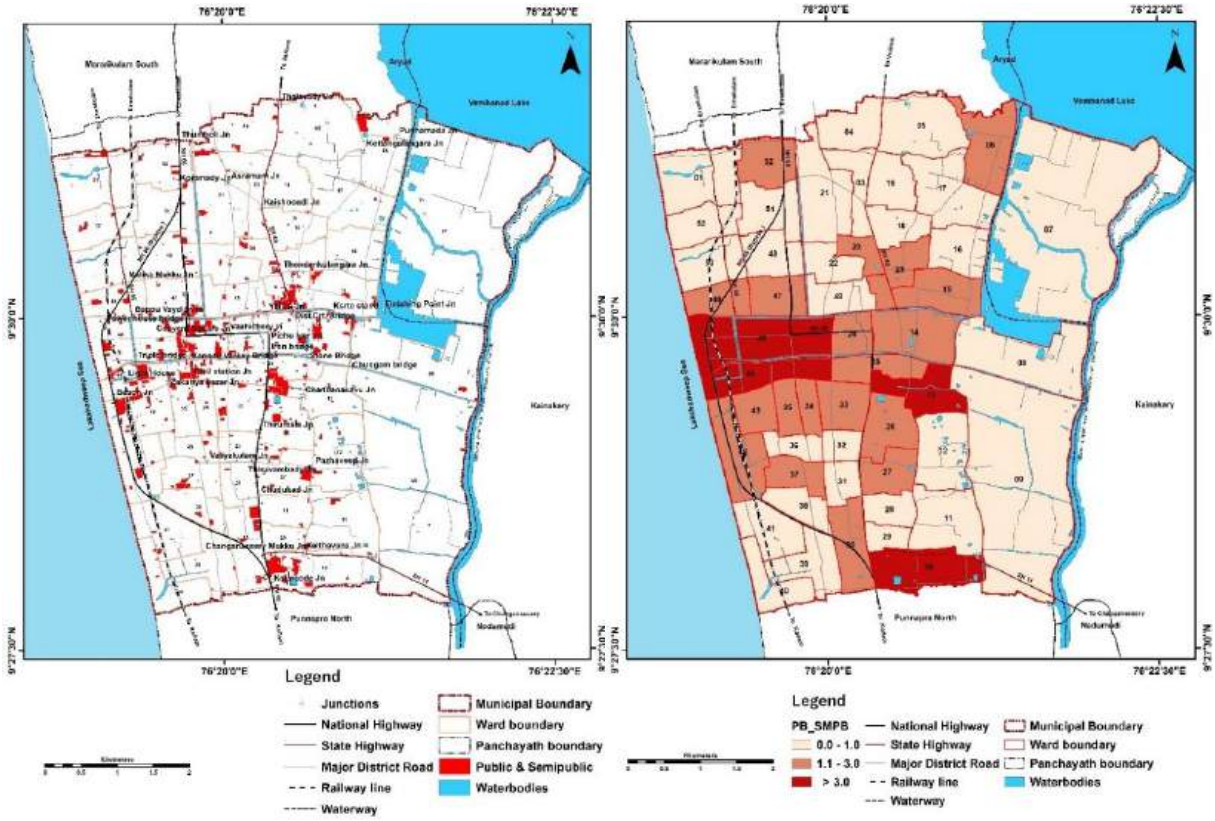


Figure 6-9: Spatial Distribution & Concentration Pattern of Public & Semi-Public Land Use

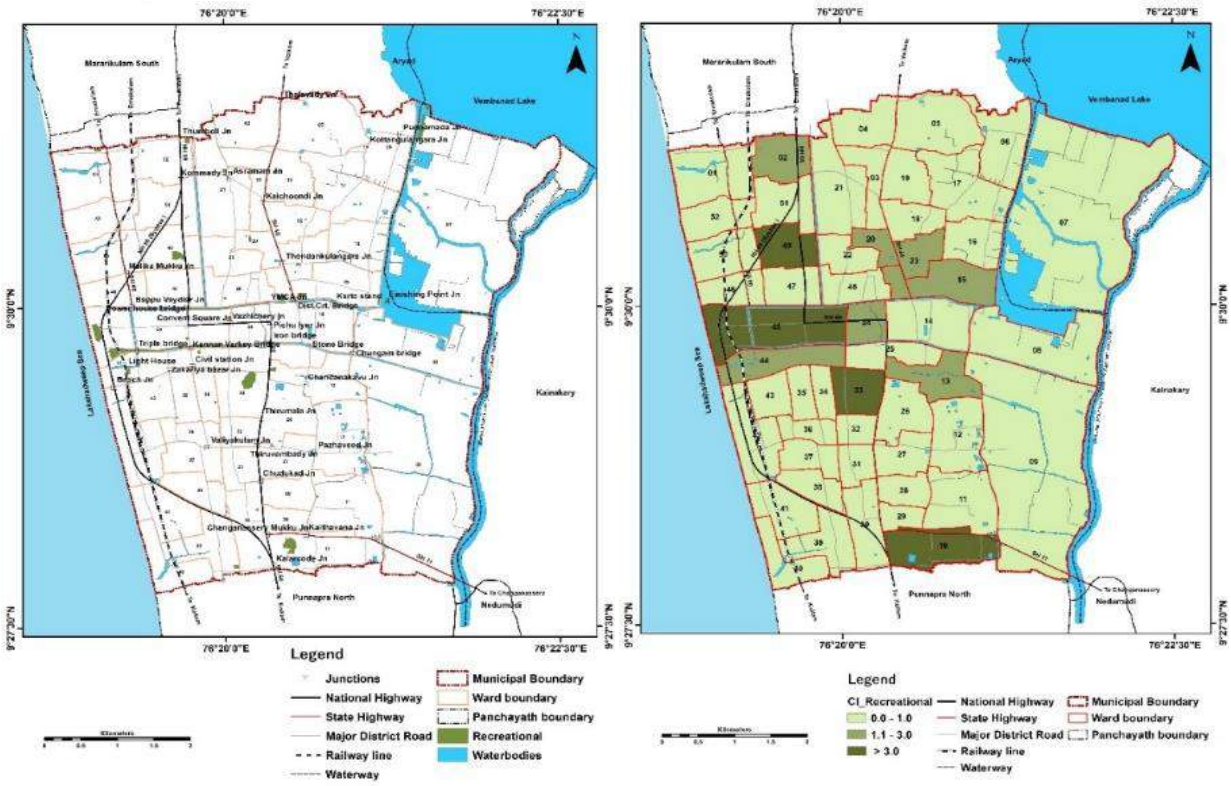


Figure 6-10: Spatial Distribution & Concentration Pattern of Recreational Land Use

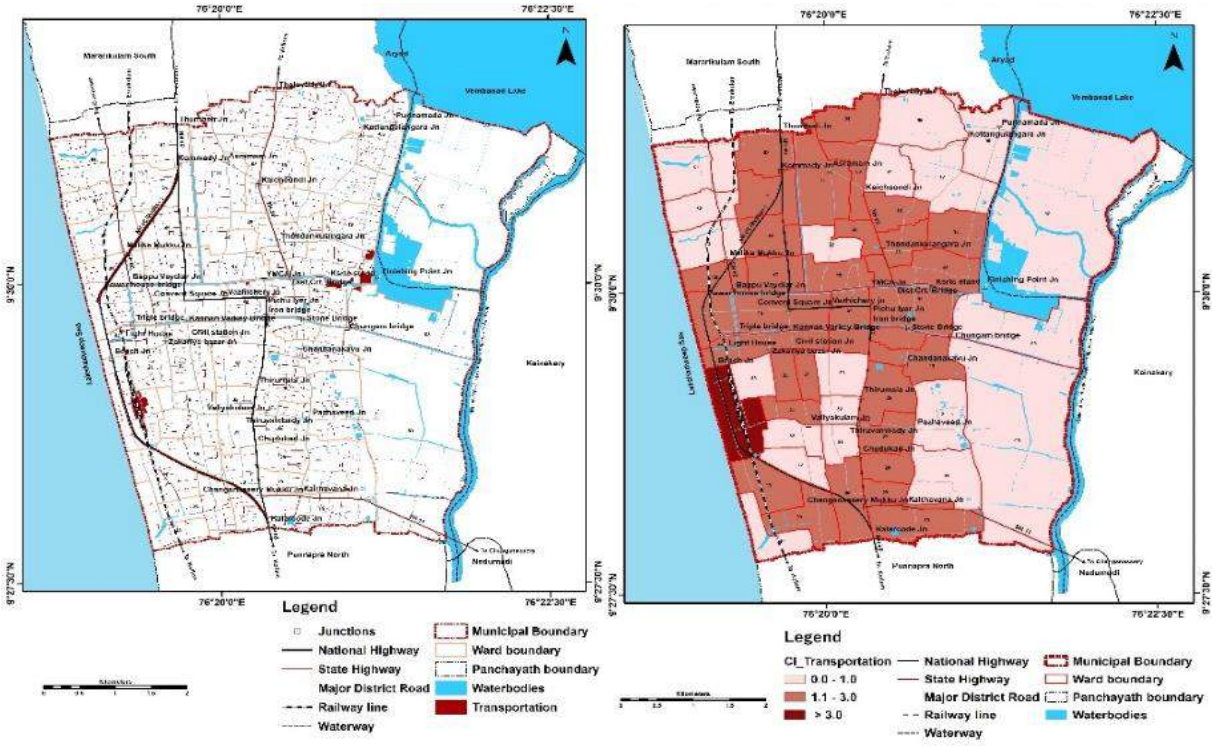


Figure 6-11: Spatial Distribution & Concentration index of Transportation Land Use

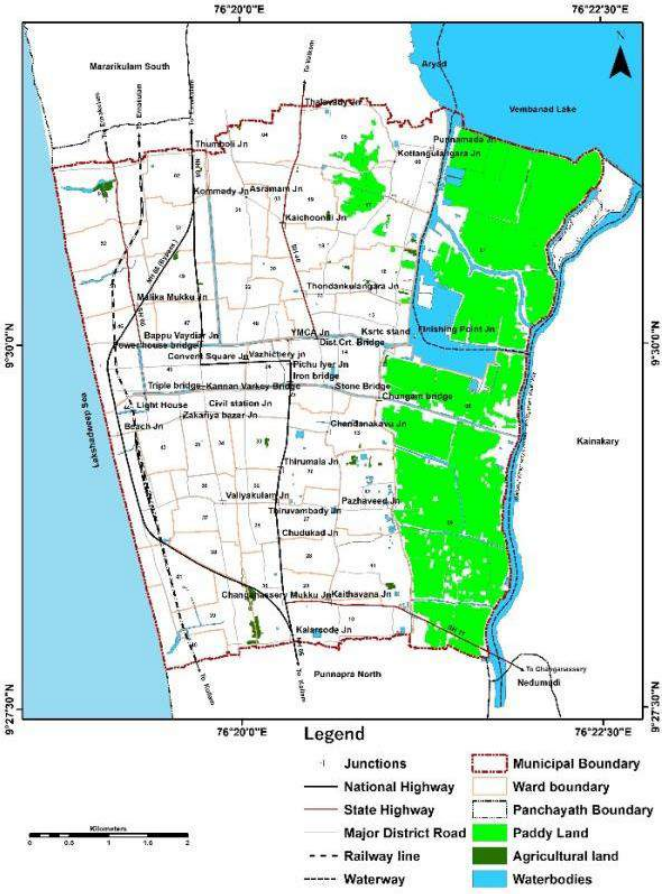


Figure 6-12: Spatial Distribution of Agriculture Land Use

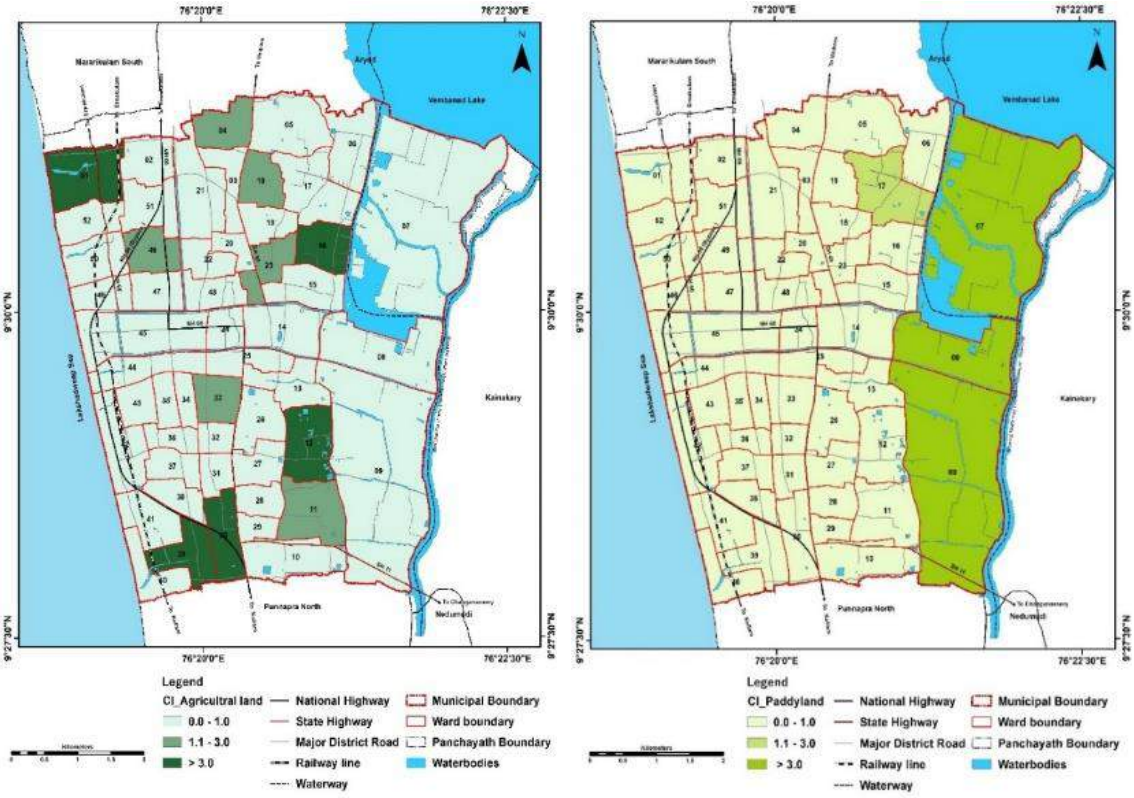


Figure 6-13: Concentration Pattern of Agriculture & PaddyLand

6.4.9 Other Land Uses

Other land uses within the town, which constitutes very less percentage are Beach area, Wetlands, Vacant Lands, Water bodies etc. The spatial distribution of these land uses are shown in Figure 6-14. Beach area constitutes 1.16%, Wetlands (1.18%) and other uses (0.11%) of the total area. Spatially locating vacant land is essential for analysing the availability of land for the development of the town. Vacant lands constitute 4.48% of the total Municipal area. The rivers, drains, canals, irrigation canals and all ponds are grouped as water bodies. The area covered by water body comes to about 4.9% of the town area.

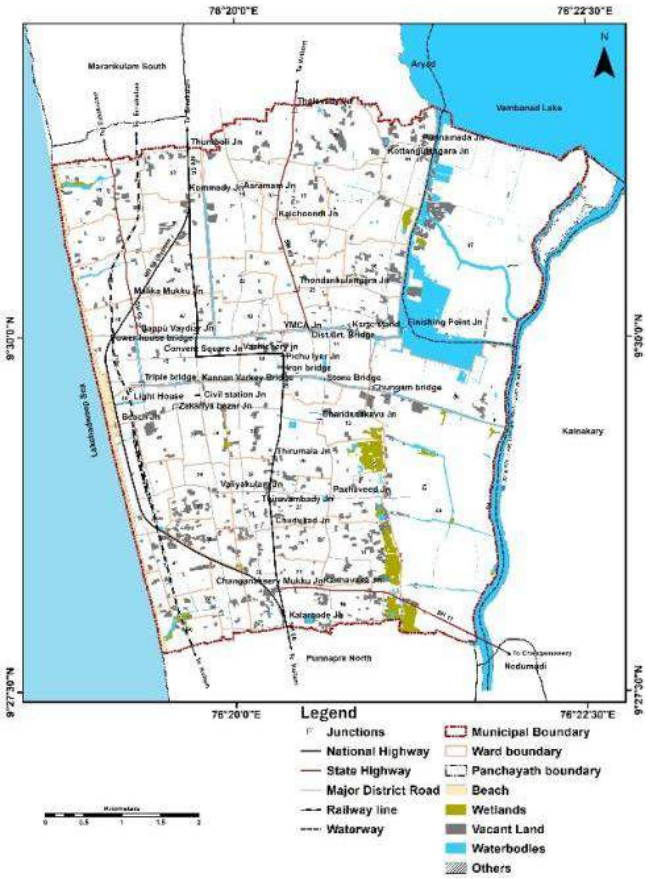


Figure 6-14: Spatial Distribution of other Land Uses

6.5 Functional Character of Wards

The function of a settlement is a derivative of the major activity in the settlement, be it primary activities (rural), secondary sector/tertiary activities (urban activities) or a combination of these. The activities in a settlement are interrelated with the land use pattern. Here an attempt is made to determine the major function of a ward by studying the major land use and the average plot size of the ward. An area can be pucca urban area, pucca rural area or mixed (Residential cum agricultural) use area. The mixed land use area can be further classified into urban, semi urban, semi-rural or rural. When the total area of LSG is concerned, the predominance of wards of any of the four (urban, rural, semi-urban or semirural) characters determines the character of the area. While this holds good, certain other conditions, from the practical point of view, are also incorporated for refining the process of categorizing the area. This is to account for the ground realities.

The character of an area can be termed as urban;

- If the pucca urban land use is more than or equal to 25 % of the total area, then the area can be termed as an urban area. (The analysis of the land use of various urban local governments and the share of various land uses of an urban area as specified in the

URDPFI guide lines shows that an urban area has a residential land use of the same share as that of pucca urban land use (commercial, industrial, public & semipublic etc.) This is actually the residential land use attached to the urban land use. So if the pucca urban land use is 25% then by adding the residential share of 25% the total urban land use share becomes 50%.

- If the urban land use share taking into account, the classification of mixed land use percentage also is 50% or above the total area.

An area can be termed as rural;

- If the pucca rural land use share is more than 50% of the total area.
- If the rural land use (taking into account, both pucca rural land use and the classification of mixed land use) share is greater than or equal to 50 % of the total area.

An area can be termed as semi-urban;

- If the mixed land use area is classified as semi - urban and the sum of urban land use share and semi urban residential land use is greater than or equal to 50% of the total area.

An area can be termed as semi-rural,

- If the mixed land use area is classified as semi-rural area and the sum of rural land use share and semi-rural mixed land use land use is greater than or equal to 50% of the total area.
- If the pucca rural land use share is at least 1/3rdof the total area and the mixed land use is not urban or semi-urban, then also the area can be termed as semi -rural area.

Based on the above concepts, the wards are analyzed to determine the character and the findings are illustrated in Figure 6-15. It shows that there are wards exhibiting urban and rural character. As per this, 3 wards show rural character, and the remaining 45 wards shows urban character. Nehru Trophy, Thirumala and Pallathuruthy are the three wards showing rural nature.

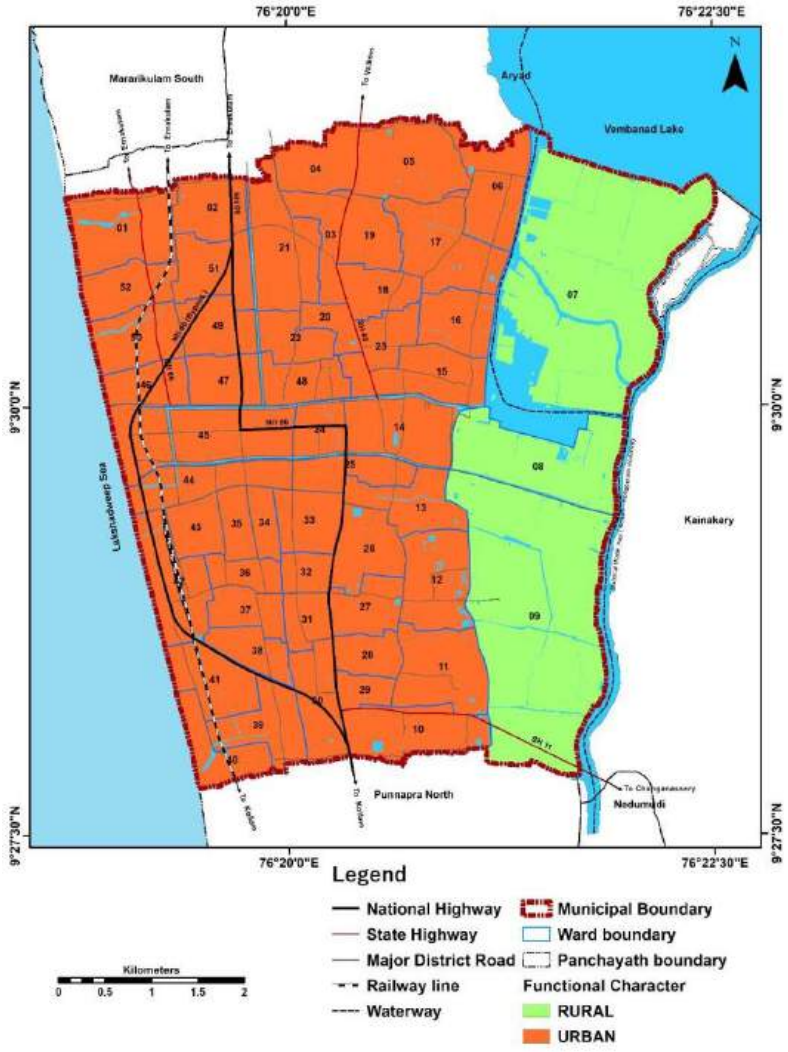


Figure 6-15: Functional Character of Settlements in Alappuzha Town

6.6 Inferences

From the analysis of land use, it is observed that 50.15% of the municipal area is used for residential activities. It is also observed that the commercial land use is concentrated at the core of the town and along the major transportation corridors. The large-scale industries are primarily coir based and most of them are more than 100 years old and they are seen mostly along the canal side. The industrial land use constitutes only 1.11% of the municipal area. On analyzing the residential land use of Alappuzha Municipality, it is seen that the residential land comes under the category of pucca residential area.

7 ECONOMIC ASPECTS

7.1 Tourism

Tourism has emerged as a fast-growing economic activity of great importance throughout the world. When systematically planned and effectively managed, it not only becomes a marketable commodity, but also helps to improve the environment and the infrastructure benefiting the local population. Globalization and its impact have greatly influenced and made it into a fast-developing industry of immense potential.

Tourism industry has become an effective tool for earning more revenue and foreign exchange, which is of crucial importance to every developing country. It provides entrepreneurial and employment opportunities. Rapid strides in economic growth and technological advancements during the past few years have accelerated the flow of tourists across countries.

7.1.1 Development of tourism sector in Alappuzha Town

Though the present Alappuzha town owes its origin to the sagacious Diwan Raja Kesavadas in the second half of 18th century, district of Alappuzha figures in classical literature. Kuttanad, the rice bowl of Kerala with the unending stretch of paddy fields, small streams and canals with lush green coconut palms, was well known even from the early periods of the Sangam age. During the 9th to 12th century AD the district had flourished in the field of culture and religion under the Chera Empire. Later in the 16th century the Portugese and in the 17th century the Dutch had trade relations with the district. History says Alappuzha had trade relations with ancient Greece and Rome in B.C and in the middle Ages, as well as with other parts of India.

During the reign of Dharmaraja the district was improved by all means. Raja Kesava Das, the then Diwan of Travancore who was known as the 'Maker of Modern Alleppey' made Alappuzha a premier port town of Travancore. He constructed several roads and canals to improve communications and built warehouses. He offered all facilities to merchants and traders from far and near. During the reign of Balaramavarma Maharaja, Velu Thampi Dalava took keen interest in the development of the town and port. He brought the whole area of the island Pathiramanal under coconut cultivation and large tracts under paddy cultivation. The role of Velu Thampi Dalava in the development of Alappuzha is worth mentioning. In the 19th century the district attained progress in all spheres. One of the five subordinate courts opened in the state in connection with the reorganization of the judicial system by Colonel Munro was

located at Mavelikkara. The credit of having the first post office and first telegraph office in the erstwhile Travancore state goes to this district. The first modern factory for the manufacture of coir mats and mattings was also established in 1859 at Alappuzha. The town Improvement Committee was set up in 1894.

Alappuzha is a place of fascinating natural beauty with sparkling backwaters and water bodies, beautiful stretches of coastline and remarkable fairs and festivals. The district has become a destination for backwater tourism attracting both foreign and domestic tourists.

Alappuzha town is a sandy strip of land interlocked with lagoons, rivers and canals. There are some environmentally sensitive areas like the Vembanad lake, which is a Ramsar site and the Pathiramanal Island, lying NorthEast of Alappuzha town. The most significant aspect of the town is its geographic features i.e. the fact that it is only 4 to 5 kilometres wide and has Vembanad Lake to its East and the Arabian Sea to its West.

Alappuzha has a lighthouse, which is a major tourist attraction. Alappuzha is highlighted in every tourist map as the place to head for backwater tourism. In terms of tourist inflow, Alappuzha is among the towns that have very high number of visitors coming to spend their time mainly as a transit location while going to other parts of the state.

7.1.1 Types of Tourism

7.1.1.1 Backwater tourism

The Kerala Backwaters are a network of interconnected canals, rivers, lakes and inlets, a Labyrinthine system formed by more than 900 km of waterways, and sometimes compared to the American Bayou. In the midst of this landscape there are a number of towns and cities, which serve as the starting and end points of backwater cruises. The stretch of National Waterway No. 3 from Kollam to Kottappuram, covers a distance of 205 km and runs almost parallel to the coast line of Southern Kerala facilitating both cargo movement and backwater tourism.

The backwaters have a unique ecosystem; freshwater from the rivers meets the seawater from the Arabian Sea. In certain areas, such as the Vembanad Kayal, where a barrage has been built near Kumarakom, salt water from the sea is prevented from entering the deep inside, keeping the fresh water intact. Such fresh water is extensively used for irrigation purposes.

Many unique species of aquatic life including crabs, frogs and mudskippers, water birds such as terns, kingfishers, darters and cormorants, and animals such as otters and turtles live in the backwaters. Palm trees, pandanus shrubs, various leafy plants and bushes grow alongside the backwaters, providing a green hue to the surrounding landscape.



Figure 7-1: Back water Tourism

Vembanad Kayal is the largest of the lakes, covering an area of 200 km², and bordered by Alappuzha (Alleppey), Kottayam, and Ernakulam districts. Alleppey, "Venice of the East", has a large network of canals that meander through the town.

Backwaters of Alappuzha town are primarily centered on Punnamada Lake and Vembanad Lake. Punnamada Kayal is situated on the Eastern side of the Alappuzha town. This is linked to Vattakkayal on the East, Vembanadu Lake on the North and Pallathuruthy River on the South side. All these water bodies are connected to the various minor canals in Kuttanad area and also to other canals, which are crisscrossing the town. A cruise through this scenically beautiful region is a memorable experience for any tourist who would like to experience a slice of the unique rural life around Alappuzha town.

Alappuzha, with its vast expense of backwaters also offers a great opportunity for enjoying a trip through its natural heritage by taking a trip in the famed 'Kettuvallams' or houseboats. Cruising along the backwaters of Kerala is an unforgettable experience. Houseboats are huge and slow-moving boats designed for absolute leisure trips. Alappuzha is the palace of houseboats. Many tourists are attracted to Kerala in the charm of staying in a houseboat which provides a unique experience of living in the water with all the conveniences of a luxury hotel. House boating is the greatest attraction for the tourists owing to sightseeing, visit to other heavenly destinations such as beach, light house, traditional buildings and a feeling of homely atmosphere for a change.

The Nehru Trophy boat race held in August every year on Punnamada Lake is a great sporting spectacle attracting thousands of foreign as well as domestic tourists. A pavilion was constructed in the Punnamada Lake for the spectators of Nehru Trophy boat race. These snake boats have its origins in Alappuzha with a history of over 400 years when kings of erstwhile Chembakassery, Kayamkulam, Thekkumkoor and Vadakkumkoor fought battles on these

boats in the backwaters. Usually, a snake boat is managed by 4 helms men, 25 Cheerors, 100 to 125 oarsmen who row in unison to the fast rhythm of vanchippattu. Other boat races held in and around Alappuzha district are the following Chambakulam Boat race, Rajiv Gandhi Boat Race Pulinkunnu, Kayamkulam Boat Race, Neerattupuram Boat Race, Santhosh Trophy Boat Race Chennithala, Payippad Boat Race, Karuvatta Boat Race, Chengannoor Boat Race and Kumaranashan Smaraka Boat Race. Among these only two or three boat races are famous at national and international level. There is need to market other boat races also adding tourism potential to Alappuzha district.

A Water Sports Complex under the patronage of Sports Authority of India (SAI) is also functioning here. This is intended to impart training in various kinds of water sports. Under the patronage of the State Tourism Department landing and berthing facility for houseboats are constructed by the side of Punnamada kayal. A sewage treatment plant is completed at R Block kayal for treating the waste from houseboats.

Pathiramanal Island

It is an island in Vembanad Lake lies between Thanneermukkom (Alappuzha district) and Kumarakom (Kottayam district). It is a favorite haunt of rare migratory birds from different parts of world. Pathiramanal meaning, sands of midnight are a 10-acre island on the waters of the Vembanad. Legend has it that a young Brahmin when dived into the waters of the lake for his evening ablutions, the water gave way for land to rise to serve as the serene spot for the Brahmin's prayers. Pathiramanal is accessible by one-and-a-half-hour drive by motorboat or 30 minutes' drive by speed boat from Alappuzha. The Island Pathiramanal is the only piece of habitat with least disturbance now left in Kuttanad. For this reason and for it being a locale of several endemic flora and fauna, the island should be preserved for its rare ecological value and pristineness.



Figure 7-2: Pathiramanal Island

7.1.1.2 Canal tourism

Alappuzha has extensive network of manmade canals crisscrossing the topography. The three major canals inside the town are Vadai canal, Commercial canal and Alappuzha - Cherthala canal. These canals are linked to the Pallathuruthy River. In the earlier days this

canal system was used for both passenger and cargo transport. Alappuzha town originally developed in and around the Vadai canal & the Commercial canal. Most of the heritage structures in the town are located on the sides of these canals.



Figure 7-3: View of Canal & Canal side buildings

7.1.1.3 Beach tourism

Alappuzha is gifted with immense natural beauty with the Arabian Sea on its West. Alappuzha town has a long coastline. The once busy Alappuzha Port is almost defunct now. The 125-year-old pier and the lighthouse are major attractions of the beach. These are not maintained properly and lack even basic facilities for visitors. The DTPC has constructed a park, paved passages and an open - air theatre on the beach. Some cultural programs are being staged occasionally. The foreign tourists rarely use these. Sea View park and Vijay Park are spectacular sights located close to the beach. Boating facility is available in the Sea View Park.



Figure 7-4: Alappuzha Beach

7.1.1.4 Farm tourism

One of the major features of Alappuzha is the region called Kuttanad, the 'Granary of Kerala'. Kuttanad is also known as the "Rice Bowl of Kerala" and is one of the few places in the world where farming is done below sea level. The paddy fields lie about 0.6 to 2 m below mean sea level. The *Kuttanad* area is also rich in avian population, and one can easily find flocks of parrots hovering in the paddy fields, especially those fields with rice stalks in bloom. Sometimes one can come across a black blanket sweeping across the sky, which on close look will reveal as yet another flock of birds. Some time it is the darter birds, which haunt the backwaters in and around *Kuttanad* and the adjoining *Vembanad* Lake.

Among the sights on the backwaters at *Kuttanad*, the most fascinating obviously is that of the ducks, quacking together in high decibels and moving across the backwaters in large

numbers; shepherded by men on small boats. One can also catch men plying on the backwater; some diving down to collect lime shells from the depths and others fishing with their nets and traditional cane basket called *Ottal.*

For those interested in trying out few local dishes may do so by dropping at the small traditionally built wayside eateries, which are quite famous for backwater fish delicacies and tapioca. A popular naturally extracted beverage is the toddy, which is available in plenty and enjoyed by many for its specialty. A walk along the side of canals that crisscross Kuttanad which is lined by tall coconut trees is very fascinating.

Farm tourism involving farm families and demonstration of unique farming practices is important to channelize the benefits of tourism to the local farmers. Hence, necessary development and methodology may be worked out to integrate farm tourism with the present pattern of tourism. Such exploration may consider the use of smaller boats for cruising to interior areas for interaction and overnight stay with families or farmhouse.



Figure 7-5: Paddy fields in Alappuzha

7.1.1.5 Cultural Tourism

There are a number of festivals across the breadth and length of Alappuzha which underlines the scope of cultural tourism promotion. The major cultural events are Mullakkal Chirappu, Kidangamparambu Chandanakudam, Aruthunkal Perunal, Chettikulangara Bharani, Beach festival, Edathua Perunal, Mannarasala Ayilliam, etc. All these events attract a large number of domestic and foreign tourists. Table 7.1 shows the major cultural events during a year.

The nine day 'Navarathri' festival celebrated in Mullakkal Rajarajeswary temple is of special significance to the people of Alappuzha. Another important festival of the temple is 'Thaipooyakkavadi'. Mullakkal Chirappu is on the Malayalam month of vrischikam (November – December). Festivities takes place here in all the evenings all throughout this month. The Mullakkal streets are usually filled with stream of people during the chirappu evenings. Fireworks light up the towns skies at night. Crowds gather at the town center to see the spectacular fireworks display. On some nights, the fireworks are followed by many cultural programs like music, dance etc.

Table 7-1: Major cultural events within the town

Name of Festival	Period
Major cultural events within the town	
Beach Festival	December 30 – January2
Nehru Trophy boat race	August
Mullakkal Chirappu, Kidangamparambu, Chandanakudam	December
Major cultural events outside the town	
Kandamangalam Rajarajeswary Temple	March – April
Edathua Pally perunal	May
Chambakulam moolam boat race	July
Arthunkal Perunal	January
Chettikulangara Bharani , Padanilam	February- March
Kayamkulam , Pulinkunnu boat races	August
Mannarasala Ayillyam	October - November

7.1.2 Accessibility

Alappuzha is accessible by air, rail, road and water. Cochin International Airport, which is 78kilometers to the North, is the closest airport. Thiruvananthapuram International Airport, 159 kilometers to the South, is the other airport that links the district with other countries. International tourists utilize this facility to reach Alappuzha. The other nearest airports are at Kozhikode (236 kilometers) and Coimbatore (254 kilometers). There is also a helipad in the city which however is reserved for government uses.

One major rail line passes through Alappuzha. The railway station is about 4 kilometers away from the center of the town. Alappuzha Railway Station is linked by rail to cities like Trivandrum, Cochin, Coimbatore, Chennai, Bokaro and Mumbai. A total of four trains originate from Alappuzha to cities like Kannur, Chennai, Dhanbad, and Tatanagar. Since Alappuzha is a prime destination, many trains from important cities, like Bangalore, Mangalore, Kozhikode, and Amritsar, pass through this station.



Figure 7-6: District Tourism Map

Alappuzha is also well connected by road. The town service is served by private buses with routes starting from Erattakulanagra Temple at Ambalappuzha till Kalavoor. These buses

connect the city with the surrounding suburbs. National Highway NH 66 passes through the city connecting the city to other major cities like Coimbatore, Ernakulam, Thrissur, Kollam, and Trivandrum. KSRTC runs buses connecting Alappuzha to these cities.

The presence of backwaters and canals makes water transport a popular means of transport. National Waterway-3 passes through Alappuzha. There is an SWTD boat jetty in the city that lies opposite to the KSRTC bus stand. It is served by regular boat services to major towns like Kottayam and Kollam besides to other small towns and jetties. Taking an SWTD boat is a cheaper alternative to house boats for enjoying the scenic beauty of Alappuzha.

7.1.3 Arrival of Tourists & Availability of Tourism Infrastructure

In Kerala, Tourism is having a global presence and with its clear strategy for growth and sheer marketing activities, it has gained a lot of tourists from all over the world. Foreign tourist arrival to Kerala during 2018 crossed 10.96 lakhs, witnessing an increase of 0.42% over the previous year. It is observed that there is a consistent growth in foreign and domestic tourist arrivals in Kerala state and Alappuzha district as shown in Figure 7-7 and Figure 7-8.

Table 7-2 indicates the arrival of foreign and domestic tourists to Kerala state and Alappuzha district during the last five years and percentage of variation over the previous year. Considering the district-wise domestic tourist arrivals, Alappuzha district shows the highest variation of 18.00% over 2017. (Kerala Tourism Statistics)Also, considering the arrival of tourists to specific destinations, Alappuzha shows a considerable growth in foreign and domestic tourist arrival.

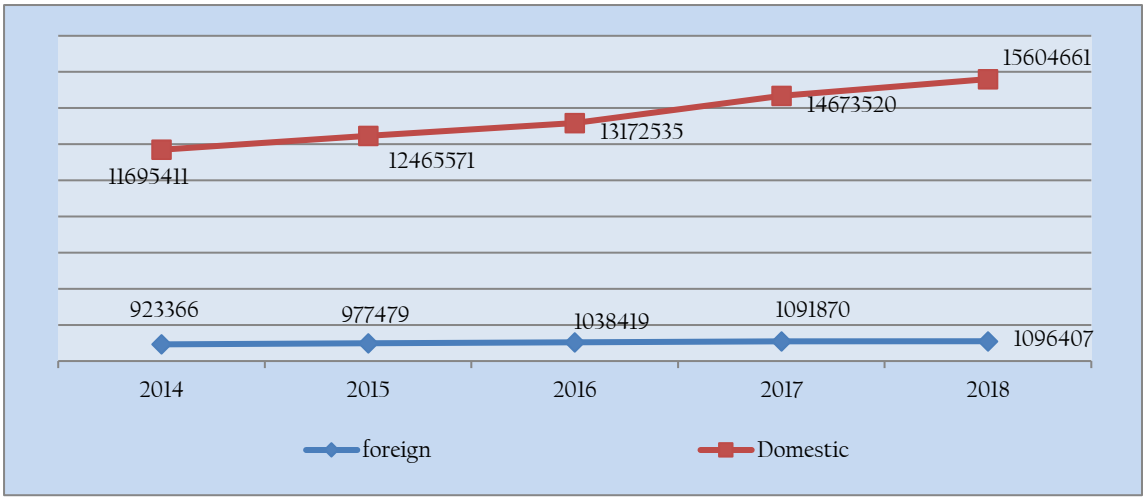


Figure 7-7: Tourist Arrival in Kerala State

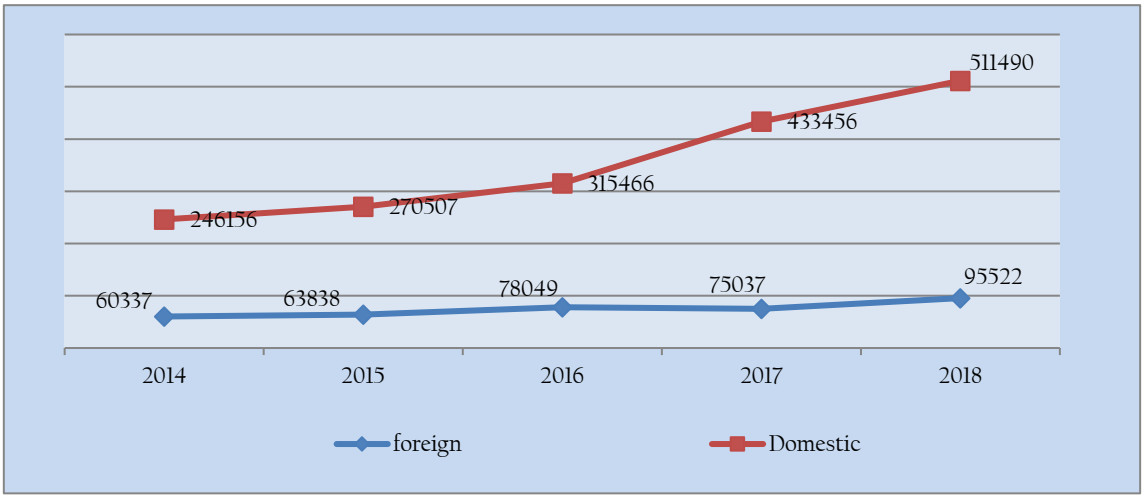


Figure 7-8: Tourist Arrival in Alappuzha District

Table 7-2: Comparison of foreign and domestic tourist arrival in Kerala State and Alappuzha District

Year	Foreign Tourists				Domestic Tourists			
	Kerala	% Variation	Alappuzha	% Variation	Kerala	% Variation	Alappuzha	% Variation
2014	923366	-	60337	-	11695411	-	246156	-
2015	977479	5.86	63838	5.8	12465571	6.59	270507	9.89
2016	1038419	6.23	78049	22.26	13172535	5.67	315466	16.62
2017	1091870	5.15	75037	-3.86	14673520	11.39	433456	37.4
2018	1096407	0.42	95522	27.3	15604661	6.35	511490	18

(Kerala Tourism Statistics)

Figure 7-9 shows the month wise arrival of foreign and domestic tourists in Alappuzha district during 2018. It shows that more number of tourists visited the place during December followed by May and January. Also more number of domestic tourists visited the place during January.

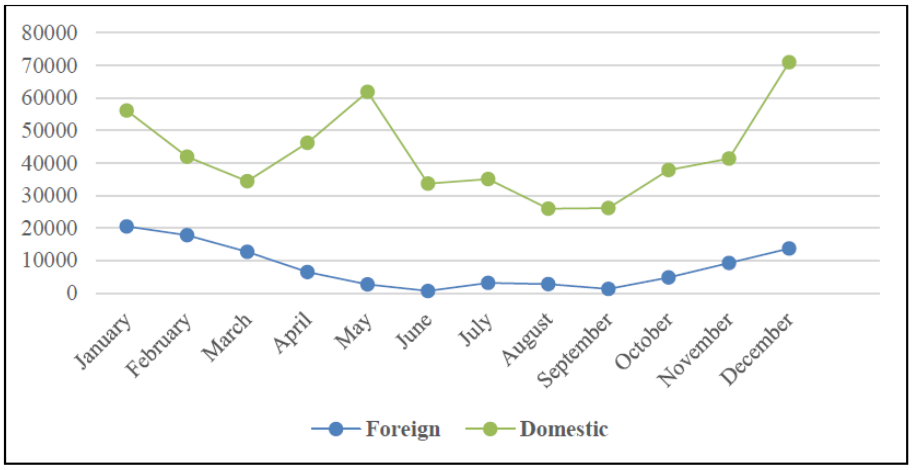


Figure 7-9: Month wise arrival of Foreign and Domestic Tourists in Alappuzha District - 2018

Figure 7-10 shows the distribution of tourist accommodation in Alappuzha as per Tourism Statistics 2018. About 64.40% of the tourist's avail houseboat facilities within the town. A good percentage of tourists visiting Alappuzha prefer to stay in the houseboats.

Houseboats have become major attraction for tourists. Houseboat stay is accompanied by boat cruise through the interior areas of Alappuzha district and Kuttanad villages. There are nearly 800 houseboats plying in the town area as per secondary data. 90 motor boat and 20 speed boat are also available. The only credible facility that is available in Alappuzha town for tourists is the DTPC (District Tourism Promotion Centre) near the boat jetty. Even in this center the information provided is only on the usual boating facilities and on the regular heritage sites.

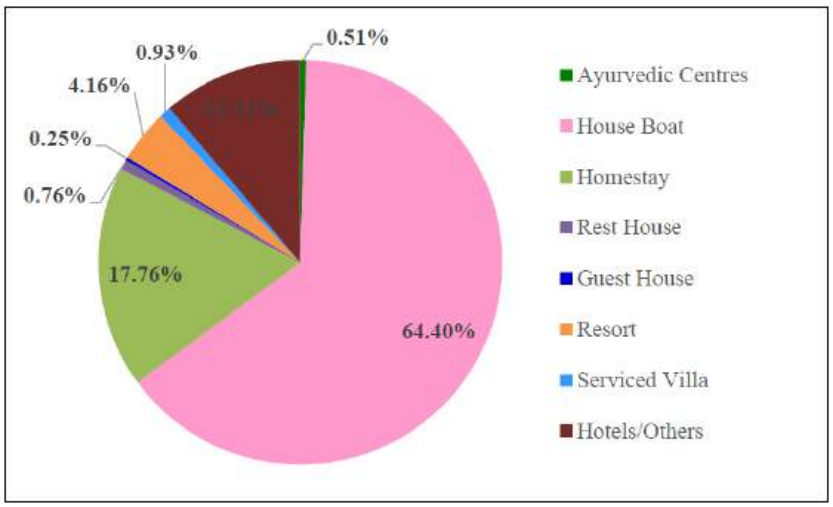


Figure 7-10: Distribution of Tourist accommodation in Alappuzha

7.1.4 Tourism Circuit

Analyzing the present pattern of flow of tourists, a major circuit is identified. Athirapally- Munnar –Thekkady- Alappuzha- Kumarakom – Guruvayoor – Kochi, the major circuit has packages of 11 nights /12 days as shown in Figure 7-11. Majority of the tourists coming to Alappuzha arrive at Kochi by air or train and then reach Alappuzha by train or road. This is the major circuit. After attending all tourists' attractions, they move to Alappuzha by city to city backwater tour or by KSWT Dept facility. Other circuits are Kochi –Alappuzha, Kochi –Kumarakom – Alappuzha, Kochi – Munnar –Alappuzha etc. These circuits are transit in nature because most of the packages are in such a way that Alappuzha acts as a transit point. The major complaint is that there is no activity here other than backwater cruises.

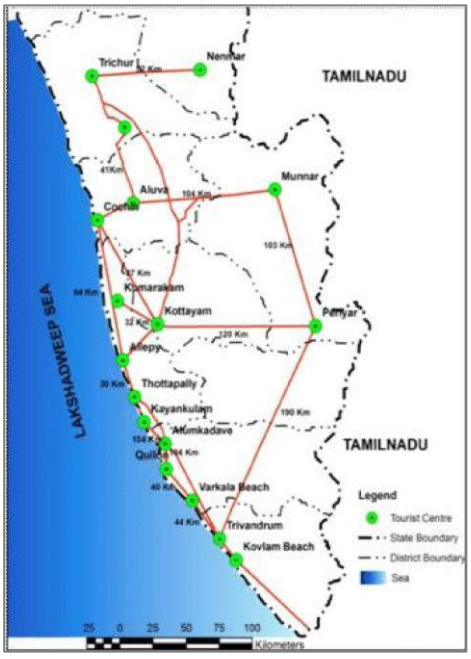


Figure 7-11: Tourism Circuit

7.1.5 Ongoing & Committed Projects in Tourism Sector

Tourism development of Alappuzha mainly depends on the lakes, canals, and beaches. The Vembanad lake is acting as the gateway to backwaters of Alappuzha. The lack of proper facilities and amenities is the main limitation facing the tourism sector in Alappuzha. Lack of sufficient accommodation facilities is another major limitation in making Alappuzha as a transit destination. The projects proposed by the Tourism Department to improve the situation are shown in Table 7-3.

Table 7-3: Ongoing and Committed projects in Tourism Sector

Sl. No:	Name of Project	Executing Agency
	Ongoing Projects	
1	Alappuzha Heritage Project-Development of Museum of Coir History	Muziris Heritage Projects
2	Alappuzha Heritage Project-Development of Living Coir Factory	Muziris Heritage Projects
3	Alappuzha Heritage Project-Development of Yarn Museum	Muziris Heritage Projects
4	Improvements to road by the side of Pamba river to Facilitate House Boat Parking at Chungam-Thirumala in Alappuzha Municipality	Tourism Dept.
5	Repair&Maintenance; of Shed B - Coir Corporation and Canteen Block for Museum	Muziris Heritage Projects
6	**Barrier Free KeralaTourism at Alappuzha beach**	**DTPC**
	Committed Projects	
1	Chungam (Chakrepurakkal) - Kayalchira Pathway Development and Boat landing by the side of Pamba River, Alappuzha	Tourism Dept.
2	Punnamada Starting Point Path way and Boat landing at Alappuzha	Tourism Dept.
3	Construction of World Class Toilet Block at Alappuzha Beach	Tourism Dept.
4	Waste Management Project at 79 Tourism Destinations, under PROJECT GREEN GRASS (2019-20) – ALAPPUZHA	Tourism Dept.
5	AHP Signages Alappuzha Heritage	Muziris Heritage Projects
	Recently Completed Projects	
1	Development of Back water Circuit in Alappuzha in Back Water Region as a Mega Circuit in Kerala	Tourism Dept.
2	Punnamada Finishing point Pathway and Jetty	Tourism Dept.
3	Punnamada - Renovation of Tourism Office & Surroundings after Flood 2018	Tourism Dept.
4	Destination development Alappuzha	Tourism Dept.

(Tourism Department, Alappuzha)

7.1.6 Problems & Potentials

The Municipality Has immense potential for the development of tourism sector with a clean and beautiful environment. Alappuzha town is a sandy strip of land interlocked with lagoons, rivers and canals. There are some environmentally sensitive areas like the Vembanad lake, which is a Ramsar site and the Pathiramanal Island, lying Northeast of Alappuzha town.

The town lacks in tourist infrastructure. The marketing efforts are minimal. The accommodation facilities in the town is deemed to be inadequate when tourists are taken into account. Sadly, most visitors to Alappuzha just take a day trip, i.e., the tourists from Kochi or Kollam come here in the morning and return back by evening. Allepey is no less exotic than Kollam or Kochi, but the very lack of infrastructure has dented its tourism profile.

Houseboats, as they are operated now, pose environmental threats. They are found to dispose the wastes directly into the backwaters and canals. Oil spillage from motorized houseboats is yet another environmental hazard. There is no strict monitoring of the movement of the houseboats. They are not route specific.

At present the tourists who come to Alappuzha town depend on auto rickshaw drivers and taxi drivers as well as local population for information on places to visit in the town. Many of these people are not aware of the possible destinations and hence very often the tourists are misguided or are advised the usual boat trips. The heritage sites get dropped out in the process.

Hygienic food and water are a prerequisite for any tourist to feel comfortable in a town. Tourists feel confident to go to places, which fulfils quality stipulations. Alappuzha has carried the tag of being on the risky side of water borne and mosquitoes borne diseases. This could affect the tourists eating out at the restaurants of Alappuzha. It is necessary to empanel and certify restaurants based on hygiene, cleanliness, politeness, ambience and quality of food. The tourists can safely visit restaurants, which carry the certification insignia. The town does not possess basic amenities for tourists like lighting, litter bins, toilet facilities, lockers etc. at beaches, parks and at places of other tourist attractions. Alappuzha is promoted and marketed only as a backwater attraction. Architectural and heritage attractions rarely find mention in tourism brochures.

7.1.7 Inferences

The town has great potential for development in this sector. The existing information centers may be thoroughly revitalized to cater the needs of both domestic and international travelers. Service of accredited guides, having adequate training to lead both domestic and foreign tourists may be entrusted in the town. Efficient, time scheduled, pre-advertised and regular tours are much appreciated by tourists. The accommodation facilities have to be encouraged to its maximum.

There is a need to enforce measures to prevent water pollution due to solid waste disposal, fuel spillage, etc. Establishing navigation aids, cleaning the canal routes regularly and protecting them from weeds, improving sanitary facilities for local population along the cruising routes, improving tourist safety measures, enforcing the recommended chemical toilets in houseboats etc. are measures suggested in this respect. Sustainable tourism also has to be sensitive to the local ecology, biodiversity, and cultural traditions and sensitivities of local communities. A code of conduct for responsible, safe and ecologically friendly tourism by resort and houseboat operators has to be evolved and put in place.

7.2 Trade & Commerce

7.2.1 Existing Scenario

Alappuzha was a center of trade and commerce over a century ago. Traders from all over the world came here to buy various items like spices, products carved out of teak and mahogany, coir mats (which is said to have a finishing as though it was interwoven with golden threads) and other coir products, coconut oil, etc. The commercial areas in the town amount to 2.73 % of the municipal area and are concentrated at the Market Road, VCSB Road, CCNB Road, CCSB Road, Cullen Road and VCNB Road. The central commercial area of Mullakkal and the establishments on the both sides of the canals constitute the highest trade and industries related activity zone of Alappuzha town. The main commodities handled in these areas are vegetables, fish, meat and other household articles. The market area is congested and the entire population of the town depends on this centrally located market. Location of bus terminals has influenced the development of certain commercial nodes. In Alappuzha Municipality most of the commercial nodes are characterized by inadequate space for efficient circulation of pedestrian and vehicular traffic.

7.2.2 Important Commercial Centers and Nodes

Commercial nodes are located along the straight stretch of road. The nodes are characterized by high concentration of commercial units. Nodes are identified on all important intersections of roads where there is a concentration of commercial activity and in case of linear development, commercial activity or physical development for a distance of 250m. Most important commercial nodes in Alappuzha Municipality are Mullakkal Street, Zilla Court Bridge, Pichu Iyer Junction, Stone Bridge, Iron Bridge and General Hospital Junction. Important nodes and their hierarchy in Alappuzha Municipality are shown in Table 7-4 and Figure 7-13 shows the location and hierarchy of Commercial nodes.

Table 7-4: Hierarchy of Commercial Nodes

Sl. No.	Name of Commercial center/ node (Y/N)	Separate Parking Area(Y/N)	Authorized Auto Stand (Y/N)	Authorized Taxi Stand (Y/N)	Authorized Lorry Stand (Y/N)	Public Comfort Station (Y/N)	Proper drainage (Y/N)	Hierarchy
1	Zillacourt Bridge	N	Y	Y	N	N	N	Ist
2	Mullackal street-AVJ Jn, Zero jn	N	Y	N	N	N	N	Ist
3	Pichu Iyer Jn.	N	Y	N	N	N	N	Ist
4	Stone Bridge	N	Y	N	N	N	N	Ist
5	General Hospital	N	Y	Y	N	N	N	Ist
6	Iron Bridge	N	Y	N	N	N	N	Ist
7	Kaichoondy	N	N	N	N	N	N	2nd
8	Kommady	N	Y	Y	N	N	N	2nd
9	Thumpoly Jn.	N	Y	N	N	N	N	2nd
10	Arattuvazhi	N	Y	N	N	N	N	2nd
11	Powerhouse Bridge Jn	N	Y	N	N	N	N	2nd
12	Pulayanvazhi Jn	N	Y	N	N	N	N	2nd
13	Vellakinar Jn	N	Y	N	N	N	N	2nd
14	TP Bridge	N	Y	N	N	N	N	2nd
15	Kidangamparampu Jn	N	Y	N	N	N	N	2nd
16	YMCA bridge	N	Y	Y	N	N	N	2nd
17	Kaithavana Jn	N	Y	N	N	N	N	2nd
18	Changanasserry Jn	N	Y	N	N	N	N	2nd
19	Chudukadu Jn	N	Y	N	N	N	N	2nd
20	Thalavady	N	Y	N	N	N	Y	3rd
21	Kalathu Jn	N	N	N	N	N	N	3rd
22	Kalarikkal Jn	N	Y	N	N	N	N	3rd
23	Convent Square Jn	N	Y	Y	N	N	N	3rd
24	Civil Station Jn	N	Y	N	N	N	N	3rd
25	Vazhicherry	N	Y	Y	N	N	N	3rd
26	Vazhicherry Market	N	N	N	N	N	N	3rd
27	Indira Jn	N	Y	N	N	N	N	3rd
28	Thondankulagara	N	Y	N	N	N	N	3rd
29	Alinchuvadu Thathampally	N	Y	N	N	N	N	3rd
30	Pallimukku	N	Y	N	N	N	N	3rd
31	Punnamada Jn	N	Y	N	N	N	N	3rd
32	Out Post Jn	N	Y	N	N	N	N	3rd
33	Pazhavangady Jn	N	Y	N	N	N	N	3rd
34	Pazhaveedu Jn	N	Y	Y	N	N	N	3rd
35	Thiruvampady Jn	N	Y	N	N	N	N	3rd

(Commercial Survey)

7.2.3 Markets

Alappuzha does not have a one stop market place where people can get all the things, they need on a day-to-day basis. At present the two main markets dealing mainly in agricultural and marine produces are at Vazhicherry and Pulayanvazhi. Both the markets deal with vegetables, grains, pulses and fish. The main bazaar road has a mix of all kinds of trade

without any specialization. One feature of the Vazhicherry market is that both wholesale and retail activities are mixed. The market network in the city is outlined below:

- Main market at Vazhicherry
- Sub-market at Pulayanvazhi
- Sub-market at Zacharia Bazaar
- Municipal market at Arattuvazhi
- Sub-market specialized in gold, flowers and garments at Mullakkal



Figure 7-12: Markets

- Informal roadside markets at various places across the town
- Vegetable and fruit stalls in residential areas
- Fish and vegetable vendors

Except for the market at Arattuvazhi mentioned above, there are no markets coming under the Municipal administration. The sub markets at Pulayanvazhi and Vazhicherry are under the church in the respective areas. The present market area is very congested with both men and women selling the produce within a limited space. The basic amenities available within this area are quite inadequate when compared to the total buyers and sellers who utilize this space.

7.2.4 Street Vendors

Street Vendors are a common sight in many towns. In many towns, they make a significant portion of the unorganized sector. The National Policy on Urban Street Vendors, 2009 recognizes the positive role of street vendors being an integral and legitimate part of the urban retail trade and distribution system for daily necessities of the common man. The policy views street vending as a source of self-employment to the poor which gives affordable and convenient services to a majority of the urban population.

There are about 275 street vendors throughout Alappuzha Municipality. Figure 7-14 shows the ward wise number of street vendors. Mullakkal ward has maximum number of street vendors. Figure 7-15 shows the type of vending and items sold by these street vendors.

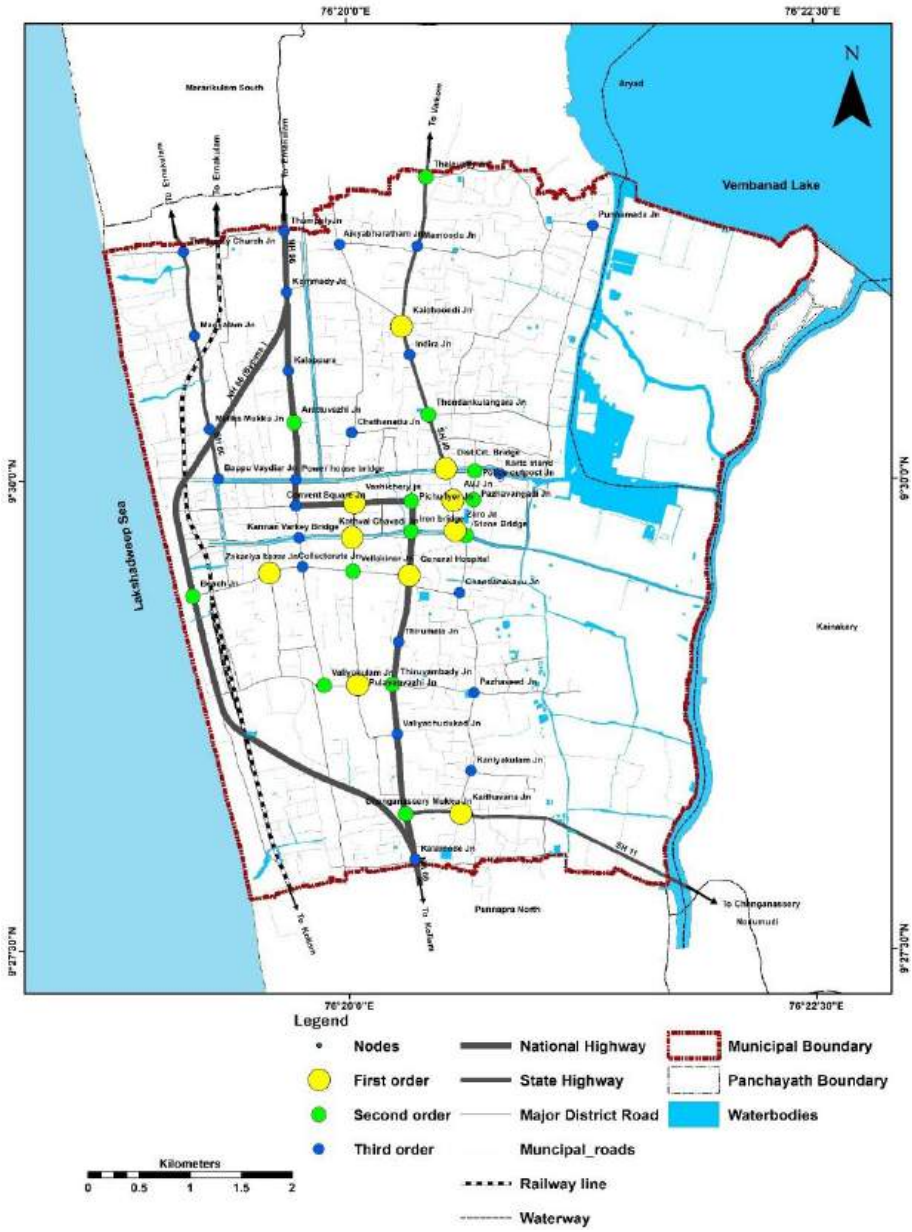


Figure 7-13: Location & Hierarchy of Commercial Nodes in Alappuzha Town

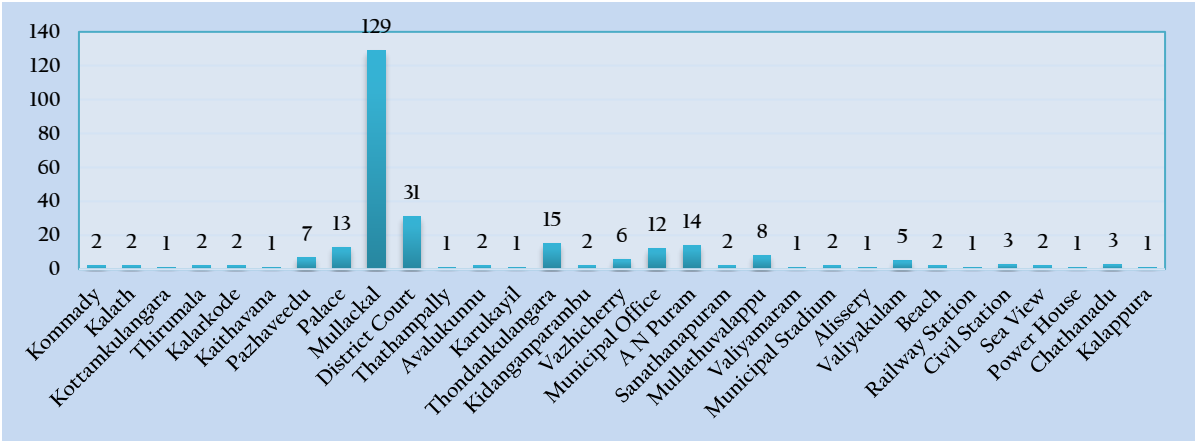


Figure 7-14: Ward wise number of street vendors

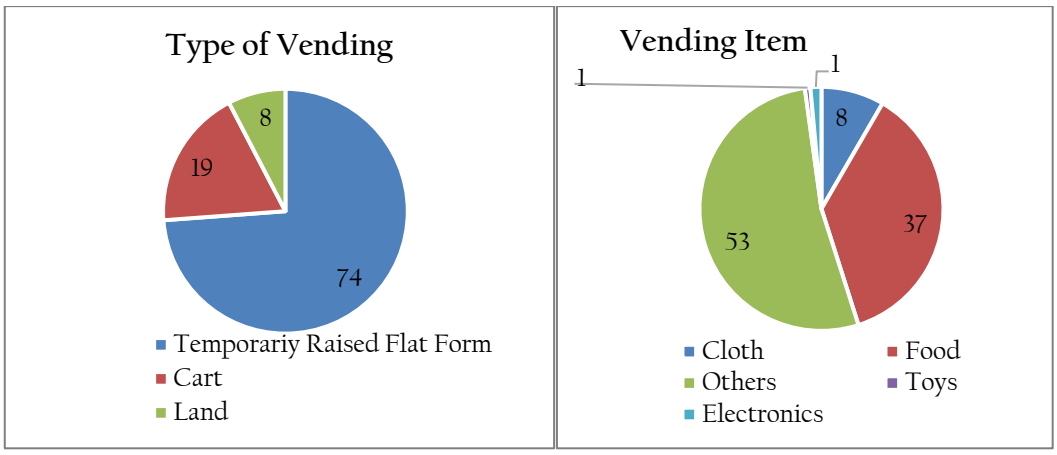


Figure 7-15: Type of Vending & vending item



Figure 7-16: Street Vendors

7.2.5 Problems & Potentials

Alappuzha Municipality is the only first order settlement in the district. Commercial facilities are concentrated at the Market Road, VCSB Road, CCNB Road, CCSB Road, Cullen Road and VCNB Road. Problems faced by the town are insufficient space for parking and for loading & unloading. Market area which is the main center for vegetables, fruits and fish commodities is very congested. The primary issue identified is the lack of proper waste disposal from these markets. The drainage facility is also not sufficient causing flood in the area during rains.

7.2.5 Inferences

Alappuzha town is the main commercial center of the district. Commercial nodes within the town are mostly characterized by congestion due to vehicular and pedestrian traffic which is beyond the capacity of the existing facilities. The town needs a faster commercial development to catalyze the economic development and to serve the nearby local bodies.

7.3 Agriculture

The rice fields in the Alappuzha have major importance compared to other districts in Kerala. Here the paddy cultivation takes place below the sea level in the Kuttanad region. The elevation of the region changes from 0.6m above sea level to 2.22 m below sea level. The Kuttanad region is spread over three districts, Alappuzha, Kottayam and Pathanamthitta. This is known as '*the rice bowl of kerala*'. The paddy is cultivated in three seasons, autumn, winter and summer. Rice cultivation in these seasons is called Viruppu, Mundakan and Puncha. The 'Viruppu' is the first crop and in general the season will start from April-May to Sept-Oct. In Onattukara region (Southern part of the district) the viruppu season starts from April to August. The Mundakan season starts from September-October to December –January. In Onattukara the Mundakan season starts from August – September and ends in December–January. The season of Puncha, the third crop starts from December –January and ends in March-April of the year. In Kuttanad area the Puncha season starts from October-November and ends in February – March. In Kuttanad the additional crop starts from May - June to August –September.

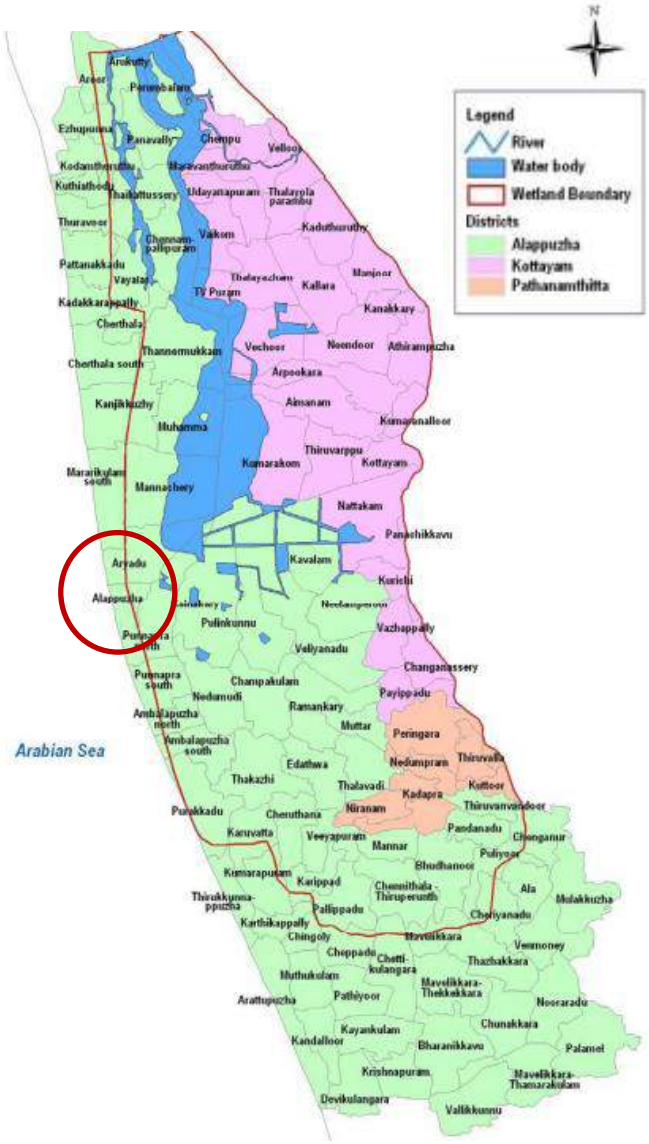


Figure 7-17: Kuttanad Wetland System

As per the MS Swaminathan report, the area approved for special plan of action included Alappuzha district and the Kuttanad Wetland Ecosystem spread across Alappuzha (57% area), Kottayam (30% area) and Pathanamthitta (13 % area) districts. This area is shown in Figure 7-17. Eastern belt of Alappuzha Town comes under Kuttanad region. Agriculture is the major economic activity in Kuttanad and other parts of Alappuzha. (Measures to mitigate agrarian distress in Alappuzha and Kuttanad Wetland system, 2007)

7.3.1 Area under Cultivation

Agricultural land use covers only 21.43% of municipal area. The spatial distribution agricultural land use is shown in Figure 7-18. Paddy field constitutes 20.96% and Dry Land (mixed crop and coconut) constitutes 0.47% of municipal area. The paddy lands exist mainly in Nehru Trophy, Thirumala and Pallathuruthi wards. The agricultural activities are concentrated in the Eastern portion near the backwaters of Alappuzha.

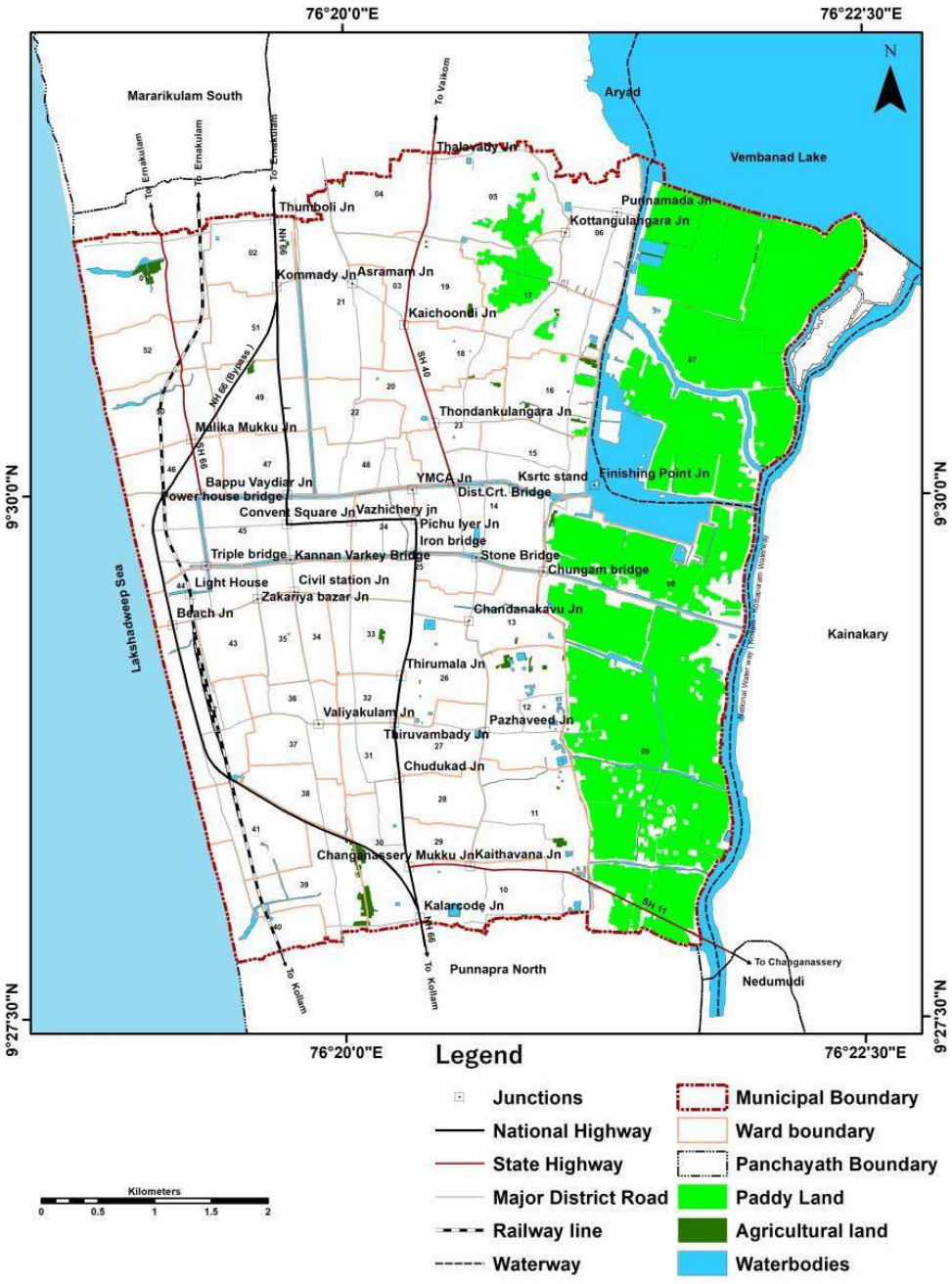


Figure 7-18: Spatial Distribution of Agriculture Land Use

7.3.2 Important Crops and Production

Important crops and their area of cultivation in Alappuzha municipal area are shown in Table 7-5 and its production and productivity are shown in Table 7-6.

Table 7-5: Area of cultivation of major crops

Year/ Type of Crop	Area of Cultivation in hectares				
	2014-15	2015-16	2016-17	2017-18	2018-19
Paddy	717.4	717.4	717.4	717.4	717.4
Coconut	140	150	150	155	160
Banana	70	70	75	80	80
Turmeric	0.5	0.5	1	1	1
Total	927.9	937.9	943.4	953.4	958.4

Source: (Agriculture Office, Alappuzha, 2019)

Table 7-6: Production and Productivity of major crops

Year/ Type of Crop	Production (MT)					Productivity (MT/Ha)				
	2014-15	2015-16	2016-17	2017-18	2018-19	2014-15	2015-16	2016-17	2017-18	2018-19
Paddy	4447.88	4447.88	4447.88	4483.75	4483.75	6.2	6.2	6.2	6.25	6.25
Coconut	1176	1267.5	1267.5	1317.5	1360	8.4	8.4	8.5	8.5	8.5
Banana	2100	2100	2250	2400	2400	30	30	30	30	30
Turmeric	6.250	6.250	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Total	7730.13	7821.63	977.88	8213.75	256.25	57.1	57.1	57.2	57.25	57.25

Source: (Agriculture Office, Alappuzha, 2019)

7.3.3 Irrigation Facilities

No irrigation facility is needed for Kuttanad area, only mitigation of flood in padasekharam is needed and the same is done by Irrigation Department. Formation of outer bunds, dividing bunds and strengthening of bunds etc. are done by Irrigation Department (Kuttanad Package Project).

7.3.4 Watersheds

A watershed describes an area of land that contains a common set of streams and rivers that all drain into a single larger body of water, such as a larger river, a lake or an ocean. Watersheds are more than just drainage areas in and around our communities. Protection of the natural resources in our watershed is essential to maintain the health and wellbeing of all living things, both now and in the future.

A total of 229 watersheds are identified in Alappuzha district, distributed under five river basins such as Pamba, Pallikkalthodu, Manimala, Achankovil and Muvattupuzha.

Out of the 229 watersheds, 79 are put under high priority and 150 under medium priority. Alappuzha town covers 7 medium priority watersheds which is coming under Pamba river basin. They are; Bhagavathipadam, Thattampally, Thiruvambady, Thumboli, Thondankulangara, Vattayal, and Komalapuram. Figure 7-19 Shows the watersheds in Alappuzha Municipality.Interventions should be made for watershed based development programs to improve the agriculture sector as well as the local economy.

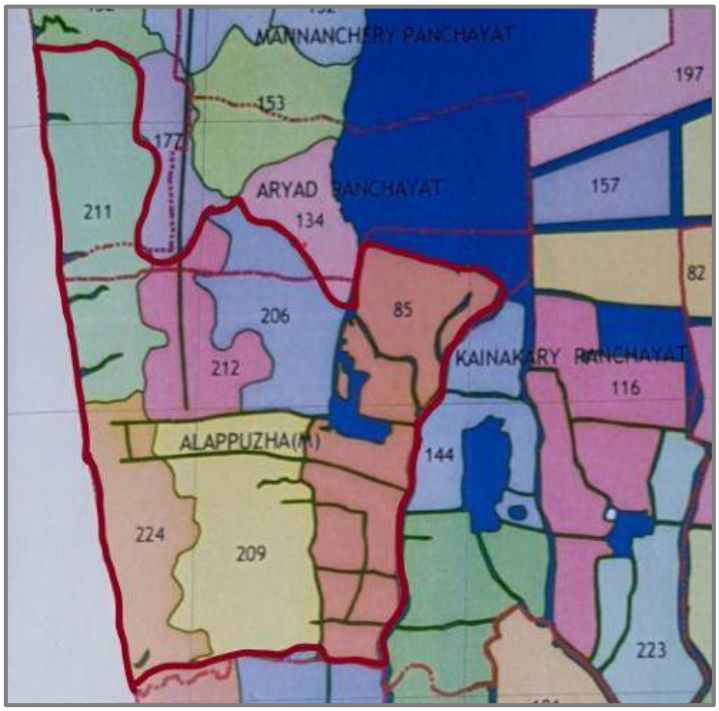


Figure 7-19: Watersheds in Alappuzha Municipality

Table 7-7: Details of watersheds

Name of Watershed	Area (ha)
Bhagavatipadam (85)	942
Thattampally(206)	488
Thiruvambady(209)	840
Thumboli(209)	832
Thondankulangara (212)	413
Vattayal(224)	534
Komalapuram(134)	285

Source: (Prioritized Watershed Atlas of Alappuzha District)

7.3.5 Soil Suitability

Alappuzha district covers sandy, peaty, alluvial and laterite soil. Sandy soil covers the Western parts of Cherthala, Ambalappuzha, Karthikappally and Mavelikkara taluks. The peaty or kari soils are occurring in small belt of the Eastern region of Cherthala and Ambalappuzha taluks and the Western region of Kuttanad taluk.

As per the Integrated District Development Plan, Alappuzha is suitable for agriculture. Productivity of rice has to be increased, especially puncha cultivation. Crops suitable for the area as per the soil conditions within the Municipality are coconut and cashew. Figure 7-20 shows the geology map and crop suitability map of Alappuzha.

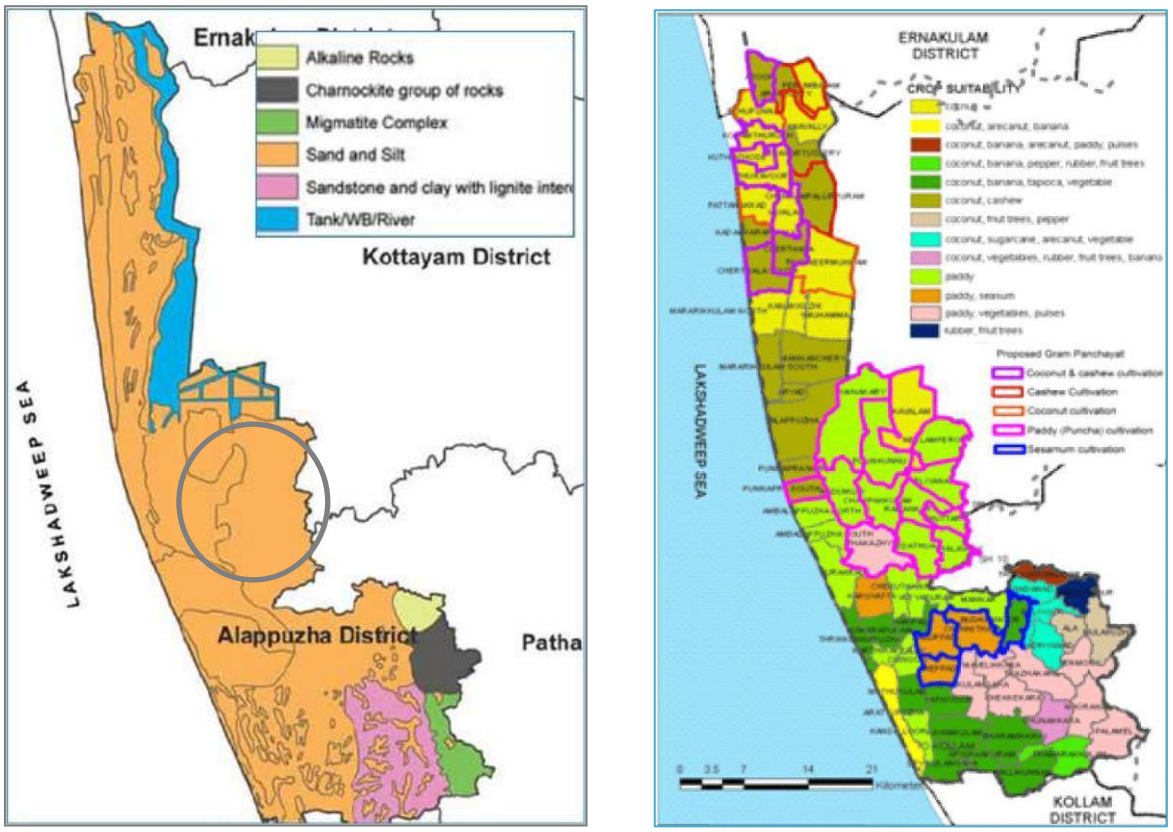


Figure 7-20: Geology map & Crop suitability map of Alappuzha District

7.3.6 Problems & Potentials

Even though a large area is under paddy cultivation, agriculture has not become organized and is not being done on a professional basis. The infrastructure facilities are also not commensurate with the area under cultivation.

- Reduction of rice cultivation due to lack of agriculture labour and lack of efficient utilization of mechanization.
- Reduction in the area of cultivation as agricultural lands is converted into other uses.
- Majority of the workers are entering into tertiary sectors.
- No organized market for selling agriculture products within the town.

7.3.7 Inferences

Paddy is the major cultivation in the town. Agriculture products are mostly imported to the town from other areas in the district as well as from the surrounding district and state. Majority of the workers are entering into tertiary sectors making agriculture production uneconomical due to non-availability of laborers. There is no organized market for selling agriculture products within the town.

7.4 Fisheries

Fisheries are an important sector in the national and the state economies. Apart from its contribution to GDP and employment, the sector catalyzes growth in a number of industries. It is a source of cheap and nutritious food and also earns foreign exchange for the economy. Kerala, God's own country blessed with 590 km of rich coastline, 44 rivers and innumerable numbers of water bodies plays an important role in ecological diversity sustenance and livelihood. Many species of fish, invertebrates, plants, algae and other aquatic living organisms occupy a wide variety of habitats along the vast coastline and associated waters.

7.4.1 Existing Scenario

According to the Annual Report of the Department of Animal Husbandry Dairying and Fisheries, Government of India (2017-18), inland water resources of Kerala constitute over 7 per cent of the same in the country. However, according to statistics from Indian Agricultural Statistics Research Institute (ICAR), the share of Kerala in total inland fish production (2014-15) is only about 2.4 per cent. Kerala has scope to improve the utilization of its potential in inland fishing. The population of Kerala is 334 lakhs according to Census 2011 and the fisher folk population in 2018-19 is estimated to be around 3.1 per cent of Census population. They reside in 222 marine fishing villages and 113 inland fishing villages of the State. The fisher folk population of the State for 2018-19 is estimated as 10.39 lakh. Out of this, 8 lakhs belong to the marine sector while 2.39 lakhs belong to the inland sector.

Alappuzha (1.93 lakhs) is the district with largest fisher folk population, followed by Thiruvananthapuram (1.72 lakhs) and Ernakulum (1.38 lakhs). Thiruvananthapuram district had the largest number of active fish workers, followed by Alappuzha and Malappuram. The number of allied fish workers in Alappuzha district was also highest during 2017-2018. Alappuzha is one of the leading districts in the case of inland fish production (Economic review, 2019). Figure 7-21 shows the spatial distribution of active fishermen population in Alappuzha district. The total population engaged in fisheries in Alappuzha Town is 56985. This accounts 29% of the total fishermen population of the district.

Alappuzha is a landmark between the broad Arabian Sea and a network of rivers flowing into it. Alappuzha town three fishing villages viz. Kanjiramchira, Thumboli South and Vadackal North. Alappuzha town has a coastline of 8 km, which is part of the 83 km costal boundary of the Alappuzha district in total. This accounts for 14% of total seacoast of the State.

As a result of the long coast line Alappuzha occupies a very important position in the fisheries map of Kerala. The Vembanad and Kayamkulam backwaters and network of canals and streams that flow into them have enriched the water potential and the fishery wealth of the region. More than 20% of the total area of the district is waterlogged and the vast area of Kari lands and Paddy fields are suitable for pisciculture.

The continental shelf of Alappuzha is without any rocky or coral formations and thus affords excellent beds for trawling operation by mechanized vessels. The fishing season in the marine sector is from October to May and in inland sector it is throughout the year. The mud bank formation (commonly between the Alappuzha to Purakkad Coast) during the monsoon season (Chakara) which develops by the end of June and continues up to August is of great economic importance in which large quantities of fish are netted (especially prawns) and are exported. The average fish landing varies from year to year. There are four fishing landing centers in Alappuzha Municipality. Vadackal (Natural), ESI Beach, Kanjiramchira and Thumboli. Details of fish landings of the district are given below:

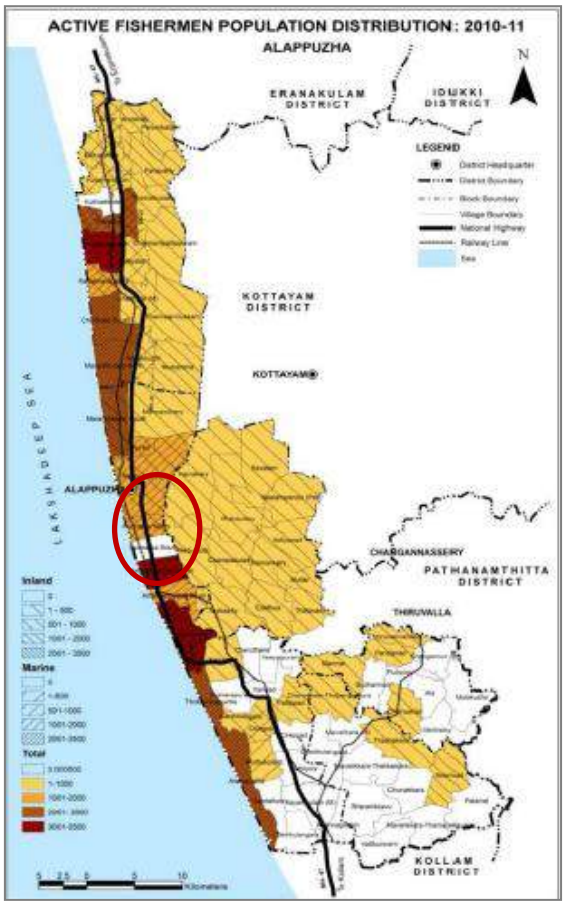


Figure 7-21: Spatial distribution of active fishermen population (Integrated District Development Plan for Alappuzha, 2012)

i) Marine Fisheries

i. Non-mechanized fishing crafts (no.) : 2365
ii. Mechanized fishing crafts (no.) : 255
iii. Fishing gear (no.) : 5595
iv. Marine Population : 112,043

ii) Inland Fisheries

i. Panchayat Ponds : 330.03 ha.
ii. Irrigation Tanks : 16.00 ha.
iii. Holy Ponds and Streams : 12.08 ha.
iv. Private Ponds and other Waterholds : 64 no./314
v. Public water bodies : 3359.29 ha.
vi. Canals : 2228 ha.

vii. River : 5 rivers
viii. Lakes : Vembanad and Kayamkulam
ix. Area available for fresh water fish culture : 2800 ha.
x. Fresh water hatcheries : 4
xi. Inland Population : 62,388

7.4.1.1 iii) Brackish Water Fisheries

i. Main Brackish Water:
Cherthala :(7464ha.)
Ambalapuzha :(4515 ha.)
Kuttanad :(1191 ha.)
Karthikapally :(2022 ha.)

ii. Brackish water available for prawn culture : 350 ha.
iii. Hatcheries : 4

7.4.2 Problems & Potentials

Alappuzha is the only Municipality which has fishermen villages as part of it and has a coastline of almost 8 km. Hence it is necessary to address the issues related to fisheries sector with all the seriousness it deserves, as the problems are plenty. Ranging from poverty to lack of skill in taking up any new work. Some of them are given below:

- The flow of income into the families is not regular.
- The fisher men families are not well equipped to find alternatives during off season.
- Women have lost a major income source with the introduction of nylon nets in place of handmade nets.
- There have been change overs to new sectors.
- This shift to non-fishing sector has resulted in unemployment or even under employment due to lack of opportunities for occupational diversification and employment potential.
- The coastal area of the town does not have a fishing harbour.

7.4.3 Inferences

Alappuzha Town has fishermen villages as part of it and has a coastline of almost 8 km. The irregular flow of income due to off seasons causing poverty and absence of a fishing harbor in the coastal town are the major issues in the fishing sector.

7.5 Animal Husbandry

Animal Husbandry and dairying plays a pivotal role in national economy and socio-economic development of the country. It also contributes to the rural economy by augmenting family income and generating gainful employment in the rural sector particularly among the landless laborers, small and marginal farmers, weaker sections and women. In Kerala, the livestock sector is prominent and one of the fastest growing sectors of rural economy.

7.5.1 Existing Scenario

As per 20th Livestock Census (2019), the livestock population in the State was 38.36 lakh. It is 1.34 per cent less as compared to previous Census of 2012. The reason for decline is the reduction in the population of other animal's especially domestic dogs, rabbit, donkey and elephants (which form the majority share) by 14.69 per cent. The poultry population of Kerala as per 20th Livestock Census is 298.18 lakh, which accounts for 3.5 per cent of the total poultry population in the country. It registered 25 per cent increase over the 19th Livestock Census. Growth rate of poultry population in Kerala is higher than the growth rate recorded at the national level (16.81 per cent). Kerala ranks 9th among States in poultry population of the country. Milk, meat and egg are the major livestock products in the State. The production of meat, milk and egg has shown a marginal decrease of 1.57 lakh MT, 25.49 lakh MT and 229.17 crore respectively (Economic review, 2019).

Shift to livestock unfriendly cropping pattern, increased labor cost, scarcity of input for cattle feed etc., and heavy dependence on "imported cattle feed" are making dairying difficult and unattractive. All types of livestock have been showing a declining trend in Kerala after 1996. Animal husbandry and dairy development sector is of vital importance in generating additional employment opportunities and supplementing income of families. Mostly peasants and agricultural laborers are engaged in cattle rearing and allied activities. Hence any development in this sector will strengthen the economy of the town. Milk, egg and meat are the principal primary products of animal husbandry in Kerala. This sector can also contribute its share to the industrial development of the state by way of supplying industrial raw materials like bacon, hide, skin etc. In this circumstance this sector has importance as far as Alappuzha Municipality is concerned.

7.5.2 Livestock Population

Livestock population in Alappuzha Municipality as per 2012 census is 2668.Total Livestock population of Alappuzha district as per 2007census is 158657. The main species of

live stocks found in Alappuzha Municipality are: Bovines (Cattle and Buffaloes) Ovines (Goat). Table 7-8 shows the temporal variation of livestock population. There is large scale reduction in the number of Bovines, but the number of ovine is increasing.

Table 7-8: Temporal Variation in number of Livestock

Sl. No:	Species	2007	2012
1	Bovines	1404	1240
2	Ovines	1264	1435

(District Veterinary Center)

7.5.3 Poultry Population

The poultry population of Alappuzha consists of fowl and duck only. The temporal variation of poultry population is shown in Table 7-9. It shows that there is reduction in number of both hen and duck over the years.

Table 7-9: Temporal variation in number of poultry

Sl. No:	Species	2007	2012
1	Fowl	21517	31674
2	Duck	2815	3220

(District Veterinary Center)

Increased pesticide load in the water environment is suspected to cause immunosuppression in ducks. The local breeds, 'Chara' and 'Champally' are proved to have better resistance than the 'Khakhi Campbell', a breed imported from United Kingdom for its smaller egg size. Absence of insurance cover to these birds, particularly the large flocks, is a major constraint in duck farming. The floating nature of the flock is held as a reason for not extending insurance cover. Duck farmers are also facing increasing resistance in feeding ducks in harvested paddy fields. All these are adversely affecting duck farming and declination in duck population. The Duck Farm at Niranam is the only hatchery in the State with a turn out capacity of 30,000 chicks a year.

7.5.4 Production

7.5.4.1 Meat

Even though the livestock population is showing a decline, products from livestock does not follow such a trend. Eating habits of people have changed and there is an increase in demand for meat products. The Alappuzha town is at present served by one service abattoir that too built in an unscientific manner. Providing 'service abattoirs' is one of the mandatory responsibilities of Alappuzha Municipality. An average of 220 quintal of meat is produced

through the abattoirs working under the Municipality as well as through the various illegal slaughter houses spread across the town. 8 quintals of meat are sold through 12 cold storages and various approved meat shops within the city. Almost 80% of the cattle required for this are brought from Tamil Nadu.

The Health Officer of the Municipality is required to certify that the animals are healthy before slaughter. Since there is only one operational service and it is not always practical to herd animals from faraway places to the abattoir. Unauthorized killing of animals for meat is very prevalent in the city. In such centers killing of animals and collection of meat is going on in unhygienic environment. The animals procured for killing are not examined for illness or contamination. Moreover, the waste generated during the operation is strewn around with general garbage. This spoils the city environment.

Based on the stipulations issued by the Supreme Court of India, Government of India has issued guidelines with regards to killing of animals for meat, transport of meat, and for storage of meat for sale. But these instructions are rarely followed. Construction of partially mechanized modern abattoirs in the different identified zones in the city may considerably reduce 'unauthorized slaughtering'.

7.5.4.2 Egg

Poultry development is one of the important activities of livestock sector. There are individuals and agencies engaged in poultry farming, piggery and growing rabbits. The most useful and productive activity was found to be poultry farming. About 75,000 – 1 lakh eggs are traded through major Egg Trading centers in the town, of which only 2.5% are produced internally from the city. Around 363 households are found to be engaged in poultry farming. Average production of eggs per day is found to be 1700. Table 7-10 shows the details of poultry farms in Alappuzha Town.

Table 7-10: Details of Poultry Farms

Ward No.	Name of Ward/Place	Farm within the Mpty	Quantity of production per month
45	Vazhichery	Mukkadan Broiler Farms	5100 birds
44	Civil station	Jazz broiler farms	5350 birds
45	Vazhichery	Edathil Chicken Centre	5400 birds

(District Veterinary Center)

7.5.4.3 Milk

There is only one dairy farm with a total number of 30 cattle in Alappuzha Town as shown in Table 7-11. There are 3 milk co-operative societies each at Kalarkode (10), Karalakom (17) and Gurumandiram (39). Milma, Punnapra is collecting and marketing milk from Alappuzha and surrounding areas and it is observed that 52000 liters per day milk is collected through milk societies and 80000 liters per day is sailed from Alappuzha Dairy and hence a shortage of milk 28000 liter per day in the district is reported. Table 7-12 shows the details of diary outlets and collection centers in Alappuzha Town.

Table 7-11: Details of Dairy Farms

Ward No.	Name of ward/ Place	Name of Dairy Farm	No. of Cattle	Quantity of Milk produced per day (specific unit)
49	Powerhouse	Thuvampallil	30	240lit./day

(District Veterinary Center)

Table 7-12: Details of dairy outlets and Collection centers

Ward No.	Name of Ward/Place	Dairy Society Ltd. No.	Name of Outlet and Collection Centre	Average Quantity Collected per Month in Liters
10	Kalarkode	244	Alappuzha South	4080
17	Karalakom	269	Nehru Trophy	4050
39	Gurumandiram	260	Kuthirapanthy	3300

(District Veterinary Center)

7.5.5 Physical Infrastructure

There is a District Veterinary Center and a motorboat Veterinary hospital at Mullackal in the Municipality. There are 3 poultry farms, 1 dairy farm and 3 dairy outlets in the Town. But there is no hatchery available in the town.

7.5.6 Ongoing Programmes

i) Calf feed subsidy programme

Calf feed subsidy programme has been implemented by Animal husbandry department. The objective of the project is to provide extension support, adequate health and insurance coverage and good quality feed at subsidized price to growing crossbreed female calves of below poverty line farmers for a period of 32 months or still its first calving whichever is earlier.100 beneficiaries have been enrolled in this scheme.

ii) Animal disease control project (Goreksha)

The main objective of this project is to control the incidence of foot and mouth disease in the state gradually resorting to a combination of activities like mass vaccination, education of farmers etc.

iii) Gorekha

Objectives of the project are to collect baseline information on performance of animals assessing current production situation, establish long term genetic improvement programme, to help farmers in culling decision and buying of animals.

iv) Mechanization for assistance to cattle farmers

Farmers with more than 5 milk cattle are selected for this scheme. Rupees one lakh is given as subsidy for mechanization of cattle farmers. Fund is given for the purchase of milking machine, cow mats, automatic water drinking system, bio gas plant etc.

v) Feed distribution

Based on the production of milk, cattle feeds are given on subsidized manner. The subsidy is given as for each liter of milk; feed costing Rs .2/ is given to farmers through selected milk societies.

vi) Promotion of backyard poultry rearing

Objective of the project is to make the household self-sufficient in egg production and to overcome protein deficiency.

vii) Duck distribution to SC category

To uplift the rural poor, 18000 ducks are distributed thereby to increase the egg production of our state.

viii) Assistance to state for control of animal diseases

The scheme envisages the control of major animal diseases by providing strategic immunization cover, strengthening of important diagnostic laboratories and biological production centers, information communication campaign and equipping of technicians.

ix) Infertility camps

Adult animals which are not conceiving even after 3-4 artificial insemination will be identified and will be given detailed check-up and adequate treatments by the experts in the field.

7.5.7 Problems and Potentials

Cattle rearing are not found to be a profitable venture for many. With the decline of integrated farming system, the cattle do not get sufficient grass for its feed. Now cattle feed and grass have to be procured externally. Kuttanad area is part of Alappuzha district and paddy cultivation is done in 39076-hectare area eventhough the availability of calf feed is not sufficient. Also fodder cultivation is done in very less area. As mechanization was widely introduced, scarcity of labour and non-availability of land for cattle rearing are burden to farmers. At the same time milk and milk products, egg, mutton etc. are having appreciable demand in the municipal area. The infrastructure facilities available in the sector are minimal and needs enhancement.

7.5.8 Inferences

Animal Husbandry sector is weak in the town. The increasing cost of cattle feeds, land scarcity for fodder cultivation, low yielding varieties of cattle and poultry have made this sector non-profitable. Fodder cultivation has to be promoted and quality control of cattle feed has to be ensured. Larger commercial diary units may be promoted to get hold of a leap in the field of milk production. Better credit facilities at low interest rate have to be made available to the farmers.

Efforts may be made in poultry sector to establish commercial layer units in the town area. Rearing of other birds like quail, turkey, rabbit, fancy bird etc. have to be promoted for the development of the animal husbandry sector. Thus, Animal husbandry sector offers plenty of employment opportunities and with regard to the food security, it is high time to pay more attention on enhancement of animal products in Alappuzha Municipality.

7.6 Industry

The rise and fall of Alappuzha, once known as the 'Venice of the East' is closely linked to the history of the port, the main factor which propelled the region to dizzying heights of prosperity long ago and later to the depths of stagnation and backwardness with its downfall. It was with the construction of the port in 1775 by Raja Kesavadas, the then Dewan of Travancore, that Alappuzha gained a coveted slot in the international trade map. Monopoly in the global coir market was just one of the feathers in the crown of this port town those days. Merchandise like copra, pepper, ginger, coir etc. was handled by this port. It was inhibited by settlers from different parts of the country like Gujarat, Rajasthan, Maharashtra, Madras province etc.

7.6.1 Existing Scenario

The existing land use survey reveals that only 0.40 sq.km, which is only 1.11% of the total area of the town is under industrial use now. Figure 7-22 shows the spatial distribution of industrial land use.

The concentration of industrial land use is high in Sea View, Vazhicherry, Power House and Kommady wards. The high concentration in these wards is explained by the presence of the establishments on both sides of the canals and those by the side of NH-66 to the North of the town which constitute the highest industry related activity zone of Alappuzha town. The concentration index is relatively low in the remaining wards. Even among these wards, some industrial activity co-exists with commercial land use along the major traffic corridors of the town.

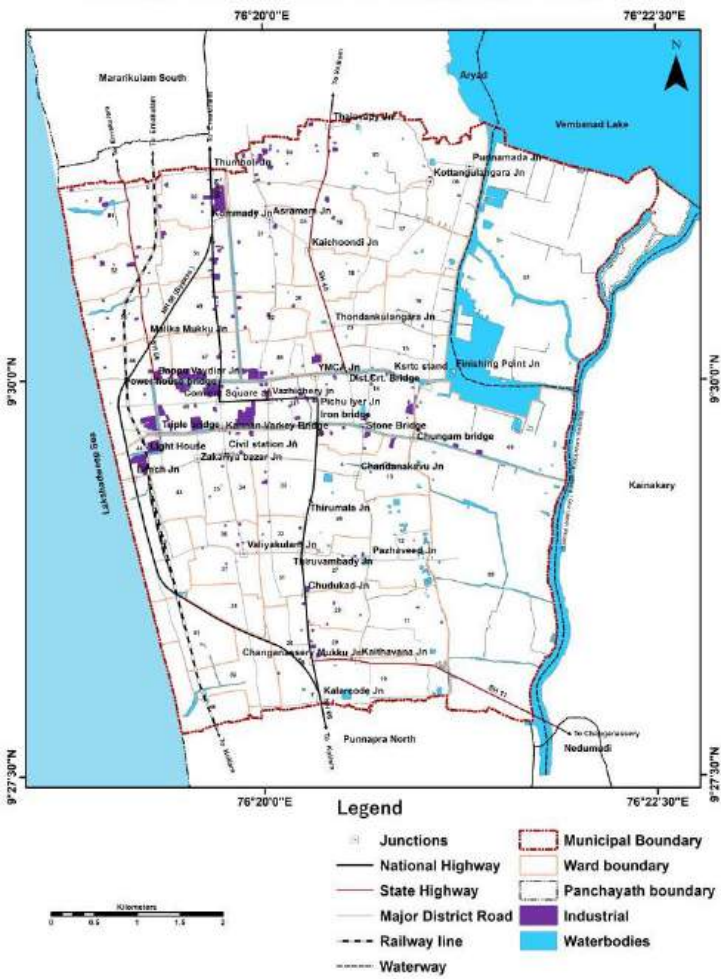


Figure 7-22: Spatial Distribution of Industrial Land Use

Enterprises under MSMED Act 2006 are classified into two types such as enterprises engaged in the manufacture or production of goods and enterprises engaged in providing or

rendering of services, both types are again classified on the basis of investments into three such as Micro, Small and Medium. Earlier, enterprises are broadly classified into Agro Based, Rubber based, forest based, animal husbandry based, textile materials, chemical, engineering, electronics, minerals, plastic based, building and others. There are no large scale industries in Alappuzha Municipality. There are 352 industries out of which only 3 are medium scale units, 331 small units and 18 micro units. Table 7-13 shows the growth of industries in Alappuzha Municipality. Table 7-14 shows the details of industries for the year 2019.

Table 7-13: Growth of Industries in Alappuzha Municipality

Type of Industry	2015	2016	2017	2018	2019
Medium	3	3	3	3	3
Small	331	331	331	331	331
Micro	18	18	18	18	18

(Directorate of Industries & Commerce)

Table 7-14: Details of Industries (2019)

Type of Industry	No. of Units	No. of workers	Run by Manual /HP	HP
Medium	3	269	HP	269
Small	331	2864	HP	9999
Micro	18	67	HP	70
Total	352	3200		10335

(Directorate of Industries & Commerce)

Establishments on both sides of the canals and those by the side of NH-66 to the North of the town constitute the highest industrial related activity zone of Alappuzha town. This stretch inturn provides the highest employment in the town. At present there are more than 62 oil mills in the municipal area which engages 1200 workers and about 3500 tons of coconut oil production is carried out in these units. Newer enterprises like timber, electronics and engineering goods, small production units, readymade garments, building material have come up, replacing the traditional coir, coconut oil and spices based economy of the town. Even now the most important commodity manufactured in town is coir, copra and coconut oil and among the exports it is coir, coconut and spices. Out of the total industrial sector, 23% of the employment is provided by the coir industries.

All the medium scale industries are of coir product units. Majority of the small-scale industries in the Municipality are Agro based especially coir and its allied products. Only two units are of umbrella making. Industrial production is limited to coir and allied products, matches, umbrella, rice and rice products. Value addition or diversified productions are limited.

7.6.2 Coir Industry

The history of coir and its association with the state of Kerala dates back to the 19th century. Kerala is one of the most beautiful states in India. A tropical paradise of waving coconut palms and wide sandy beaches, this thin strip of coastal territory slopes down from the mountain Ghats in a cascade of lush green vegetation and varied fauna. One of the most commonly seen tropical trees in Kerala is the coconut tree. In fact, even the name Kerala (Keralam in Malayalam) is derived from this tree. Everything from Kerala's culture to its dishes is evolved around the coconut tree. Coir industry being one of the major traditional industries in the state and agriculture is second as a source of employment in Kerala, provides employment to around 4 lakh persons, of which 84% are women. With 10.05 lakh hectares under coconut cultivation, this accounts for 45% of the net cropped area in the state.

Alappuzha is the nerve center of Kerala's famous coir industry. Both men and women are actively involved in the production of the coir. The women are mainly involved in the yarn spinning sector and the men in weaving sector. Coir industry enjoys the status as the largest cottage industry in the state of Kerala, giving employment to over millions of people.

Main coir products produced and exported include mats, matting, rubberized coir, pith, rugs, carpets, curled coir. Among the several natural industries 'hard' fibers which enter the world markets today, coir occupies a unique place. It is put to many uses in industrial, agricultural and also as a substitute for certain cordage for which it is claimed to be superior to hemp and sisal. Coir is one of Kerala's most important products. Husk is a natural fiber that helps hold together the coconut shell. When extracted, it can be spun into one of the world's strongest threads and woven into mats and baskets of all kinds. In most coconut producing countries the main coconut product is "copra" the coconut meat. The husks are burned as fuel, used as manure, or discarded. In Thailand, East Africa, India and Sri Lanka, coconut husk fibers are used for making various products. Fifteen countries of the Asia-Pacific region produce 86% of the coconut in the world. But only a handful of them are known to be coir producers. India is the largest producers and exporters of coir and coir products. SriLanka, Indonesia, Malaysia, Philippines, Thailand and now Vietnam are the other primary producers of coir with varying levels of production capabilities.

The coir industry, which was confined to Kerala, has now spread to other states like Tamil Nadu, Karnataka, Andhra Pradesh, Orissa, etc. over the years largely on account of various developmental and promotional programs of Coir Board. The state of Kerala accounts for more than 75% of the total coconut production. Hence, Alappuzha, in Kerala became a hub for the coir industry in India producing beautiful coir mats in various designs, matting, geo textiles / geo-fabric for soil bio engineering and garden articles. The byproduct of coir industry, coir pith, is increasingly being used as a soil conditioner and manure. In the recent past, Alappuzha coir industry has seen acute shortage of fiber with deep escalation of fiber cost. This has affected the domestic manufacturers and exporter on basic costing.



Figure 7-23: Coir Making

The first coir factory for the manufacture of coir floor furnishings was made by Mr. James Darragh an American and Mr. Henry Smail jointly during 1859. Followed by these 25 major coir factories was setup in Alleppy town by Europeans. The easy availability of raw materials and existence of backwaters and canals suitable for the wetting of green husk and accessibility of transportation are the main factors for the development of this industry. During post-independence period Europeans migrated to their homelands and coir industry became a totally decentralized industry. Now there are 320 micro industrial units of coir functioning within the municipal area.

Various agencies involved in coir sector are Kerala State Coir Corporation, Foam Mattings India Ltd, Coirfed, and Coir Board. Two coir project offices and 10 coir circle offices are functioning in Alappuzha district. Under coir project office 177 societies are registered out of which 145 societies are only functioning. Of these 65 societies are working in yarn making sector and 80 societies are working in coir products manufacturing sector. It is estimated that 1.50 lakh people are engaged in coir sector in Alappuzha district, of which 20% employees are registered in coir cooperative societies and the rest in private sector and self-employed. An international fair named Coir Kerala is conducted every year at Alappuzha. Activities performed by the Coir Project Office Alappuzha are:

- Registration of Coir co-operative societies

- Inspection of Coir co-operative societies
- Supervision of plan schemes implementation
- Recommendation of plan scheme application of coir co-operative societies
- Financial assistance given for infrastructure development
- Re- vitalization of co-operative societies
- Government share participation in cooperative societies
- Market development assistance
- Production and marketing incentives
- Coir debt relief
- Publicity and propaganda assistance
- Assistance to set up defibering Mills
- Margin money loan to new entrepreneurs
- Income support scheme to coir workers
- Mechanized coir production unit and common facility service centre are distributed.
- Husk collection consortiums are established
- For participating in trade fairs 50% grant for total expenditure is given to individuals

7.6.3 Problems and Potentials

It was once thriving industrial sector, particularly in copra and spices, began to decline with the development of Kochi as industrial hub. Apart from the coir manufacturing units, the industry in Alappuzha has nothing much to speak of now. The town has not attracted any large scale or medium scale industrial investment for a long time in spite of accessibility and availability of land. Labour problem can be attributed to one of the main causes for industrial decline in this town.

One of the remedial measures to save coir industry is to reduce the cost of production. The reason for high cost of production is the high rate of coir fiber imported from Tamilnadu. Requirement of raw material (coconut husk) for the entire coir industry is only one –third of the total coconut production of Kerala. Presently the industry mainly depends on the coconut husk from Tamilnadu. In Alappuzha district alone coconut is cultivated in nearly 56830-

hectare area. Hence a new scheme for collecting husk from households, through the Kudumbasree units and distributing the same to co-operative societies shall be introduced. Also, defibring machines shall be introduced.

Coir workers are diverted to other categories due to the unemployment in this sector. New generation is not coming forward to coir sector. Mechanization is the only remedy to solve this problem.

The draft Industrial and Commercial Policy, 2011 of the Government of Kerala envisages in bringing the state to top three positions in per capita income in the country (the state is in the seventh position at present). NRI remittances create demand for trade, commerce and service in the state. However, recent developments in West Asian region and North Africa demanding employment for local population is expected to bring in drastic changes in employment structure in those countries severely affecting the out migration of people for employment from the state. So, there is an urgent need to create a strong economic base (and thus employment) in the region.

7.6.4 Inferences

The traditional industrial sector of coir and coconut oil have potentials for flourishing as the relevance of coir related products are gaining importance as an alternative to plastic products. Hence with modernization and diversification there is a potential for the development of coir related industries. Other small-scale industries of importance to Alappuzha are umbrella parts manufacture and processing of spices and other agro-based industries.

8 TRAFFIC & TRANSPORTATION

8.1 Introduction

For any country to develop with right momentum modern and efficient transport as a basic infrastructure is a must. Transportation is the aid of any human settlement, since it permits movement of people and goods from one location to other.

Alappuzha town was planned and developed to promote trade and export, and the town acts as a trade and export center for hill products and spices of the erstwhile Travancore State. The network of canals was planned to allow transport of goods from the hilly areas of Kottayam to the port at Alappuzha. The present network of roads is primarily the result of the trade and commerce developments that took place along Vadai canal and Commercial canal, the two main canals in the town. The builders of Alappuzha town were able to convert the existing physical assets to its advantage.

Initial reconnaissance studies show that the existing roads and bridges of the town are narrow. This is primarily because the town developed around the canals and spread mostly depended on water transport. But gradually the transport system shifted to road based on the water bodies gaining more of a heritage, aesthetic value and tourism activities. This chapter explains the characteristics of transportation network within the Municipality based on the study conducted by National Transportation Planning and Research Center (NATPAC) for AMRUT cities.

8.2 Transportation Network

Alappuzha Municipality connects by road, rail and inland water transport. The area covered by transportation network comes to 5.90% of the municipal area. The total length of roads in the Municipality comes to 213.87 km and the road density is 7.7 km/sq km. NH 66 passes through the heart of the town and connects Alappuzha to Thiruvananthapuram and Ernakulam. The NH 66 covering a distance of 7.2 km passes almost through the middle of the town starting from North at Thumpoly to South at Kalarcode. The total traffic on NH diverts through arterial roads to accommodate the growth in traffic. There are three State Highways passing through the Municipality *viz.* SH 11 (Alappuzha- Changanassery AC Road), SH 40 (Alappuzha – Madurai Road) and SH 66 (Alappuzha- Arthungal- Cherthala Road). Alappuzha bypass road, passing through the Western side of NH 66, links Kommady in the North to Kalarcode in the South. The proposed Coastal Highway passes around the Western coast of the Municipality. Apart from these roads, numerous Municipality roads constitute the road

network of this town. The road network is of grid pattern and the roads are parallel to each other. Figure 8-1 shows the transportation network of Alappuzha Town.

The study area is served by public transport system consisting of both State-owned Kerala State Road Transport Corporation (KSRTC) and private buses. The mofussil services and inter-city services are provided by KSRTC buses operating from the KSRTC bus station located near the Boat Jetty. The private buses are operated from the new bus stand near Vazhicherry.

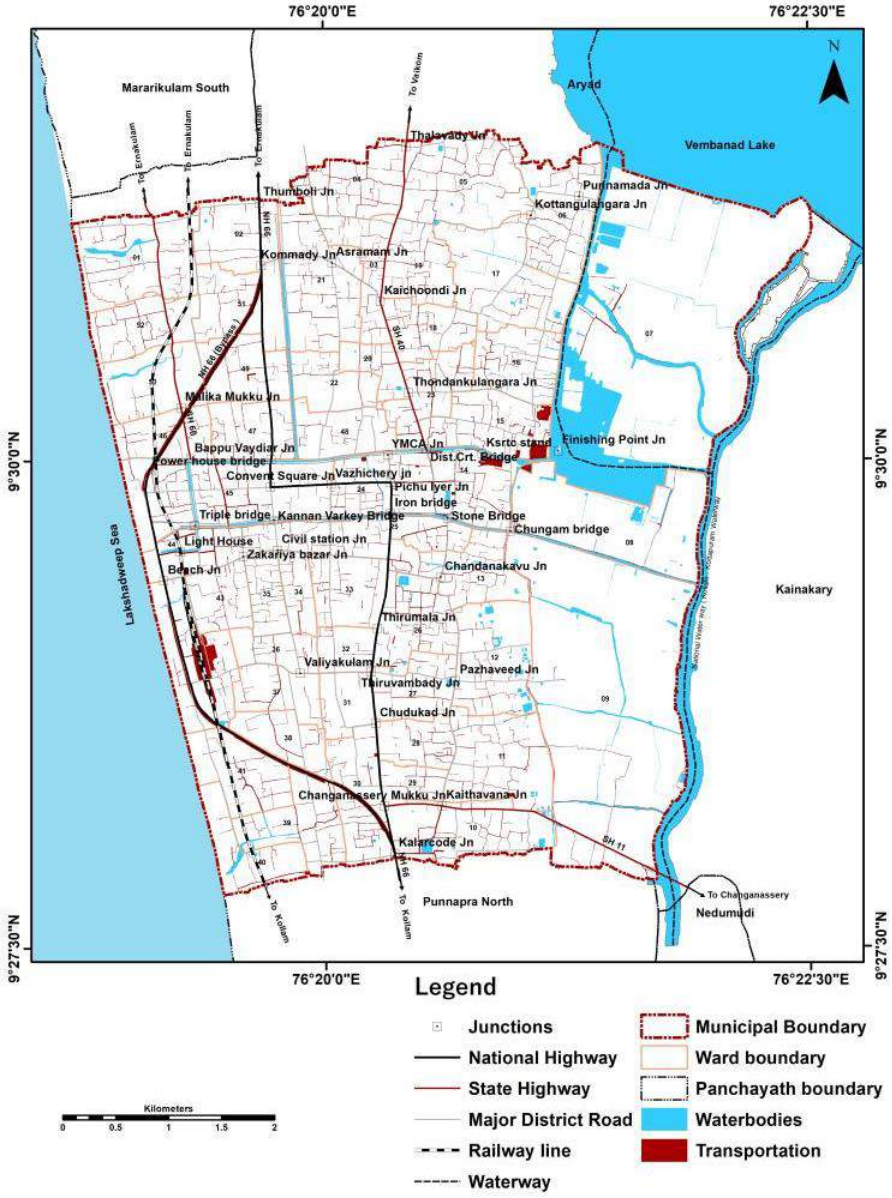


Figure 8-1: Transportation Network of Alappuzha Municipality

Alappuzha Railway Station is a major railway station in the Thiruvananthapuram railway division, Southern Railway Zone (India). Alappuzha town is connected by a broad-gauge railway line to Ernakulam in the North and Thiruvananthapuram in the South. The railway line passes through the Western part of the town in the North South direction. The railway station is located at the outskirt of the study area.

The nearest Airports are Nedumbassery International Airport and Thiruvananthapuram International airport which are at a distance of 85 km and 150 km from Alappuzha respectively. Alappuzha Municipality is well connected with the other parts of the district and nearby districts by inland water transport. The State Water Transport Department is operating regular boat services to different places from Alappuzha such as Kottayam, Mannar, Kavalam, Kainakary, Kayalpuram, Nedumudy and Krishnapuram.

8.3 Vehicle Population

The growth of motor vehicles in Alappuzha district during the last years shows an increasing trend. It can be seen that the vehicle population in Alappuzha district has grown by more than 2.7 times during the last 5 years and is at par with the state growth (Table 8-1 and Figure 8-2). Table 8-2 shows the number of newly registered vehicles during last year's.

Table 8-1: Growth of Motor Vehicles

	2013-14	2014-15	2015-16	2016-17	2017-18
Kerala	8547966	9421245	10171913	11030037	12042691
Alappuzha	561495	618697	697203	762880	830790

(Traffic & Transportation Studies for AMRUT cities - Alappuzha Municipality, 2020)

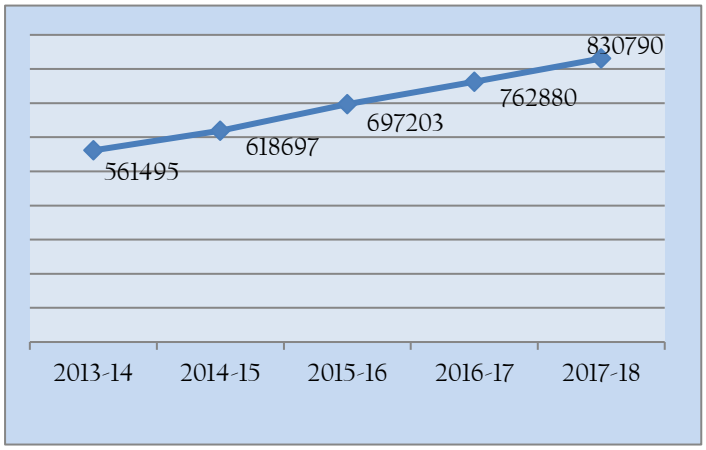


Figure 8-2: Growth of vehicle population in Alappuzha District

Table 8-2: No. of newly registered vehicles

Year	No. of Newly Registered Vehicles
2014	59858
2015	56569
2016	53092
2017	65677
2018	69821

(Traffic & Transportation Studies for AMRUT cities - Alappuzha Municipality, 2020)

8.4 Road crashes

Information on traffic crashes within the Municipality shows that total number of crashes shows (Table 8-3) an increasing trend and number of grievous injuries has increased from 2016 to 2017 where as in the year of 2017 and 2018 it seems to be slightly decreasing.

Table 8-3: Number of road crashes in Alappuzha Municipality

Number of Crashes	Name of Police Station								
	Alappuzha Traffic			Mannamchery			Punnapra		
	2016	2017	2018	2016	2017	2018	2016	2017	2018
Number of Fatal Crashes	28	30	34	9	14	7	10	17	17
Number of Grievous Injury Crashes	220	282	272	83	81	104	69	67	94
Number of Minor Injury Crashes	71	60	70	13	8	14	15	18	25
Number of Non-Injury Crashes	1	0	12	0	0	0	0	0	3
Total Number of Crashes	320	372	388	105	103	125	94	102	139

(Traffic & Transportation Studies for AMRUT cities - Alappuzha Municipality, 2020)

8.5 Traffic Characteristics

All primary and secondary data collected were analyzed systematically and the results of base year traffic characteristics are reported in this section. For the purpose of studying the traffic characteristics of the study area, major travel corridors are divided into 109 homogeneous sections based on road and traffic characteristics.

8.5.1 Road Network Characteristics

The NH 66 covering a distance of 7.2 km passes almost through the middle of the town starting from Thumpoly at North and ends in Kalarcode at South. The total traffic on NH is diverted through arterial roads, and the newly constructed bypass on the Western side of NH 66. Three state highways originate from this Municipal area viz: SH 11, SH 40 and SH 66. SH 11 connects Alappuzha town with Changanasserry and SH 40, Thanneermukkam road, connects Alappuzha town with Kuruppanthara via. Muhamma. The State Highway SH 66, a coastal road, originates from this town at Power house junction and ends at Thoppumpady in Ernakulam via Mararikulam and Chellanam. Apart from these roads, numerous Municipality roads constitute the road network of Alappuzha town in a grid pattern. Most of the road sections of NH and SH's passing through the town have two-lane carriageway width. The carriageway width of most of the Municipality roads within the town is two lane or intermediate lane width. Mixed land uses including commercial, residential, agricultural and water bodies (canal) are the major features of the road sections.

8.5.2 Speed and Delay Characteristics

As part of the study, speed and delay survey was carried out on nearly 44 km of road stretches within the Alappuzha study area. The road sections include parts of National Highway, State Highways and other major urban roads within the study area.

i. Average journey speed

The maximum journey speed in Alappuzha was observed in SH 40 and was about 22.71 km/hr. The minimum journey speed was 7.77 km/hr and was observed in Mullakkal Temple road. The average journey speed of NH 66 in Alappuzha municipal area was observed as 15.45 km/hr. Maximum journey speed on NH 66 was observed between Thumpoly and Kommady and was equal to 22.50 km/hr. Minimum journey speed in NH 66was observed in the 200 m long section between General Hospital North junction and General Hospital South junction and was equal to 3.33 km/hr. The minimum journey speed in this section is mainly due to traffic congestion and presence of two intersections within a short distance.

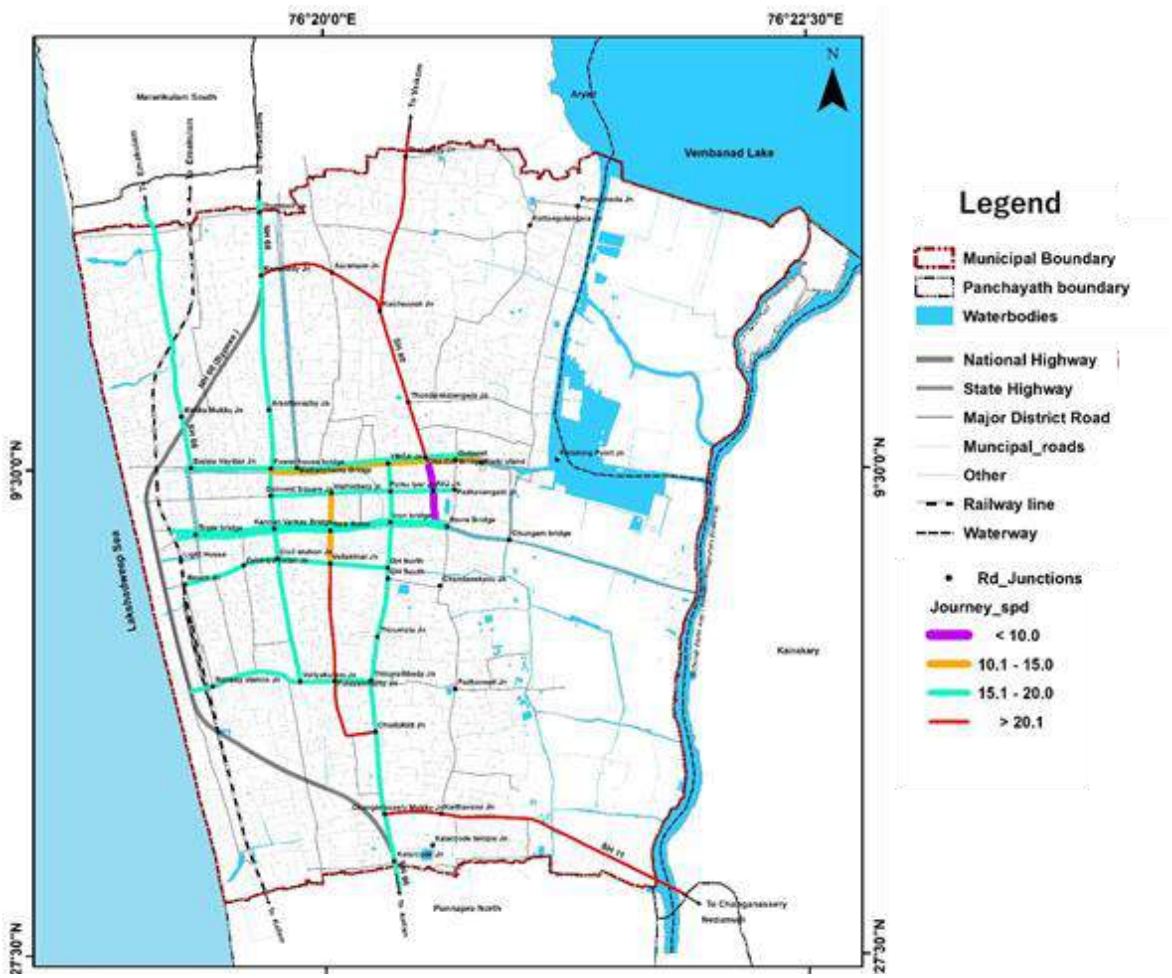


Figure 8-3: Average Journey Speed in Major Roads

8.5.2.1 Causes of delay

From the speed and delay survey, it was observed that the major causes of delay for traffic flow on major roads are traffic congestion and presence of intersections within short distances. It could be seen that the major delay of 87 seconds was observed between Zero junction and Mullakkal Junction and is mainly due to congestion and presence of intersection.

8.5.3 Link Volume and Capacity Utilization

i. Link Volume

One of the fundamental measures of traffic on a road system is the volume of traffic using the road in a given interval of time. It is also termed as flow and is expressed in vehicles per hour or vehicles per day. When traffic is composed of a number of types of vehicles, it is the normal practice to convert the flow into equivalent passenger car units (PCUs), by using certain equivalency factors. The flow is then expressed as the PCUs per hour or PCUs per day. Figure 8-4 shows the traffic volume on various homogeneous sections within the town.

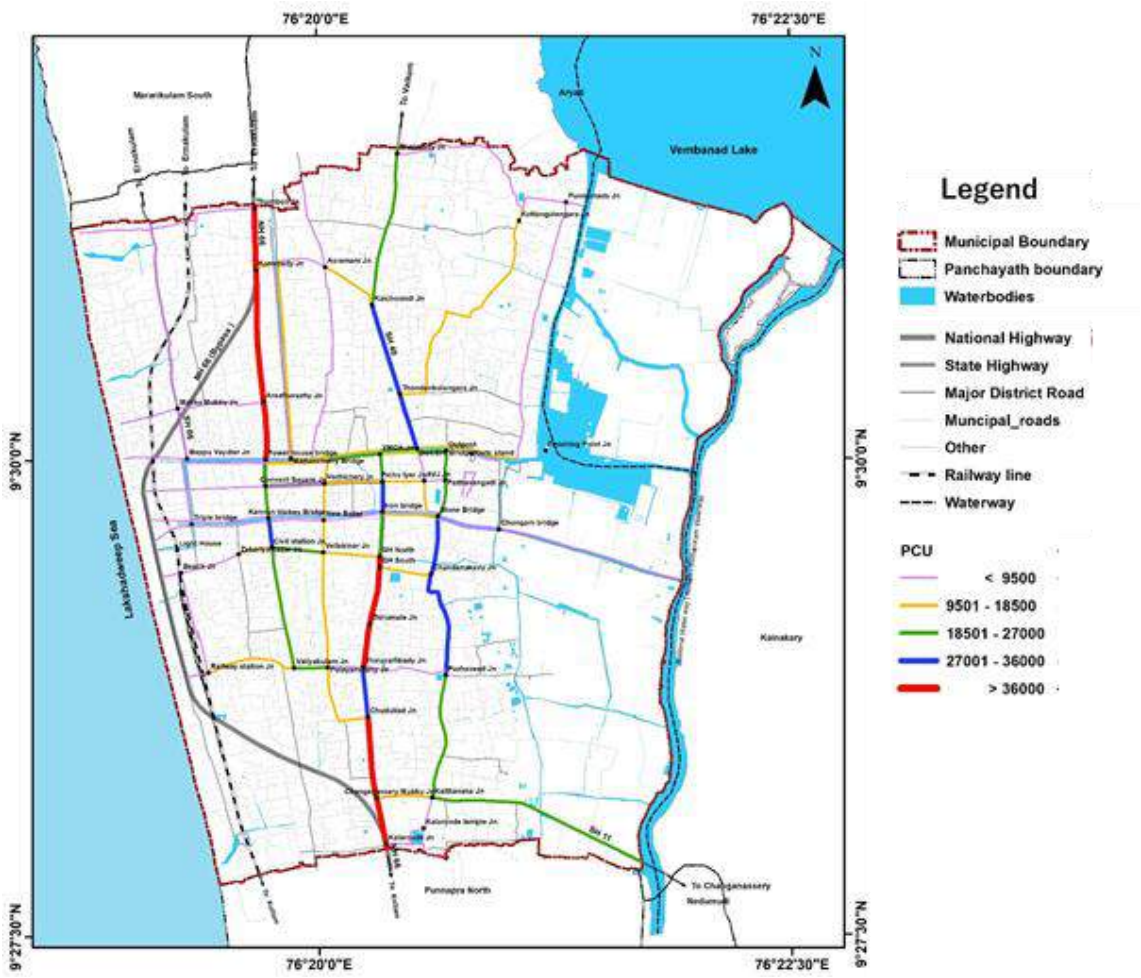


Figure 8-4: Traffic volume on various homogeneous sections within the town

On National Highway 66, the daily traffic volume varies between 9027 PCU/day at Vazhichery - Convent Junction and 45,039 PCU/day at Changanassery junction - Chudukadu section. On SH 11 maximum traffic was observed in Pallathuruthy - Kaithavana section and is about 20,960 PCU/day. On SH 40 maximum daily traffic observed was 33287 PCU/day and is on District Court Bridge North to Thondankulangara section. Low traffic was observed on SH 66 as compared with other State highways originating from the study area. Maximum traffic observed on SH 66 was 7,806 PCU/day between BappuVaidyar and Malikamukku. Fairly high traffic volume was observed on the NS Bose Road and maximum of 34,336 PCU/day on Stone Bridge.

ii. Capacity utilization

Capacity utilization of the road stretches was measured by volume to capacity ratio (V/C Ratio). For working out the capacity of different road sections, the information compiled during the road inventory survey was compared with the specifications of IRC: 106-1990 (Guidelines for capacity on urban roads). While working out the capacities due consideration was given to carriageway width, junctions, parking, lateral clearance, shoulder, surface condition etc. The traffic volumes observed at different road stretches were compared with the capacity of road sections in order to calculate the volume-capacity ratio (V/C ratio). Many road stretches within the study area were over-utilized to the extent of more than 200% of their carrying capacity. Table 8-4 shows the road sections found to be overloaded more than twice their carrying capacity for the current year and horizon period.

Table 8-4: Road sections overloaded more than twice their capacity

Sl. No	Name of road Section	V/C Ratio	
		2019	2039
1	Kalarcode(Municipality Border) to Changanassery Junction	2.63	5.55
2	Changanassery Junction to Chudukadu	3.00	6.33
3	Chudukadu to Thiruvambadi	2.34	4.94
4	Thiruvambadi to GH South Junction	2.73	5.75
5	GH South Junction to GH North Junction	2.63	5.55
6	Iron bridge South to Iron bridge North	2.02	4.18
7	Iron bridge North to PitchuIyer	2.05	4.31
8	Power House Bridge South to Power House Bridge North	2.09	4.40
9	Power House Bridge North to Kommady	2.63	5.55
10	Kommady to Thumpoly	2.76	5.83
11	Stone Bridge North to Stone Bridge South	2.29	5.552
12	District Court Bridge North to Thondankulangara	2.16	5.20
13	KannanVarkey South to Civil Station	2.23	5.38

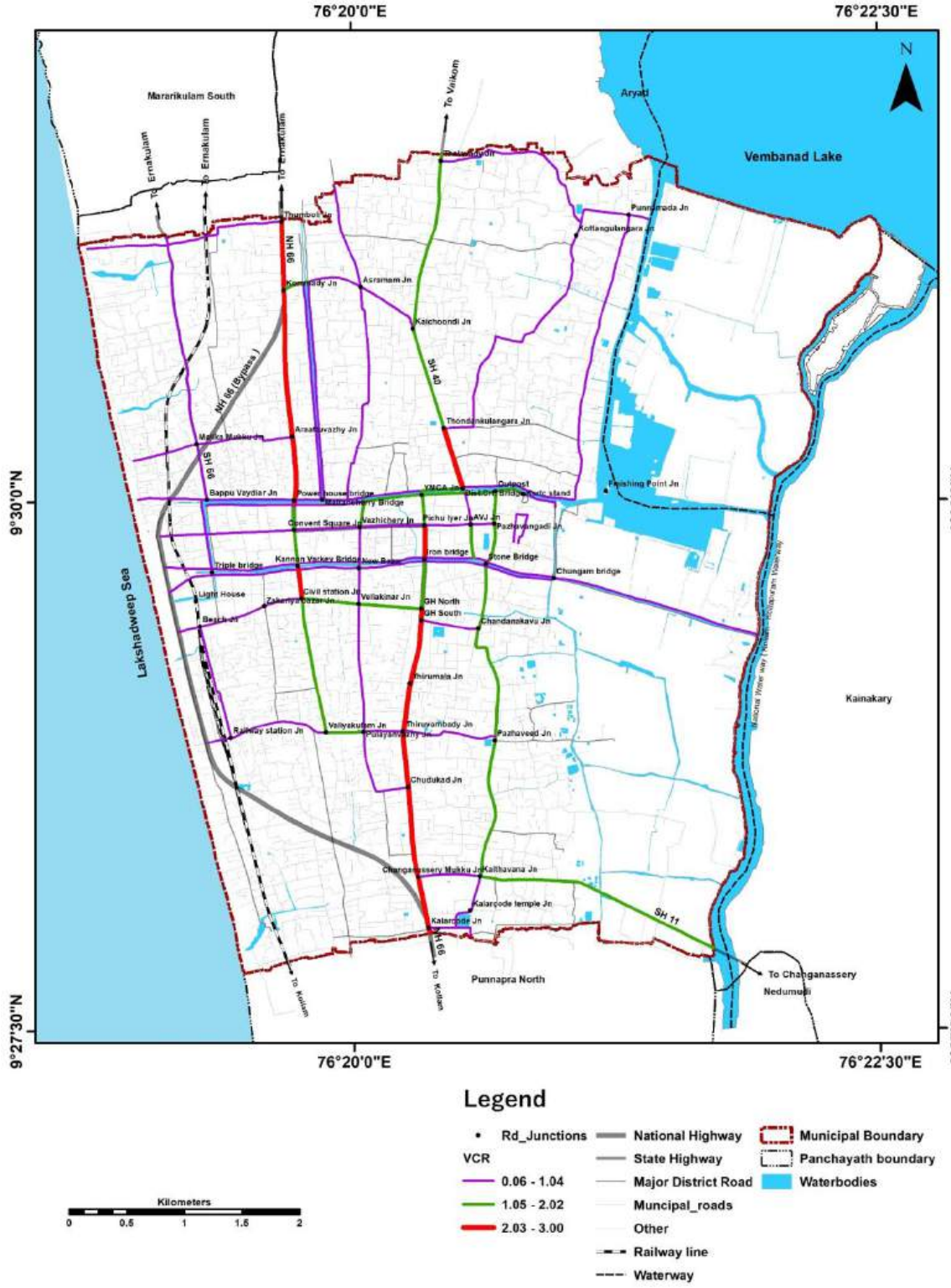


Figure 8-5 Volume Capacity Ratio of Major roads

(Traffic & Transportation Studies for AMRUT cities - Alappuzha Municipality, 2020)

8.5.4 Traffic Volume at major Intersections

As per the survey carried out by NATPAC at major intersections during the morning and evening peak periods, it could be seen that the Changanassery Junction witnessed the maximum peak hour traffic flow of 3,974 PCU/hour. District Court North junction had a peak hour traffic of 3,621 PCU/hour, while Chudukadu Junction had a peak hour traffic of 3,343 PCU/hour followed by Kommady junction with a peak hour traffic of 3,244PCU/hour. For the other intersections, the peak hour traffic flow varied between 1,021 PCU/hour to 3,094 PCU/hour.

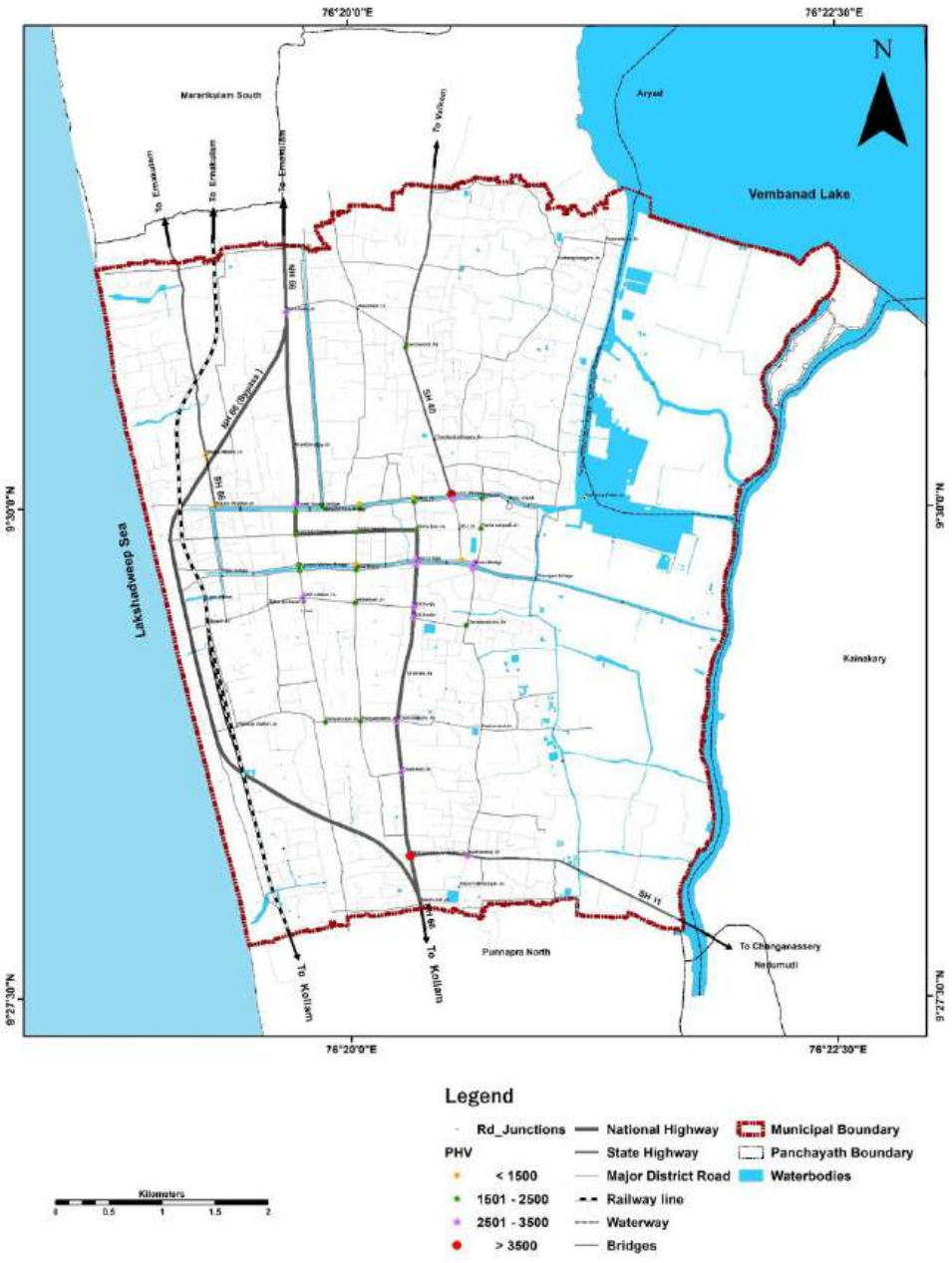


Figure 8-6 Traffic Volume at Major Intersections

8.5.5 Parking Characteristics

i. Parking Accumulation

On-street parking was found to be maximum on the link from District Court Bridge to KSRTC and Beach area with an ECS value of 172 and 122 respectively. Also, vehicles were parked on links such as District court to Thondankulangara, District Court Bridge to Punnamada Finishing Point, District Court to Mullakkal, YMCA to Pitchu Iyer etc.

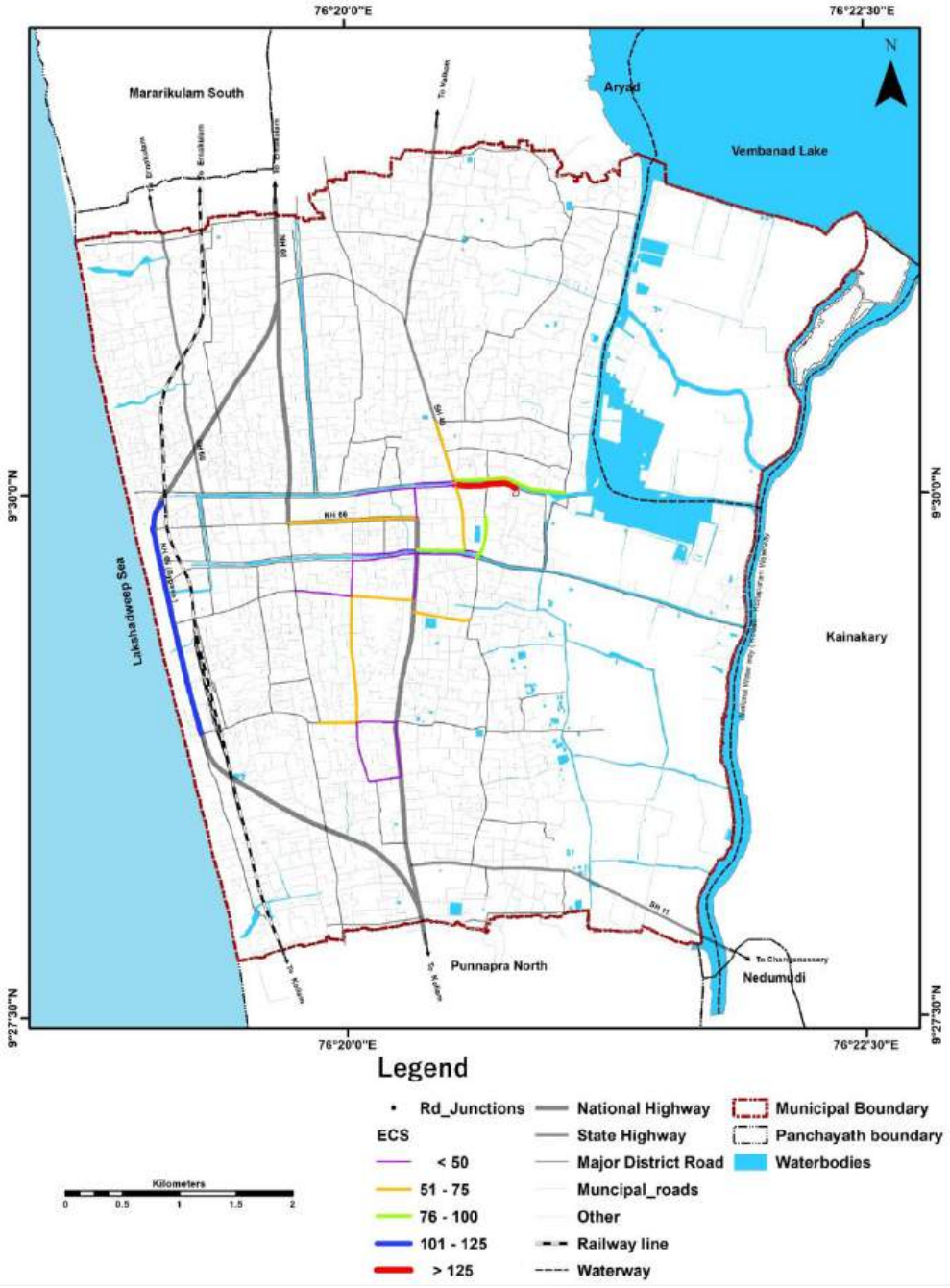


Figure 8-7 Parking Accumulation in town

ii. Duration of Parking

At most of the locations, majority of the vehicles parked were found to be for short duration of less than 30 minutes. 10 to 20 per cent of vehicles were parked for a period ranging between 30 minutes and one hour.

8.5.6 Pedestrian Volume

Analysis of pedestrian movements at major activity/ traffic generation areas has shown that a maximum of 929 pedestrian movements occurred at District Court to Outpost during the one-hour time period between 11:30 am and 12:30 pm followed by 892 pedestrian movements at Iron Bridge to GH North between the time period 8:45 am and 9:45 am. A high volume of 685 pedestrian movements occurred at Kannan Varkey to Iron Bridge in the cross direction during evening hour between 3:30 pm to 4:30.



Figure 8-8 Pedestrian Lateral Movements

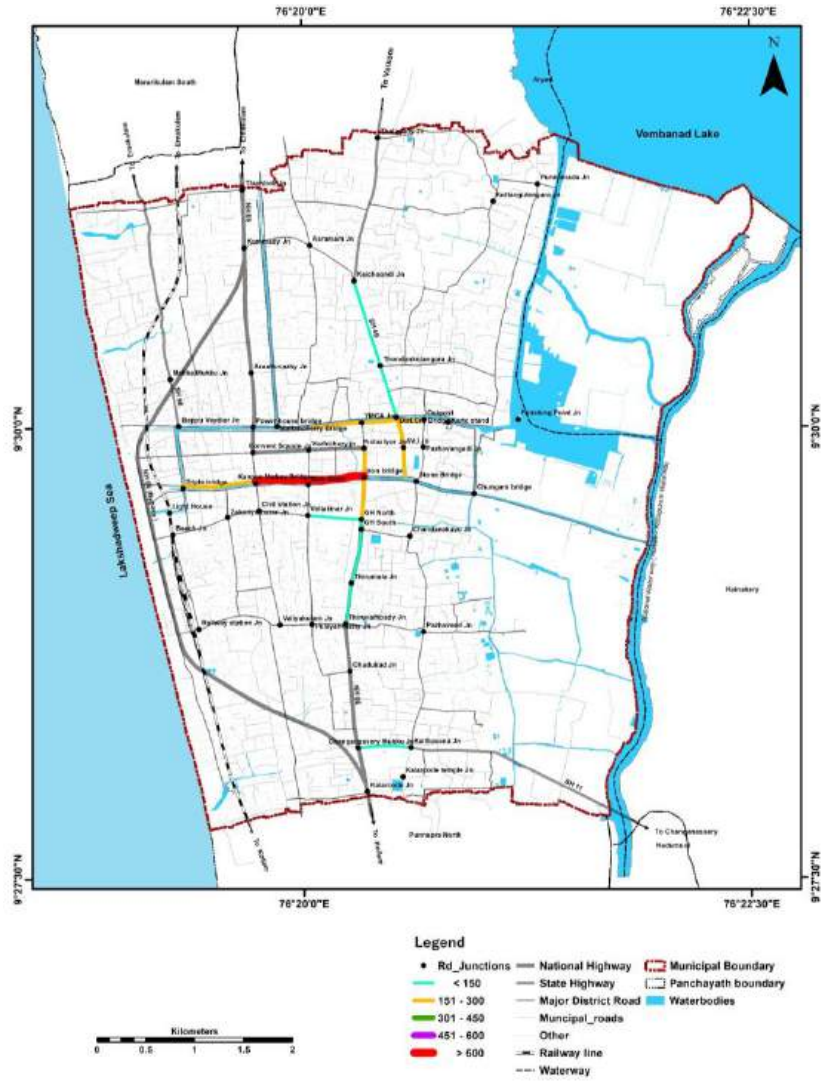


Figure 8-9 Pedestrian Cross Movements

8.6 Bus Operator Characteristics

There are separate terminals for KSRTC and private transport buses in Alappuzha. As part of the study, Ingress and Egress survey was carried out on both KSRTC Bus stand and Municipal Private Bus stands.

Alappuzha has a wide network of buses that connects most parts of the town. KSRTC Bus Stand is located at Boat Jetty Road, Mullakkal. At present there are 84 schedules operated daily from the stand which includes one Deluxe, three Super-Fast, 21 Fast Passenger, three Low floor (non-AC) and 57 Ordinary buses. Around 800 to 900 ordinary bus services are there which covers an average distance of 28000 km daily. An average of 50,000 passengers depends on the bus services daily. The Alappuzha Municipal Private Bus Stand is located at Vazhichery. There are around 110 buses operated daily from 5:30 am till 8:30pm. One of the major bus routes

from the station is towards Irattakulangara, which covers a distance of 12 km and passes through Vandanam. There are around 50 buses operated via this route. Kalavoor is another important place which is connected from the Municipal Bus stand. The distance to Kalavoor is 8.5km and there is an average of 15 buses operated daily. Other bus routes from the stand are towards Mannanchery, Beach, Railway station, Cherthala etc.

8.7 Vehicle Operator Characteristics

The characteristics of intermediate passenger transport modes were studied to make ascertain the performance in terms of number of trips, average trip length and operational characteristics. The study included both auto rickshaws and taxis in Alappuzha Municipality.

8.7.1 Trip Characteristics

As per the survey, the trips performed per day is about 4.54% of IPT vehicles performed less than two trips a day and 90.91% of vehicles performed two to five trips a day. Trip length is about 47.29 percent of the drivers responded that the IPT vehicles travel less than 5km for a single trip, followed by 23.13% of vehicles with 6 to 10 km per trip. About 1.94 % of the vehicles performed above 100 km per trip.

8.7.2 Operational Characteristics

The vehicles operated in the study area were of different type, make and model. Most of the vehicles operating in Alappuzha Municipality have the model year 2006-2016. About 40.91 % of the vehicles belonged to the model year between 2011 and 2013, while 21.21% of the vehicles belonged to the model year between 2013 and 2016. 2006- 2010 year models also have same share as that of 2013-2016.About 29% of intermediate public transport vehicles available in Alappuzha Municipality were the make of Piaggio Ape, followed by about 23% of Bajaj and about 24% vehicles of Mahindra Alfa.

In case of seating capacity, about 87.88% of vehicles were found to have less than five seats, and 12.12% of the vehicles had 6 to 10 seating capacity.

Cost structure of vehicles operating in Alappuzha Municipality was compiled from vehicle operator survey. It was found that cost of most of the vehicles varied between Rs 1.5 lakh and 25 lakhs. Most of the vehicles (60.72%) had the value up to 2 lakhs, followed by 22.13% vehicles having a value greater than 10 lakhs.

Operating cost is varied from vehicle to vehicle and time to time. In Alappuzha Municipality, the operating cost of vehicles varied from Rs 10,000 to 1 lakh per month.

Maximum of 34.93% of vehicles operated at a cost of Rs 15,001 - 20,000 per month. About 8.20 % of vehicles incurred an operating cost less than Rs 15,000/- per month.

8.8 Goods Vehicles

8.8.1 Trip Characteristics

About 70% of goods vehicles performed less than three trips per day, followed by 20% of vehicles performing 3 to 5 trips a day. Only 10% of goods vehicles performed more than 5 trips. Analysis of trip length performance of the goods vehicles in the study area reveals that 11.76% of the vehicles performed less than 5 km in a single trip. Same percentage of vehicles was also performed 5 to 10 km per trip. About 29.41% of the vehicles performed 71 to 100 km in a single trip, while 5.88% of vehicles performed 31 to 50 km per trip. About 5.89% of vehicles performed above 100km per trip.

Construction materials like sand and gravel were the major commodities carried by goods vehicles in Alappuzha Municipality. About 37.5% of the vehicles carried earth and sand, followed by 31.25% of vehicles carried fruits and vegetables. About 25% of goods vehicles carried rubber and coir items.

8.8.2 Operational Characteristics

The goods vehicles operated in Alappuzha Municipality were of different make and model. The model of the vehicles varied from 2005 to 2019. About 25% of the goods vehicles belonged to 2005 -2010 model. Same percentage of goods vehicles was also found to be the model year of 2010 - 2015. About 50 % of the vehicles belonged to the model year 2015- 2019. About80% of the goods vehicles in Alappuzha Municipality were the make of Ashok Leyland and Piaggio Ape. Only 20% of goods vehicles were the make of TATA.

8.9 Base Year Inter-Town Travel Characteristics

8.9.1 Traffic Volume at Outer Cordon Points

Volume survey of all the vehicles entering/exiting the study region was conducted at five outer cordon points of the study region. Classified volumes of vehicles were recorded according to their direction of travel.

The maximum daily traffic volume of 41,467 PCU was observed at Kommady which consisted of 20,468 PCU of inbound vehicles and 20,999 PCU of outbound vehicles, followed by SD College with 39,472 PCU/day. About 20,960PCU/day were found passing through Pallathuruthy of which 10,890PCU/day were inbound vehicles and 10,265 PCU/day were

outbound. As many as 19,460 PCU/day of vehicles passed through Thalavady and 5,692 PCU of vehicles passed through Thumpoly survey points. Two wheelers constituted the maximum followed by four wheelers and auto rickshaws at all locations. Considerable amount of buses, bicycles and goods vehicles also passed through all locations.

For a meaningful analysis of O-D survey data, the study region was divided into five traffic zones, the boundaries of the zone forming the combined boundary of one or more wards. In a similar way, outside study region was divided into 14 traffic zones, which include the immediate surrounding areas, adjoining districts and neighboring States. Figure 8-10 shows the zoning pattern adopted for the study.

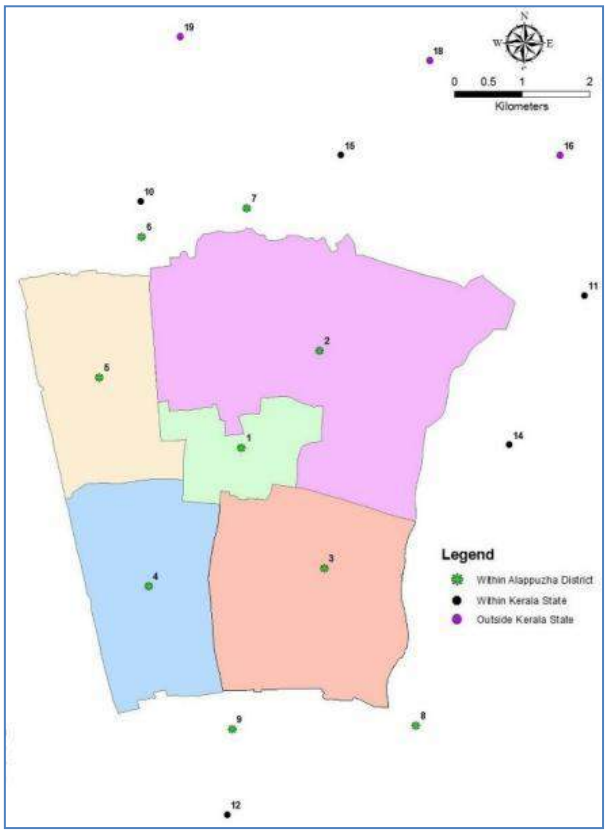


Figure 8-10: Zoning Pattern Adopted for Alappuzha Town

Table 8-5: Zoning Pattern adopted for study

Zone No	Zone Name
1	Alappuzha CBD ward no.14,15,24,25,48
2	N-E, ward no. 3-8,16-23
3	S-E, ward no. 9-13,26-29
4	S-W, ward no. 30-44
5	N-W, ward no. 1,2,45-47,49-52
Outside Study Area	
6	Cherthala direction (Alappuzha district)
7	Thaneermukkom direction (Alappuzha district)
8	Changanasery direction (Alappuzha district)
9	Kayamkulam direction(Alappuzha district)
10	Ernakulam
11	Kottayam
12	Kollam
13	Thiruvananthapuram
14	Pathanamthitta, Idukki
15	Other Northern districts of Kerala
16	Tamil Nadu North
17	Tamil Nadu South
18	Karnataka
19	Other states

(Traffic & Transportation Studies for AMRUT cities - Alappuzha Municipality, 2020)

8.9.2 Characteristics of Inter-Town Passenger Traffic

i. Modal-split

The inter-town passenger transport in Alappuzha is met mostly by road based KSRTC buses, private buses, and a host of personalized vehicles like two-wheelers and four-wheelers. The railway and water transport, carries only a negligible percentage of inter-city passenger traffic. An analysis of the O-D survey data collected from outer cordon survey locations

revealed that an estimated 4,27,988inter-town passenger trips were performed in the study region on a reference day consisting of 2,37,324 bus passenger trips, 25,578 mini-bus trips, 60,642 car trips, 76,959 two-wheeler trips, 13,729 auto trips, 6,476 train trips and 7,280 boat trips. It could be inferred that public transport had a significant role in meeting the inter-town passenger demand. Figure 8-11 shows the model – split of inter town passenger traffic.

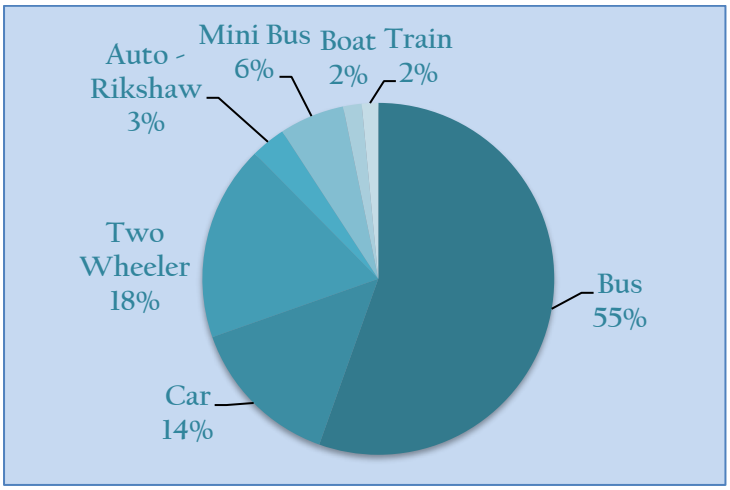


Figure 8-11: Model Split of Inter Town Passenger Traffic in Alappuzha

ii. Purpose of Trip

In Alappuzha, almost 44.79% of the total inter-town passenger movements were performed for work related purpose. This was followed by 1,03,641 trips in other categories, which constituted almost 24.22% of the total inter - town passenger movements. This was followed by 32,321 medical trips, 29,668 shopping trips, 28,552 educational trips, 24,810 recreational trips and 17,321 social trips. Figure 8-12 shows the distribution of inter – town daily passenger trips according to purpose of trip.

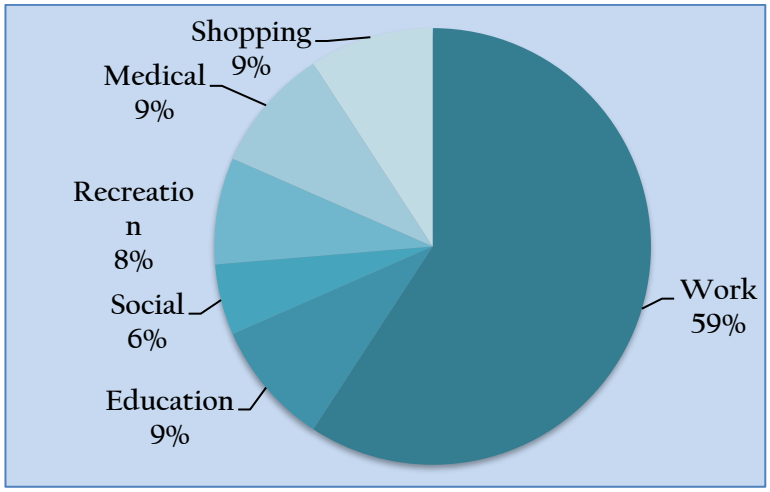


Figure 8-12: Distribution of Inter – town daily Passenger trip according to purpose of trip

iii. Occupation of Passengers

The occupational characteristics of passengers were ascertained from the O-D survey. It could be seen that the number of persons working in the private sector are maximum amounting to about 36.35% of the total trip makers followed by business men with 15.53%. The government servants constituted 15.29% of the total trips. Of the total trips, about 6.41% were contributed by casual laborers. Dependent population like unemployed, housewife, student and retired hands together constituted 14% of the total inter-town passengers. Figure 8-13 shows the distribution of inter town daily passenger trips according to occupation of trip maker.

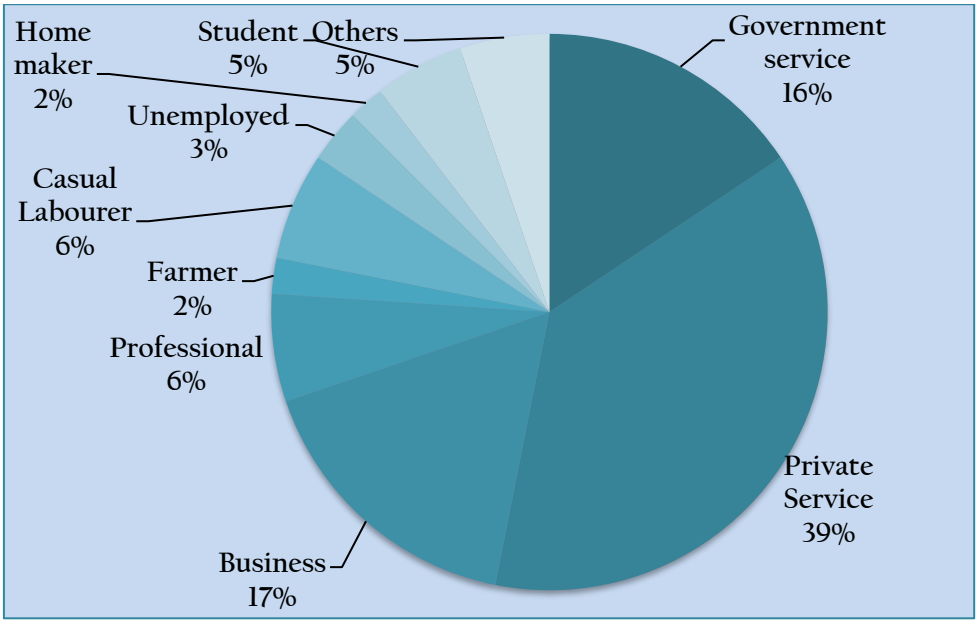


Figure 8-13: Distribution of Inter – town daily Passenger trip according to Occupation of trip maker

iv. Origin - Destination of Passenger Trips

A total of 4,27,988 passenger trips were performed as inter-town trips in the study region on a reference day. The major traffic generating zones within the study region was the CBD area with 114,463 trips constituting 26.74 % of the total trips. About 13.66% of trips were generated from the remaining area of Alappuzha Municipality and remaining Alappuzha district generated 1.94 lakh trips. Trips generated from other districts were 56,965 and that from other states were 3,661. Figure 8-14 shows the desire lines of inter – town passenger trips.

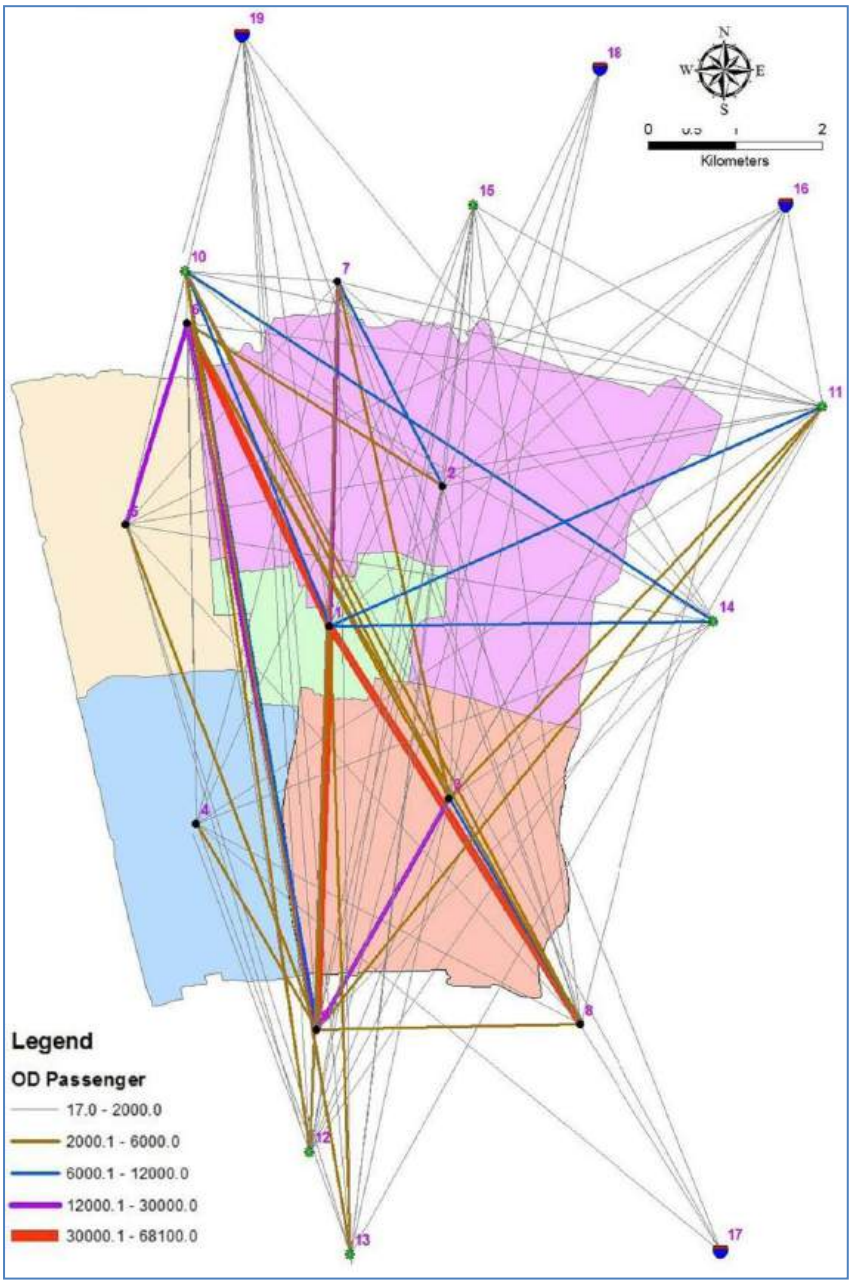


Figure 8-14: Desire line of inter – town passenger trips
(Traffic & Transportation Studies for AMRUT cities - Alappuzha Municipality, 2020)

An analysis of inter-town trip attractions revealed that the CBD area attracted 141,058 inter-town passenger trips. The remaining Alappuzha Municipality area attracted about 11% of total trips and the balance of Alappuzha district attracted nearly 1.83 lakh trips. Trip attractions by other districts amounted to 54,134. The number of trips attracted to other states was 2,092.

v. Pattern of Inter-Town Passenger Trips

The O-D pattern of inter-town passenger traffic revealed that there were 172,911 internal - external trips (Study region to outside study region), out of 427,988 inter-town

passenger trips and constituted 40.40 % of total trips. A total of 184,176trips were external – internal trips (outside study region to study region) constituting 43.03 % of the total trips. External – external trips, which are by passable, to the tune of 67,275 trips were performed through the study region and they were 16 per cent of the total trips.

8.9.3 Characteristics of Inter-Town Goods Traffic

i. Volume of Goods Vehicles at Outer Cordon Points

A total of 14,593 goods vehicles passed through the outer cordon points in Alappuzha Municipality on the reference day. The total goods volume comprised of 9,240 trucks followed by 4,186 Mini trucks and 1,167 goods auto-rickshaws.

ii. Modal Split of Goods Traffic

The quantum of goods handled by the goods vehicles was to the tune of 36,463tonnes. Trucks carried the maximum volume of goods traffic (79.94 %) followed by mini-trucks (16.92%). The remaining 3.14 percent of goods traffic was handled by goods autos.

iii. O-D of Goods Transportation

Inter-town movement of goods to the tune of 36,463 tones was carried out over the study region. The major traffic generator of goods traffic was zone 10 (Ernakulum District) with a total of 8,083 tons of goods traffic. This was followed by the Alappuzha CBD area with 7,357 tones. Other major trip producing zones were 6, 9, 12 and 13. Goods generated from other districts formed 40% of the total volume, while the goods generated from other states was to the tune of 3,684 tones.

In the case of goods traffic attraction, a maximum of 6203 tons of goods traffic were attracted by zone 10, followed by zone 1. Other major attracting zones were zones 9, 12, 13, 8, 6 and 11. Among the external zones, 24% of the goods traffic terminated in Alappuzha District, while 44% formed the volume to other districts. Goods bound to other states were 1640 tones constituting 4% of the total volume. Figure 8-15 shows the desire lines of inter – town goods traffic.

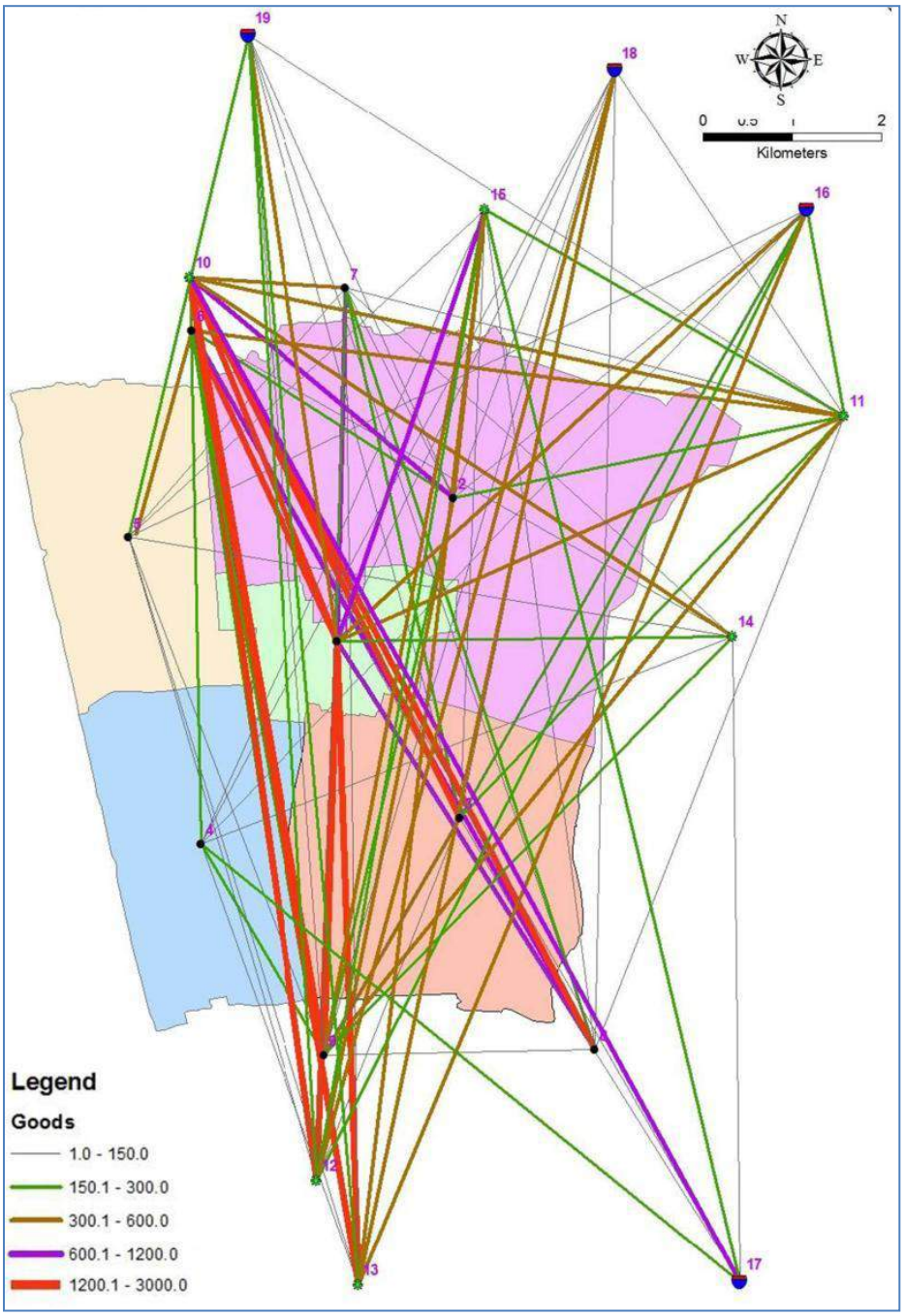


Figure 8-15: Desire line of inter – town Goods Traffic
(Traffic & (Transportation Studies for AMRUT cities - Alappuzha Municipality, 2020)

iv. Pattern and Composition of Goods Traffic

A further study of the goods traffic pattern observed within the study region vis-a-vis the outside study region revealed that 9,874 tons of goods originated from the study region and 10,041 tons of goods terminated in the study region. About 16,548 tons of traffic are of divertible nature, which, are passing through the CBD area of the town.

Out of the 36,463 tons of inter-town goods traffic observed through outer cordon survey stations, maximum volume of 8,563 tones movements were observed in the case of construction materials which amounted to 23.5%, followed by industrial goods with 22.4% and petroleum products with 19.6%.

8.10 Major Traffic Problems

The existing road network within Alappuzha Municipality is in the form of grid pattern. The roads are in a planned manner connecting most of the central parts of the town. The main arterial road of this town is the section of National Highway 66, which has already exceeded its capacity. However, the newly constructed bypass can ease the traffic situation on NH section of this town. The reasons for traffic problems in Alappuzha Municipality are:

- Narrow roads within the central area
- Poor geometrics of road at junctions
- Unorganized parking
- Heavy pedestrian crisscross movement
- Loading/unloading activities on the roads and encroachments on road side by vendors
- Movement of inter-city bus traffic on congested urban roads due to the location of intercity-bus stand within the central area of the town.
- Narrow road width and waiting at railway crossings.

8.11 Inferences

The coverage of road network is good except for some missing links. But, the width of most of the roads is not adequate even for the present traffic volume. The section of the National Highway passing through the town is overcrowded. There are number of junctions in the Municipality with volume exceeding their capacity, which require immediate improvements in geometry. Safe passage of pedestrians in the town centers is another issue to be tackled. Public transport had a significant role in meeting the inter-city passenger demand. There is a dearth of parking spaces for private vehicles in the Municipality causing kerb parking affecting the carrying capacity of the roads. A proper truck terminal is needed for the development of trade and commerce in the town.

The volume of through traffic especially that of goods is very much on the higher side. Avoiding the goods traffic from the town center would improve the traffic conditions of the

town. Waterways being more environment friendly and economical, its importance is recognized recently, specific to this town, especially in the context of waterfront tourism developments gaining more attention by virtue of the potentials in this sector. The improvement of existing canal system can promote goods movement and passenger movement within the town through water transport.

9 PHYSICAL INFRASTRUCTURE

9.1 Water Supply

9.1.1 Existing Water Supply System

The present water supply scheme for Alappuzha is considered on the basis of its delivery in Alappuzha town and eight panchayats (some of which constitute the UA). Pamba River is the main source of water, from where water is stored in an intake well located at Kadapra (40 Km from the river). Presently, 25 MLD water is supplied and is sufficient. Water is supplied at a rate of 135 lpcd for town area and 70 lpcd for rural area within the Municipality. Water is distributed through 8 overhead tanks within the town area and supplied through 46000 connections. The town has been divided into 9 zones (1 - Kommady; 2 - Chathanad; 3 – Vadicad; 4 - Thathampally; 5 – Vazhicherry; 6- Pazhavangady; 7 – Valiyakulam; 8 – Chudukad; 9 – Pazhaveedu) for water supply.

As the area is water logged and the ground water table high, open wells in this area are highly polluted by salinity and are contaminated and hence they cannot be considered as a prime source for water supply. Currently, there are 8 tube wells within the town area. According to socio economic survey, the various sources of water were identified as in Figure 9-1 .

In view of the quality problems associated with drinking water supply in Alappuzha town, the Kerala Water Authority, in collaboration with Tourism department has set up 21 reverse osmosis plants across the town as shown in Figure 9-3. A treatment plan is there at Karumady which is located outside the Municipal area. The ongoing and committed projects for water supply within the Municipality is shown in Table 9-1 .

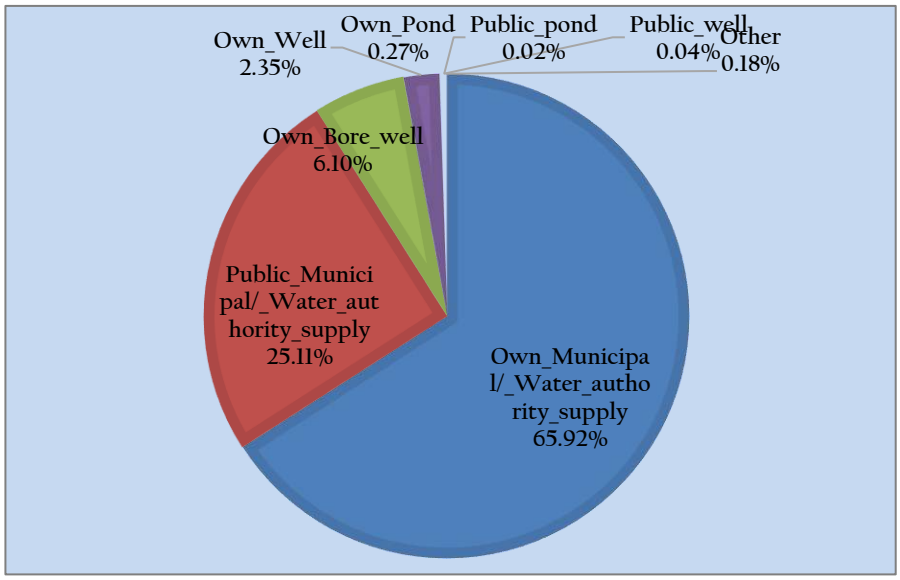


Figure 9-1: Sources of water

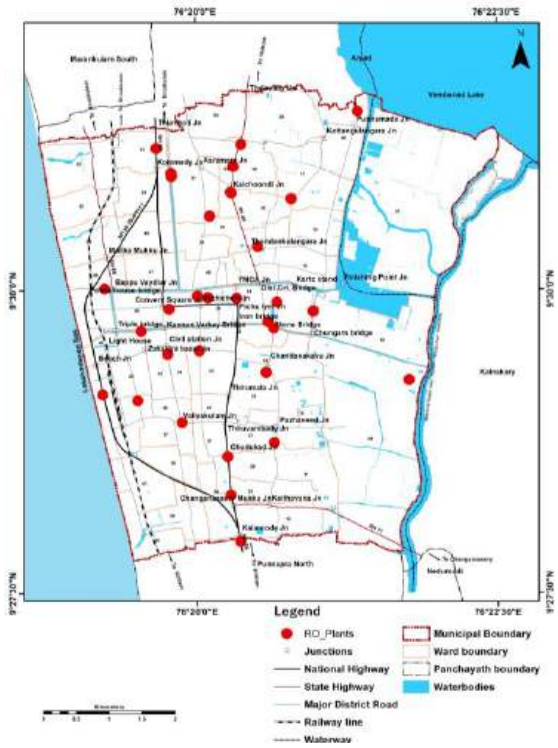


Figure 9-3: Location of reverse osmosis plants

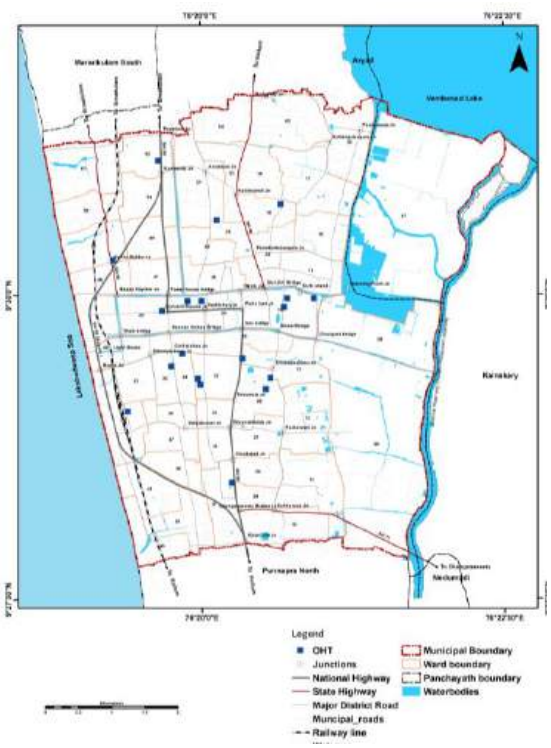


Figure 9-2: Location of overhead tanks in the Municipality

9.1.2 Scarcity

As per the studies conducted shortages in water supply do exist in some wards of Alappuzha Municipality. According to the data collected in the socio-economic survey, about 56% of the houses are not facing water shortage. The nature of scarcity as per socio economic survey is shown in Figure 9-4.

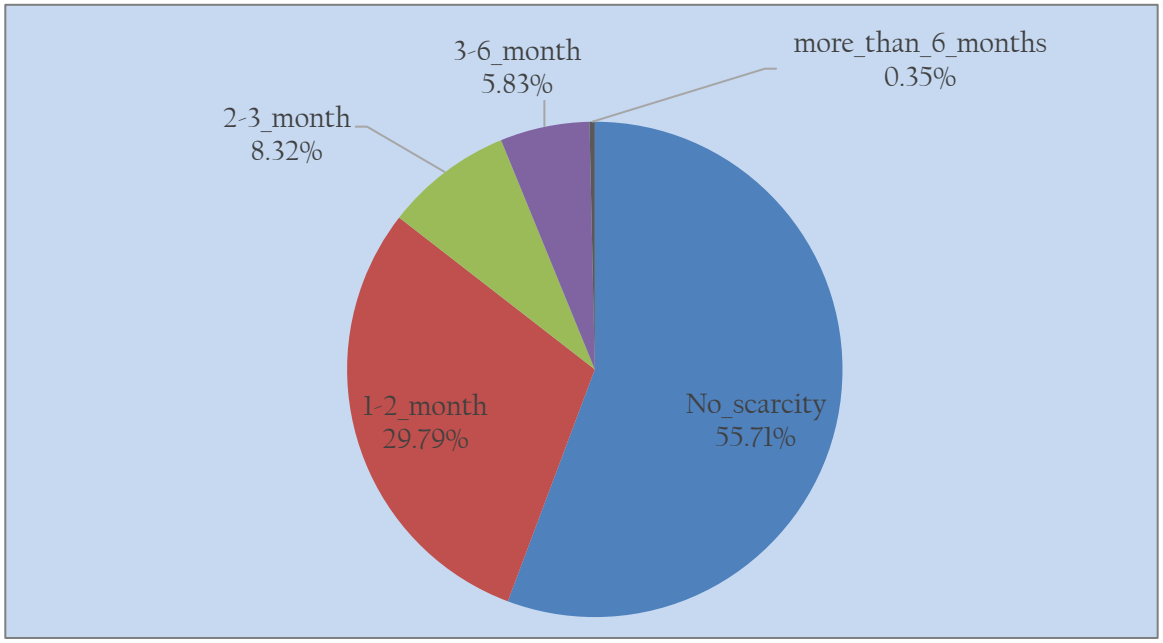


Figure 9-4: Nature of water scarcity

Table 9-1: Ongoing & Committed Projects in Water Supply Sector

Sl.No:	Projects
1	Augmentation and Modernisation of Water supply distribution system in Alappuzha Municipality Phase III
2	2nd Phase Augmentation and Modernization of water supply distribution system in Alappuzha Municipality.
3	Construction of OHSR at Kommadi(Zone-1), Valiyakulam(Zone-VII), Thathampally(Zone-IV), Pazhavangadi(Zone-VI)
4	Digital Survey & Design of Network
5	Setting up Water Kiosks
6	Providing Bulk Meters
7	Setting up 24 x 7 Customer Care Facility

9.1.3 Problems and Potentials

The ground water quality in Alappuzha municipal area and adjoining panchayats has shown substantial deterioration over the years. The surface and shallow ground water are not potable because of organic pollution. Hence the people have no other option but to depend on the water supply scheme.

All the scour valves are buried under the newly widened roads. This obstructs the periodical flushing out of sediments and dirt settled in the pipes. This results in the distribution network being clogged at a few points due to discontinuity of flow of water. The resulting dead end leads to the growth of coliforms in the line and also create hurdles in proper flushing out of the system.

Even though a new water supply scheme is envisaged for the town, the repairs and maintenance work had to be done on any account as the project envisages usage of existing facility for the upcoming project also.

9.1.4 Inferences

Even though the present requirement is satisfied by the existing water supply system, there should be initiatives to increase the supply considering the future requirement. Increased number of pumping stations in order to maintain the supply quantity consequently increases the number of operating stages making the system uneconomical. Repair and maintenance of existing distribution system and overhead tanks are required.

Improvement of the existing distribution network, reducing unaccounted flow of water and replacement of non-working meters has to be done on priority basis. Projects on rainwater harvesting are also an economical and feasible remedy for shortage of clean drinking water. Provision for safe drinking water to all households may be taken up with top priority.

9.2 Drainage

The natural drainage systems in most of the cities are in jeopardy, and the problem of flooding is worsening with time due to non-availability of properly engineered storm water drainage infrastructures. The problems are worsened due to encroachment and rampant dumping of garbage & solid waste in the drains on one hand and absence of preventive maintenance on the other.

Surface water drainage has emerged as an important component of the urban development sphere in Kerala. Many urban area changes have contributed to this situation. The per capita land availability in urban areas is decreasing at a fast rate. Majority of the residential plots has less than 400 sq.m of area. Such plots of land are almost fully occupied by buildings or are paved. There is hardly enough open ground within the building plot to allow percolation of rainwater and waste water into the soil. Therefore, such surface water from within the individual plots is left off into the street drains.



Figure 9-5: Image showing Canal in Alappuzha Municipality

The towns and cities in Kerala have witnessed fast densification due to population increase. All available vacant parcels of land, open spaces and erstwhile low lying lands and paddy fields are facing land use conversions. At the present pace of land use conversions, open land to allow collection of storm water during rains to permit percolation into the soil or to allow collected water to slowly discharge into the natural stream and manmade drains are fast depleted. This is especially true in case of low lying lands and paddy fields which used to act as drainage basins. In view of this, water during storms and high intensity rains cause flash floods in many areas of our towns and cities. The available road side drains are not designed to carry such large quantities of water.

The physical terrain of towns in the midland areas of Kerala gives rise to formation of natural areas which are bowl shaped or low lying, which stagnate water during rains. Similarly, there were many ponds, which acted as rainwater basins. Ponds which still exist in many of

the urban areas are not designed into the drainage network and conserved. However, these are quickly depleted because of land conversions due to filling up of these low lying land parcels for construction activities.

The above changes in the land use, conversions etc. in the urban areas of Kerala have increased the need for surface drainage to be dealt with as an important infrastructure component.

9.2.1 Existing Scenario

The topography of Alappuzha is almost flat except for the central strip in the North-South direction, which is slightly elevated with contours varying from 4 to 6 meters above sea level. The strips on either side slopes towards the coast and the lake. The average elevation above mean sea level is 1.5 m. The area is generally water logged and the water table is just 1.5 m below ground level.



Figure 9-6: Waterlogged Roads



Figure 9-7: Waterlogged Area Around Houses is Common

The network of canals is the backbone of the drainage system of the town. The most important canals are Vadai canal and Commercial canal running East West, on either side of the central area of the town, formerly connecting the lakes with the port. Other major canals run North South. A.S. canal (Alappuzha Cherthala canal) is on the Northern side and Amabalappuzha canal, Rani Thodu and Vada pozhithodu, Shadamony thodu are on the Southern side of the central core of the town. Table 9-2 and Table 9-3 list out the primary and secondary canals in the town.

The network of canals existing in the town can be classified into a three tier network system draining off the storm water of the town without causing severe floods in the town. The backwaters and the Lakshadweep sea acts as catchment basins for the water collected in the main canals (Vadai canal and Commercial canal) through the thodu and available road side drains.

Table 9-2: Primary canals in Alappuzha Town

Sl. No.	Name of Canal	Length(m)
1	Commercial Canal	3500
2	Vadai Canal	3950
3	East Junction Canal	640
4	West Junction Canal	880
5	Murinjapuzha Canal	600
6	Uppotti Canal	250
7	AS Canal	2800
8	Amabalpuzha Canal	5000

Table 9-3: Secondary Canals (drains) in Alappuzha Town

Sl. No.	Name of Canal	Length (m)
1	Rani Thodu	2000
2	Vada Pozhi Thodu	2000
3	Shada Mani Thodu	1500
4	Thattampally Thodu	1000
5	Pooniyil Thodu	1000
6	Kottachira Thodu	1000
7	Kottaram Thodu	1000

Source: CDP Alappuzha

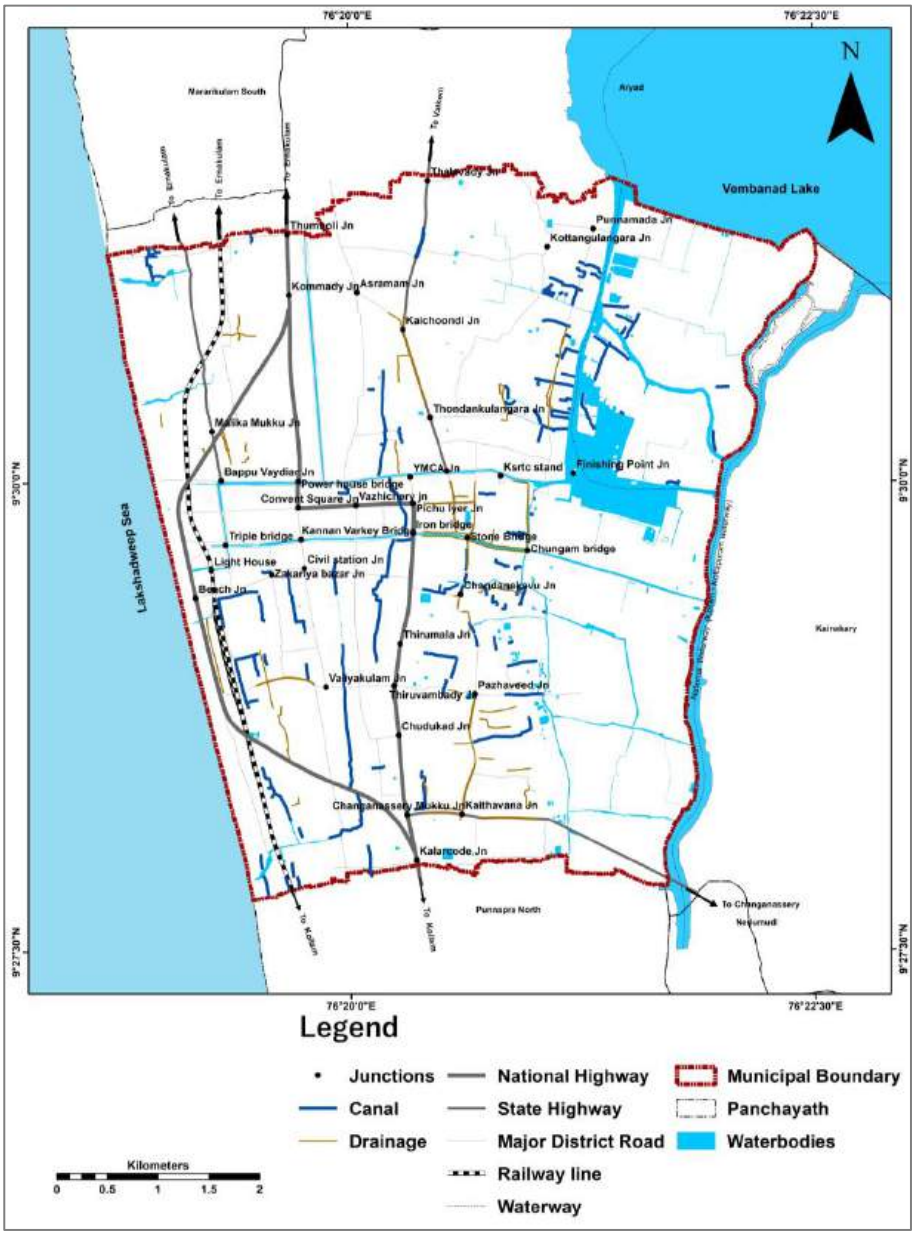


Figure 9-8 : Existing Drainage Network of Alappuzha Town

While considering the present situation of drainage of the Alappuzha Municipality, according to SLIP (Service Level Improvement Plan) a comparative information of service levels with respect to the service level bench marks prescribed by MoUD and sustainable standards for service levels under the National Mission on Sustainable Habitat (NMSH) are shown in the Table 9-4. The main indicators are coverage of storm water drainage network, incidence of sewerage mixing in the drains and incidence of water logging.

Table 9-4: Status of Storm Water service levels

Indicators	Sustainable standards	Black (Caution for improvement)	Red (Immediate action for improvement	Present Status
Coverage of Storm water drainage network	100%	<75%	<50%	24 %
Incidence of sewerage mixing in the drains	0%	<25%	<50%	80 %
Incidence of water logging	0	<25	<50	18 nos

Source: SLIP (Service Level Improvement Plan)

Table 9-5: Detail of Locations where storm water get mixed with sewer

Sl.No.	Location	Merging with which sewer	Reason
1	Mullathu valappu	Yes	Absence of sewer line
2	Railway station ward	Yes	
3	Kannita	Yes	
4	Palace ward	Yes	
5	Mullathodu	Yes	
6	Valliakulam ward	Yes	
7	Punnamada	Yes	
8	Magalum	Yes	
9	Pallathiruthi	Yes	
10	EMP colony	Yes	
11	Kangirumchira	Yes	
12	Vadakcanal	Yes	
13	Stadium ward	Yes	
14	Kidangamparampu	Yes	
15	Chunkum	Yes	

Source: SLIP (Service Level Improvement Plan)

Now the town faces severe water logging problems especially during the monsoon. This is due to the fact that most of the connecting thodu are encroached and silted up. The carrying capacity of the thodu are reduced to a lower level which does not meet the requirement of the town. The drains along the roadsides and the connecting thodus are the tertiary drains. Only 2% of the roadside drains are pucca and are mostly open. The roadside drains have a length of about 250 km; i.e. about 80 percent of the city road network length. On wide estimation only

24% of drainage is present and the rest of percentage come as a gap. So the present drainage system is inadequate. However, the canal network relieves the drainage system off overstress. In order to evade the bottlenecks in the existing drainage network preparation of Surface Water Drainage Master Plan for Alappuzha is very much essential.

Most of the canals are blocked by at the mouth by sand bars. The drains in the city are built arbitrarily without taking in account the runoff. The drainage networks are not sufficient to carry the peak flow. There is no separate storm water drainage network in the city. Detailed locations where storm water get mixed with sewer is shown in the Table 9-5.

Presently water logging is handled by de silting and cleaning the garbages at rainy season, but lack of well-maintained drainage networks and improper SWM system leads to clogging of canals. The area of flood prone points, the number of points where water logging is affected and the number of times water logging reported in a year is shown in the Table 9-6. The drains are prone to chocking due to dumping of solid waste. Some of the details of the locations prone to chocking of drains are shown in Table9-7.

Table 9-6: Flood prone points in the city

Sl.No.	Area	No of points	No of times water logging reported in a year (stagnant water for more than four hours of a depth more than 6")
1	Key road intersection	6	2-3
2	Along roads (50 metre length or more)	10	2-3
3	Locality (affecting 50 HH or more)	10	10

Source: SLIP (Service Level Improvement Plan)

Table9-7: Detail of Locations prone to chocking of drains due to solid waste

Sl.No	Location	Stretch Length Affected	Reason
1	Valliakulam ward	25m	Chocking of drains due to garbage deposition
2	Stadium ward	35m	
3	Kidangamparampu	68m	
4	Palace ward	120m	
5	Shadamani thodu	350m	
6	Mangalam ward	250m	
7	Malikamukku	350m	
8	Rani thodu	225m	

Source: SLIP (Service Level Improvement Plan)

9.2.2 Identification of gaps in the network

The canals are connected to the lake on the Eastern side. Those canals connected to the sea are blocked at the mouth by sand bars. The lake itself is stagnant for most part of the year

due to closing of the Thanneermukkam bund. Hence practically there is no flow in the canal system and this leads to the canals getting blocked with waste water, weeds and solid waste. The AC canal (Alappuzha Changanasserry Canal) is blocked by manmade bunds (by way of roads) at several places.

The drains in Alappuzha are built arbitrarily; without taking into account the run off. The drains from the private premises as well as the roadside drains do not have silt traps to intercept silt and solids. This waste is discharged into the next level of drains or the canals chocking them with solid waste including plastics. Major problems facing the storm water drainage system in Alappuzha town are the following:

- Decreased carrying capacity of the drains due to heavy silting, weed growth and discharge of solid waste and sewage.
- Reduced canal width and missing links in the canal system due to encroachment.
- Lack of awareness among the public in maintaining public drains and canals.
- Irregular and in adequate maintenance of drains and canals.
- Lack of cross drainage facilities and also closing the culverts by encroachments.

The drainage pattern in the wards when observed tells that it has been done in a very adhoc pattern not without taking into account the slope or the flow of water in the area. As a result, the drains do not work efficiently resulting in clogging and water pools during monsoons.

The departments that are jointly responsible for operation and maintenance of the existing drainage system in the town are the ULB, State Irrigation Department, National Highway, Southern Railway and State PWD. In order to ensure efficacy of the drainage system, it is important that there is better co-ordination among the departments mentioned above.

9.2.3 Inferences

Canal network is the backbone drainage system of Alappuzha and if this does not ensure smooth flow, the surface drainage system in the town is bound to fail. Stagnation is the primary drawback of the canal network caused by accumulation of all solid waste. The situation is aggravated by the growth of weeds due to lack of salinity. Removal of silt and solid waste, to ensure proper flow and controlled salinity could solve most of the problems. Lack of cross drainage facilities, closure of the culverts due to the encroachments etc. are the challenges faced by the city to achieve the service level benchmarks.

9.3 Sewerage

9.3.1 Existing system

Alappuzha does not have a sewerage system. The present scenario of sewage disposal reveals a pathetic situation since sewage, sullage and solid wastes from the households and from commercial establishments find their way into the drains, thodus canals and lakes. The wastes thrown carelessly on the ground decays and allows the leachate to flow into the ground water polluting the entire water bodies in the town. Such a situation occurs since the sub soil water table is high.

Census Data 2011 for Alappuzha Municipality points towards nearly 100% household toilet coverage and the city has been declared open defecation free. However, the census data explains only part of the sanitation service chain. The status of sewerage network and service levels of the town is shown in Table 9-8.

Table 9-8: Status of sewerage network and Service Levels

Sl No.	Indicators (as per SLB framework)	Existing Service Level	MOUD Benchmarks
1	Coverage of latrines (individual or community)	98.23%	100%
2	Coverage of sewerage network services	0%	100%
3	Efficiency of collection of sewerage	0%	100%
4	Efficiency in Treatment: Adequacy of sewerage treatment capacity	0%	100%

Source: SLIP (Service Level Improvement Plan)

The survey revealed 98.23% of the respondents had in-house toilet facilities, as per MoUD rating & categorization of cities, Alappuzha comes under red category for sewerage coverage and treatment facility. Regarding coverage of latrines, the city falls under blue category. City cover zero percentage of sewerage coverage, high ground water pollution due to excessive use of septic tanks and inadequate septage management.

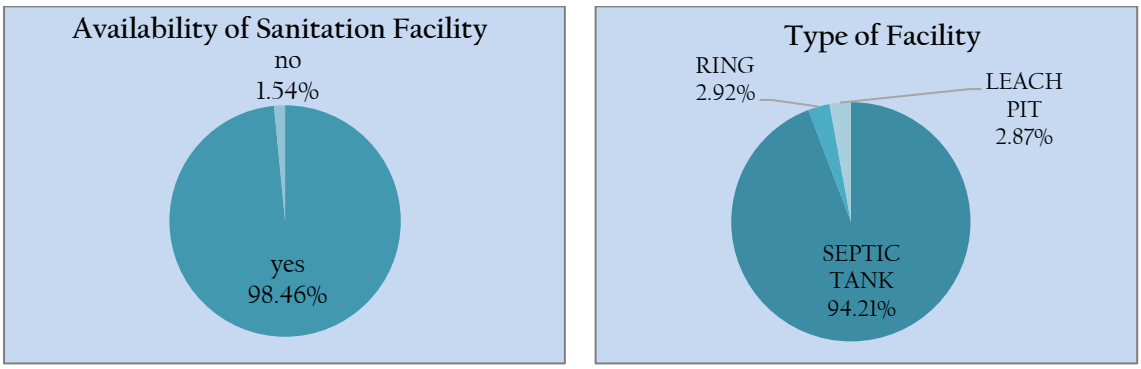


Figure 9-9: Availability & Type of Sanitation Facility

Source: Socio Economic Survey, 2019

As per socioeconomic survey, about 98% of the sample of HH has sanitation facility and the rest 2 % don't have sufficient sanitation facility (Figure 9-9). Even though many wards have cent percent toilet facility, many wards like 6, 7, and 12 lacks these basic infrastructure facilities, so they are the most sufferers of the Municipality (Figure 9-10).



Figure 9-10: Sanitation Availability

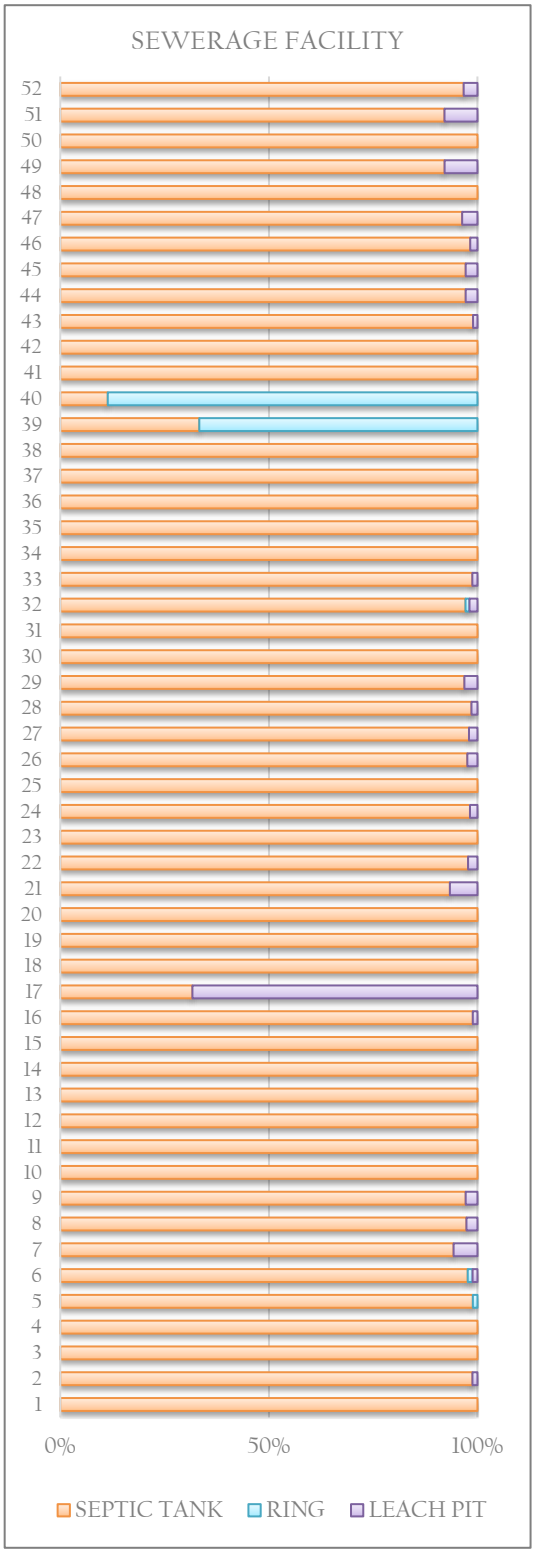


Figure 9-11 Sewerage facility

Source: Socio Economic Survey, 2019

More than 3% of the households have leach pit type latrines and ring type pits each, which directly contaminate the sub soil water. There are households with latrine not having septic tanks and the leach pits and the disposal of human excreta to the water bodies is also seen and is the main reason for water contamination. The water table of Alappuzha Municipality is about 1.5 to 2m. The construction of Septic tank is unscientific in those regions as the chances of contamination of the drinking water. Majorly, wards 39 and 40 are having ring type onsite sanitation system where as wad number 17,49,51 etc. shows leach pit type sanitation system. The detailed split up showing the discharge pit type of the Municipality is shown in the Figure 9-11. Apart from the census data and survey data collected, the actual situation that could analyze by the site visit of technicians and experts, there is a suspicion that what people reported as septic tanks may actually be pits.

9.3.2 Emptying and Treatment facilities

As per the "Town Level Assessment of major polluters and pollutants in Alappuzha Town" report prepared by IIT Bombay and KILA. A technical analysis of the OSS (On site Sanitation) was carried out based on the responses regarding the materials of the wall and bottom of the OSS as well as its outfall. The criteria used to decipher the OSS were based on literature and interviews of masons carried out before the questionnaires were formulated. The type of OSS determines the characteristics of fecal sludge (FS) emptied, which in turn influences the technology and capacity of the treatment system. This is particularly true for the state of Kerala as pits are inappropriate OSS in most cities due to high water table, and any meaningful plan for FSM (Fecal Sludge Management) will need them to be replaced. Further, the survey also found that one in two septic tanks are connected to soak pits while the remaining drain their effluent to a nearby drain or open land. (Centre for Policy Studies (CPS) and Centre for Technology Alternatives for Rural Areas (CTARA), 2018)

According to (Centre for Policy Studies (CPS) and Centre for Technology Alternatives for Rural Areas (CTARA), 2018) the following results are found, that 43 % of the on-site installations have never been emptied. Almost 40 % of the unemptied on-site systems were less than 5 years old; but more than 30 % were 10 years or older; the oldest was reported to be 50 years old. Of those emptied, the duration between successive emptying (frequency/cycle) ranged from 1 year to 20 years; 55% observed an emptying cycle of less than 3 years and the average emptying cycle of installation emptied was found to be 3.5 years. This is very close to the emptying cycle (2-3 years) suggested by the Central Public Health and Environmental Engineering Organization (CPHEEO).

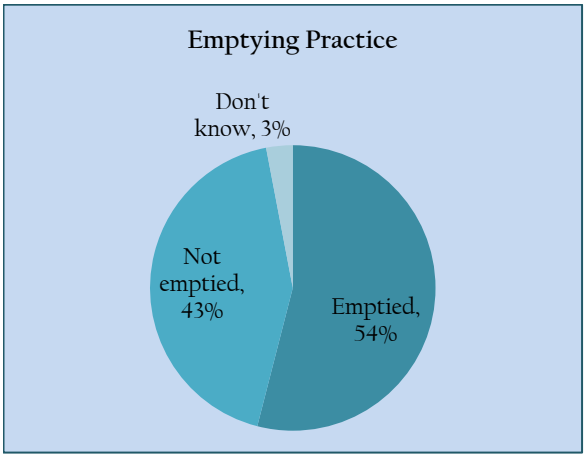


Figure 9.3-4: Emptying practice in Alappuzha

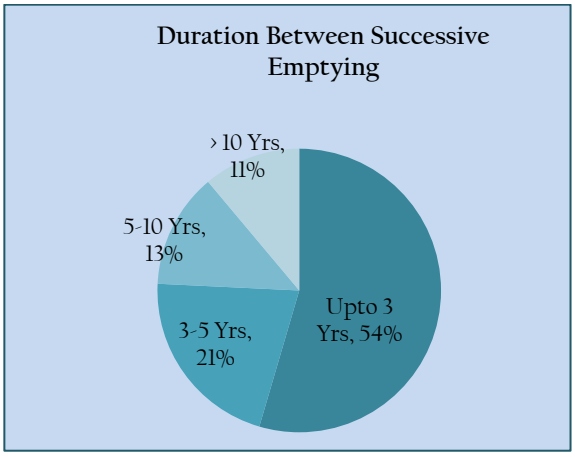


Figure 9.3-5: Duration between successive emptying

Source: Town Level Assessment of major polluters and pollutants in Alappuzha Town

According to (Centre for Policy Studies (CPS) and Centre for Technology Alternatives for Rural Areas (CTARA), 2018) studies, the Municipality does not provide emptying service nor has it licensed any private service providers. Members of Alappuzha district Septic tank cleaning Contractors Association (ASCA) provide emptying services to households and institutions like hotels, hospitals, etc. in the district as well as adjoining panchayats of the neighboring districts. The members of the association collectively operate about 50 emptying trucks of 5,000 liters each. They provide service only in the night, often well past midnight as they perceive the business risky and fear action by law-enforcement agencies. Each truck makes about 5 trips each week (from all the areas they serve, not only the town). Though not permitted by law, manual emptying of on-site installations is practiced in the city. However, a preliminary finding of an ongoing research trying to study the lives of scavengers in the city has found that the people involved themselves do not want to be identified to be working with excreta for social reasons. The discussions also revealed that whether the tanks are emptied manually or through vacuum pumps, the persons are not using any protective equipment. The average charge paid by households for emptying of septic waste is around 1-3K. This practice poses many health risks for the personnel involved. ASCA coordinator claims that the emptier carry the emptied fecal sludge to a treatment plant at Info park in Cherthala some 25 km away from the town. The treatment plant charges Rs. 1,000/- for emptying each load. They are also aware that capacity of the treatment plant is insufficient. It is safe to assume that they dispose FS at the nearest convenient location. When manually emptied, the FS is either disposed of in a pit dug for the purpose or just spread around on the same property.

9.3.3 Key Issues and Challenges

Alappuzha town lies in the coastal low land belt. The Eastern part is low lying paddy fields and lake and the area adjoining this is water logged, the soil in this area is alluvial and the soil around the sea side is sandy. The middle strip in the North-South axis is slightly elevated with contours from 4 m to 6 m above sea level. Strips of land on either side of this ridge slope towards the coast or the lake. Otherwise the topography is almost plain. The fact that the lake and canal system between Thottappally in the South and Thanneermukkam in the North is stagnant for most part of the year and the pollution caused by the nearby agricultural areas and far off plantations, make Alappuzha a very sensitive area, environmentally.

During the monsoon season the water table nearly equals the ground level, when the septic tanks face a grave situation of polluting the ground water. Also the untreated effluents released to the nearby canals or water bodies find easy access to the ground water. The polluted sub soil water spreads below the ground to all the water bodies (drains, canals and thodus) and ultimately gets discharged into the backwaters. Because of this the water quality in Vembanad Kayal deteriorates. The presence of coliform bacteria in the backwaters is also severe.

It is seen that the households with latrine not having septic tanks and the leach pits are disposing the human excreta to the water bodies, which is the main reason for water contamination. Alappuzha town has a network of canals, which are interlinked and are connected to the backwaters. The canals lack adequate maintenance and are choked with garbage. Inadequate solid waste management system results in polluting the ground water.

In spite of the susceptibility to ground water pollution in the absence of a piped sewerage system, a planned sewerage system was not established in the town till now. The main problem with the drainage in the town is that, gravity flow of sewage is difficult, as the ground is almost flat without undulations. Increased depth for laying sewers is not possible since ground water table is high. Even though the purpose of roadside drains is to carry storm water into the main canals but they are misused for disposing solid waste as well as sewage. And also the waste water discharged into the natural drains or canals is without any treatment.

The following are the key issues that municipal area has been facing:

- Even though majority of HHs have septic tanks or pits, most of them are unscientific, especially the out flow of septic tank is not proper, the reasons may be the terrain condition, water table and the soil structures, so this reasons makes difficult to find a suitable solution.
- In case of emptying and treatment of septage waste, there is no proper way of sludge treatment and management facility in Municipality and more over this, the current practice following for management of liquid waste is morbid.
- Municipality neither has a licenced/authorized scavenger nor any team /association for faecal sludge collection and management.
- In the absence of a piped sewerage system, people find canals and water bodies as a means to dispose of sewage
- The canal water has high contents of E-coli counts (38000 per 100ml).
- The dissolved oxygen content is in the range of 5-6 mg/l.
- Biochemical oxygen demand is 80mg/l.
- Since the canals are linked to the backwater, the water quality of the backwater is deteriorating. Canals are clogged with waterweeds and garbage. They have become breeding grounds for mosquitoes. Wastes from the coir factories, rice mills and the medical college also find the canal as the only place for the discharge of the hazardous effluents, which create health problems in the town.

9.3.4 Ongoing and committed Projects

Alappuzha Municipality currently does not have any faecal sludge treatment plant (FSTP). Following small plants are proposed to cater some institutions and 4 mobile treatment units under Atal Mission for Rejuvenation and Urban Transformation (AMRUT).

(1) General hospital (240 KLD); (2) Shatabdi Mandiram (15 KLD);
(3) Mobile FSTPs (2 nos) and at (4) Thottumady Colony (50 KLD)

9.3.5 Inferences

The Municipality doesn't have any facility for the treatment of waste water at present which poses a serious threat to the public health and environmental quality. So a decentralized public sewerage system is needed as the flow of sewerage cannot be maintained in a centralized system due to the plain terrain. Proper and scientific septic tanks should be installed in spite of unscientific systems as mostly followed at present. A proper collection, emptying and disposal mechanism should be adopted for good public health and environmental quality.

9.4 Solid Waste Management

The main goal of municipal Solid Waste Management (MSWM) is to reduce the waste volumes and to protect the health of the urban population, particularly that of low-income groups who suffer most from poor waste management. In urban areas, solid waste is generated by households, commercial and industrial enterprises, as well as healthcare facilities and institutions. With the exception of industrial, construction and debris waste, the aforementioned waste generated in cities is referred to as municipal solid waste. (Güdel), 2008).

Solid waste management plays a key role in ensuring a healthy city and in turn healthy people. Solid waste management has increasingly become one of the key areas of concern of the urban local bodies in Kerala. Alappuzha town has gained international attention for the utmost management of solid waste. Alappuzha city being recognized by the United Nations Environment Programme (UNEP) amongst five cities in the world that are working towards curbing pollution through their sustainable solid waste management practices. However, the town got a worldwide attention, there are some problems still which affects the current practices of solid waste management.

The solid waste management is one of the municipal services to the city. The Health Department is responsible for sanitation, solid waste management and public health. The collection, transportation, disposal of MSW is the responsibility of the Health Department. The Health Officer (HO) is supported by Sanitary Inspectors who attend to problems related to SWM. The Engineering Department also assists them. The Project Engineer is responsible for engineering components of SWM and vehicle procurement and maintenance. Alappuzha Municipality presently has a network of community collection points, mainly they are aerobic composting units. Community level collection & transportation of street waste to municipal collection center has done by sanitation workers. On the Administration side there is a chief officer (Municipal Secretary) under whom there are the Health Officers. In addition to this there is a Health and Engineering committee with a President and ward councilors constituting part of the team.

9.4.1 Generation and collection

The total waste generated per day is around 58 Ton, which is inclusive of waste generated by tourists and floating population. The major sources of generation of solid waste

in the town are the market, abattoir and about 48000 households. The details of waste generators in Alappuzha Municipality is shown in Table 9-9.

Table 9-9: Waste generators status in Alappuzha Municipality

Total number of houses	48000
Auditoriums	35
Public Halls	28
Market	5
Number of Hotels, Banquet, Hall	205
Number of Shops, Commercial Establishments and Institutions	7800
Government office	94
Schools	95
Health care and establishments	76
Private office	620
Street vendors	720
Beef, mutton, chicken stall	59
Public toilets	6
Community toilets	8
Scraps shop	42
Slaughter house (not working)	1
Authorised slums	12
Un-authorized slums	70

Source: DPR of Solid waste management

9.4.1.1 Composition of waste

Table 9-10 shows the composition of waste (bio degradable and non-bio degradable) in municipal area. Major percentage of waste composed of bio degradable and the rest is non-bio degradable. Plastic waste consist of 15- 30% percentage.

Table 9-10 Composition of waste

Bio-degradable Waste	70% -75%
Non-Biodegradable Waste	25% - 70%
(a) Plastic waste	15 % - 30 %
(b) Cloths, Coir	4 % - 6 %
(c) Rubber, Leather	1 % - 2 %
(d) Metals	0.5 % - 1 %
(e) Construction Waste	3 % - 5 %
(f) Paper etc.	2.5 % - 3.5 %

Source: DPR of Solid waste management

Out of the total waste generated, around 27% of the commercial wastes are managed by private agency. One of the appreciable thing which has been practicing in Municipality is that, around 25% of waste generated is handover to recycling and reusing and 23% waste is composting onsite by community aerobic units. (Alappuzha Municipality).

As per socioeconomic survey, about 96% of the sample of HH has been disposing biodegradable waste in their own land and the rest are disposing by garbage bin and collection agencies. The details showing biodegradable waste disposal is shown in Figure 9-12. In case of non-biodegradable waste 73% of Sample HH has been disposing waste in their own compound, and the rest 13% each by collection agency and garbage bin (Figure 9-13).

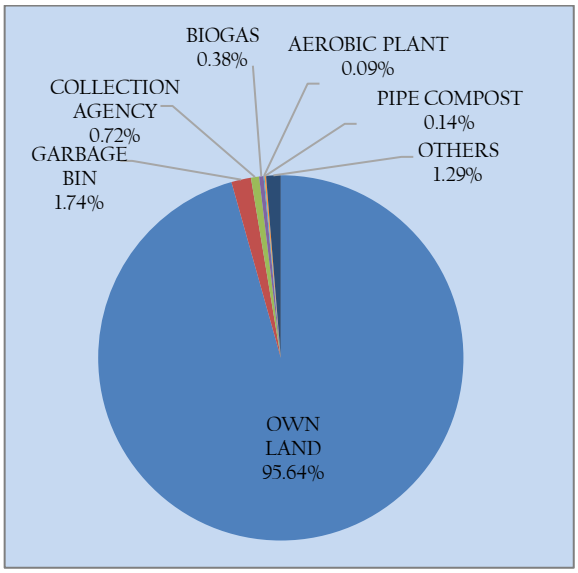


Figure 9-12 Biodegradable waste disposal

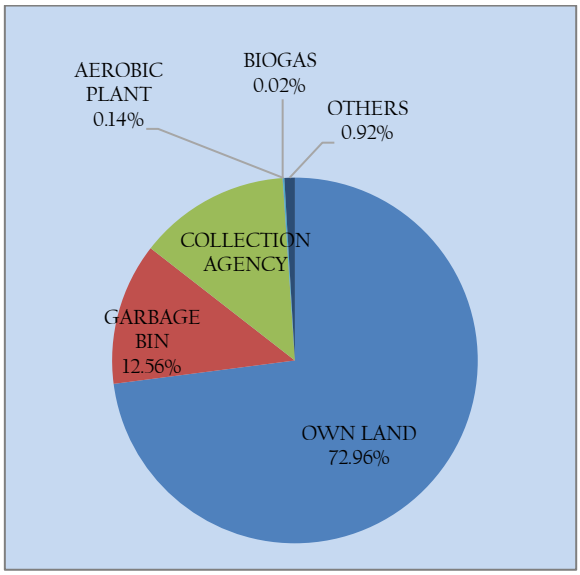


Figure 9-13 Non-Biodegradable waste disposal

Source: Socio Economic Survey, 2019

As per socio economic survey, majority of the sample HH has been disposing bio degradable waste in their own compound. Ward 52,46,42,40,36 etc. have cent percentage disposal in their own compound. HHs in ward 34, 15 and 24 are using garbage bin more, compared to other wards to dispose biodegradable waste. More ward wise details of disposal of biodegradable waste is shown in Figure 9-14.

In case of non-biodegradable waste disposal majority of HH samples has been disposing their non-biodegradable waste in their own land. While comparing the other wards only ward 6 promotes distribution of aerobic units. Whereas wards 13, 23 and 33 encourage pipe composting method of disposal. Almost half of the wards are using garbage bins and some prefer collection agencies for disposal. Ward 8 and 26 are majorly depending on collection agencies. The thorough details of ward wise disposal of non-bio degradable waste are mentioned in Figure 9-15.

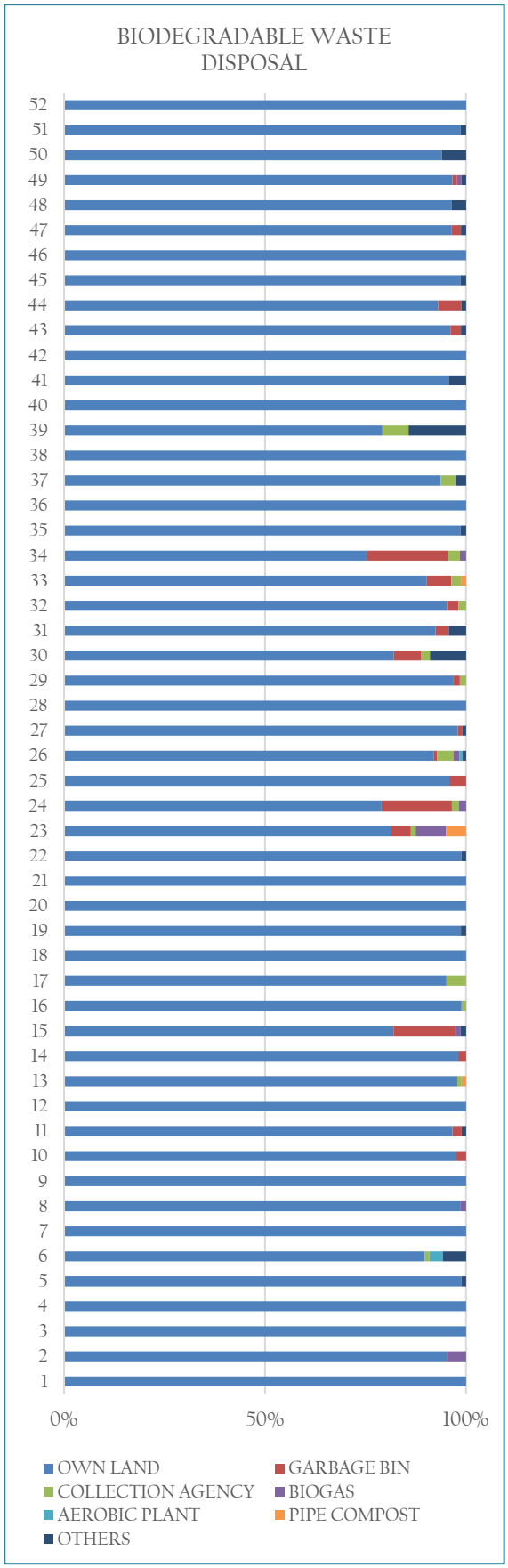


Figure 9-14: Ward wise Biodegradable waste disposal

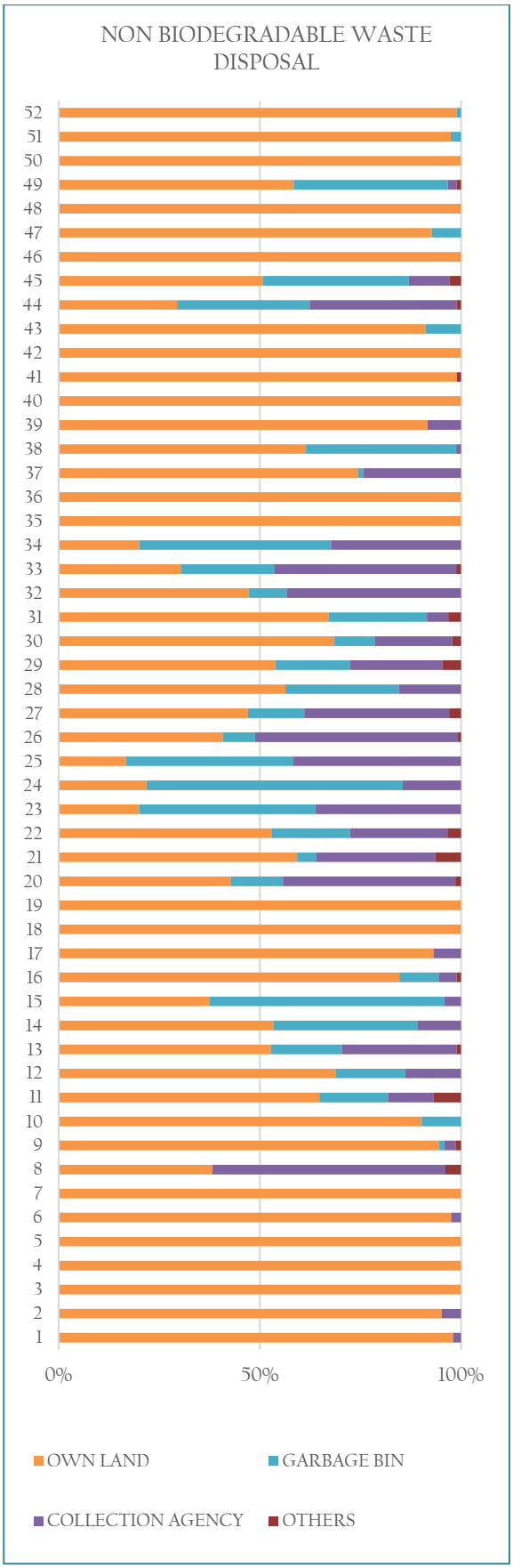


Figure 9-15: Ward wise Non-Biodegradable waste disposal

Source: Socio Economic Survey, 2019

Domestic biogas and pipe compost biogas were mainly set in 12 wards of the Alappuzha Municipality, where waste management posed a very huge crisis before the authorities. In these wards, the Municipality set about 2850 biogas plant and 1800 pipe composts. For follow ups and servicing the kudumbasree units were given the responsibility. The members of the units were given training to help the people in handling the biogas and pipe compost units.

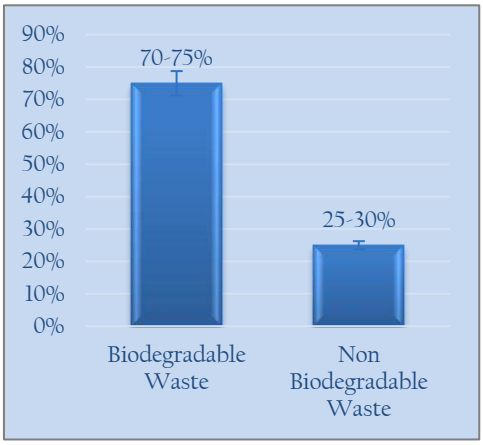


Figure 9-16 Segregation of MSW

Segregation of wet waste at house hold level, has been done at source level itself by using decentralized waste management system like bio-gas, bio-bin, pipe compost etc. Segregated waste is being deposited directly by public themselves in aerobic composing unit. Figure 9-16 shows the segregation of bio and non-biodegradable waste in municipal area. Around 70 % of biodegradable waste and 25% of non-biodegradable wastes are segregating before disposal.

Community level collection & transportation of street waste to municipal collection center has been done by sanitation workers who were entrusted by the municipal authorities. Segregation of dry waste has been done by MCF (Material Collection Facility) center. Segregation of the non-bio-degradable waste brought by the public to MCF units other than plastic is handed over to scrap dealers or private agencies. Plastic is later on shredded and utilized to mix with tar for road tarring.



Figure 9-17: Biodegradable waste management centre



Figure 9-18: Aerobic compost unit

In case of secondary Collection wastes, Aerobic composting units are used, (Thumburmuzhi model). The model consists of a tank of 4x4x4 feet size made of ferro-cement or bricks. It is designed in such a way that it enters into the tank through the gaps on the sides. It should be kept under a roof to avoid rainwater falling into the tank. About two tons of waste

can be processed into compost in 90 days in the tank. A layer of fresh cow dung or slurry from the biogas plant is put at the bottom of the tank to generate microbes for decomposing. Above this, a 6-inch layer of dry leaves or dry grass or small pieces of paper is placed. Over this layers of bio-waste and cow dung are placed. Instead of cow dung, an inoculums developed from cow dung by the Kerala Agriculture University is also used. Dry leaves and dry grass absorb water oozing from garbage. The temperature inside the tank goes up to 75ºC. This prevents mosquitoes and flies and other small creatures from entering.

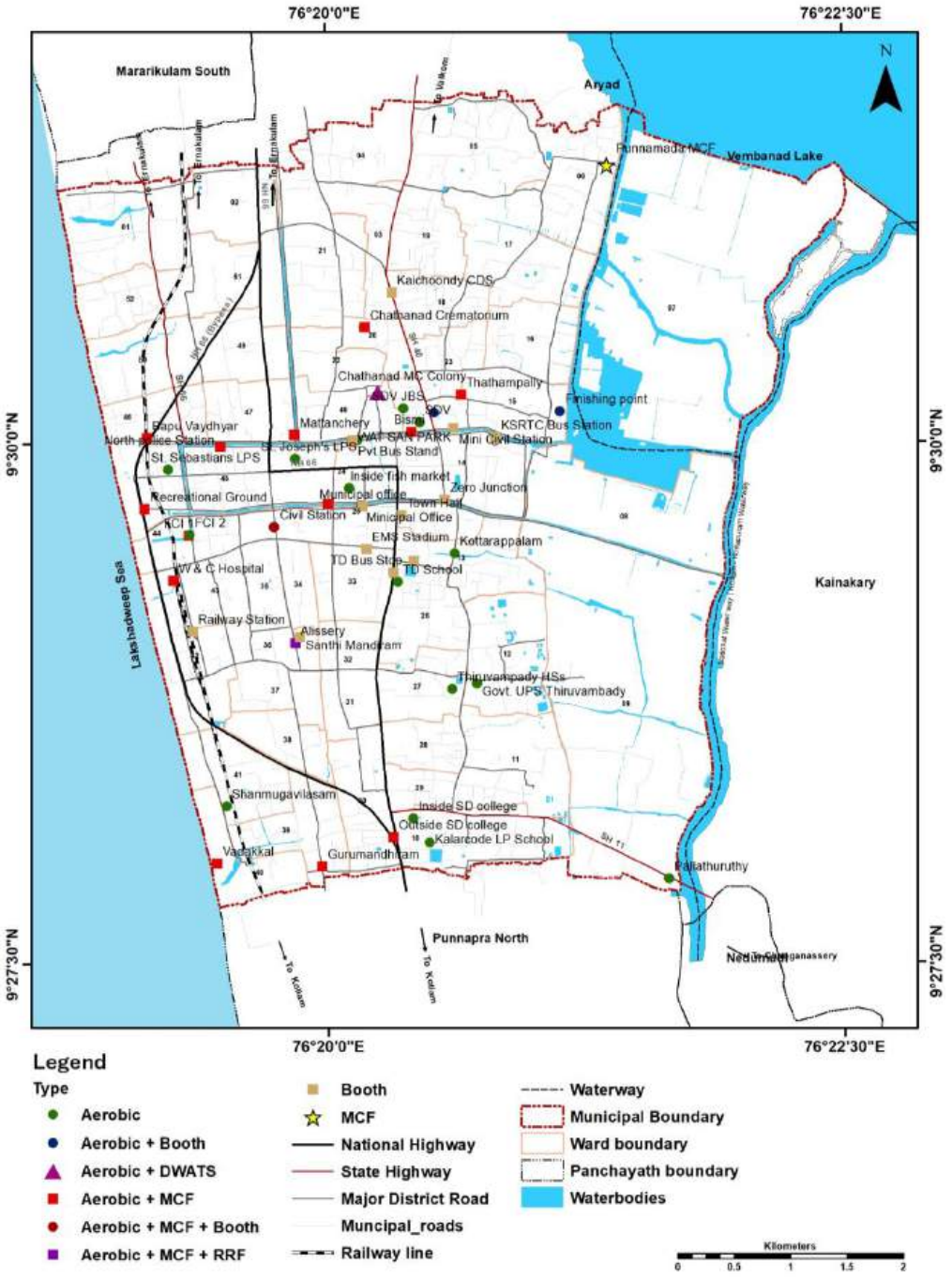


Figure 9-19 : Existing waste management units in Alappuzha Municipality

Figure 9-19 shows the locations of existing waste management units in Alappuzha Municipality. At present municipal area consists of 23aerobic units in different wards. And there are 235 aerobic bins and 2850 biogas plants working in municipal area for composting of bio degradable waste. There are 10 material recovery facility units operating in different locations which can manage non-bio degradable waste generated in Municipality. Table 9-11 shows the existing MSW processing system in municipal area.

Table 9-11:Details of existing MSW processing system

No. of Aerobic units	23
No. of Aerobic bins	235
No. of Biogas plants	2850
No. of pipe compost units	1800
No. of MRF units	10

Source: CSP (City Sanitation Plan)

Another major problem that was observed was the insufficiency of litter bins. The bins have to be provided in sufficient numbers and at regular distances. A very major lacunae noticed was that segregation of wastes as biodegradable, non-biodegradable and hazardous waste is not attempted at source. Community based collection facility is either open/ metallic/concrete bins on open points. The unequal distribution of facilities (average spacing 2 km as against 1 km recommended for community collection) and inadequacy have resulted into open throwing, overflowing of bins. The open bins provide easy access to cattle and rag pickers. 60% of the waste goes uncollected.

9.4.2 Existing treatment facilities

A new method of decentralized waste treatment through aerobic composting is tried out in the municipal area which has successfully tackled the solid waste disposal to great extent. The dedicated efforts of the municipal authorities and employees is gaining state wide attention. The programme was conceived following a protest by residents of Sarvodayapuram in the monsoon of 2012. They objected to more waste coming to the dumping yard located near the town. The yard at the time got 40-50 tons of unsorted waste daily.

When the Municipal Authorities, mooted the idea of installing the Thumboormozhi model aerobic bins at various locations in the Alappuzha town early last year as part of the launch of a clean-up drive, there was stiff opposition from the local people. Their reaction was informed by the experiences of those living near garbage dumps in various parts of the State.

To convince them, the Municipality cleared one of the biggest garbage dumps in the town and set up a batch of bins inside tents. The processed compost from the bins was made use of in a garden set up there. Other waste treatment methods such as biogas plants were also installed. Soon, artists who organized the Kochi Biennale came and painted the walls. The area, named Water and Sanitation (WATSAN) Park, was thus turned into a model for all to see.

Twenty-two months later, the Municipality with a population of 1.74 lakh no longer has 40-50 truckloads of garbage headed daily to a nearby dumping yard, saving Rs. 10,000/- to Rs. 15,000/- a day on fuel bill alone. The roadside Aerobic Composting Bin Cluster situated near Y M C A, Alappuzha is a new experience in the field of waste disposal. This unique Municipal Solid Waste management campaign is gathering the attention of the whole state and elected representatives and officials from different ULBs and delegations from different parts of the nation started visiting Alappuzha.



Figure 9-20: A programme conducting at WAT SAN Park



Figure 9-21: WAT SAN Park at YMCA

9.4.3 Gaps in current waste management systems

The following are the current gaps in waste management system in Municipal area.

- *Community level wet waste management systems*

At present Alappuzha Municipality has 23 aerobic units with 235 aerobic bins to process 15-16 tonnes of degradable waste produced each day. It needs approximately 90 days to convert fertilizer, thus 720 bins are needed to convert wastes. But only 235 aerobic bins are currently functioning. Municipality need to construct 500 more such aerobic bins for effective waste management. This could be constructed in different wards within a distance of 500 meter (half kilometre).

- *Decentralized wet household waste management system*

Presently some of the household waste produced in the town is being dumped irresponsibly and unscientifically. Our ultimate aim is to involve all the houses in the

Municipality to get access to this new waste management method. Used bio-waste is converted into bio-fertilizers. Through this way, waste is processed at source and converted into usable products.

- *Commercial wet waste management system*

At present 27% of the commercial waste has been managed by private agencies. Since there is a chance of withdrawal of this private service at any time creating a high risk in waste management. In this juncture the Municipality is planning to introduce effective commercial waste management methods like bio-tumbler, bio-gas crematorium, community bio-gas etc.

- *Gap - Dry waste management system*

Water flow in canals has been hampered owing to the depositing of plastic waste, which includes plastic carry bags. In Alappuzha Municipality 25-70 % of non-degradable waste is being produced out of which 15-30% consist of plastic waste. At present 10 MCF (Material Collection Facility Centre) is installed in Alappuzha Municipality, which is not sufficient for the disposal.

Other gaps include;

- Unavailability of cloth carry bags
- Lack of general awareness among the public on their responsibilities towards SWM
- Unavailability of reusable utensils
- Gap in surveillance system lack of human resource in waste management
- Lack of waste management in schools
- Lack of monitoring in door to door dry waste collection
- Lack of proper monitoring in waste carrying vehicles

9.4.4 Inferences

The total solid waste generated is not treated properly, especially plastic wastes. The waste collection system is not efficient and segregation at source is not being attempted. The new model of waste treatment through aerobic composting implemented in the town is making Alappuzha a clean town. Promotion of this model to the remaining areas of the town can make the town a really clean town.

9.5 Energy

Energy is the resource input by which the human civilization grows. Energy can be in various forms, of which electrical energy is the most adopted form of energy. Electricity has become a fundamental necessity for the development of any society and level of consumption of electricity is often considered an indicator of development.

9.5.1 Existing Status

Hydroelectric projects were used for the major generation of electricity. Petroleum products such as petrol diesel and biomass etc. also were used but these non-conventional energies did not come to the main grid.

The most consuming energy is electrical energy. The Kerala State Electricity Board (KSEB) is responsible for power distribution in the Municipality. The area of destitution has been divided into KSEB North and KSEB South sections. Table 9-12 shows the category wise number of connections. The trend in power consumption is shown in Table 9-13.

Table 9-12: Year wise and category wise number of connections

Year	Domestic	Industrial	Commercial	Agriculture	Others	Total
2015 - 2016	44013	10880	523	122	84	55622
2016 - 2017	44437	11278	524	123	85	56447
2017 -2018	44849	11861	525	123	436	57794
2018 -2019	45097	12241	517	126	726	58707

Table 9-13: Year wise and category wise power consumption (MU)

Year	Domestic	Industrial	Commercial	Agriculture	Others	Total
2015 - 2016	61.46	22.41	2.51	0.03	5.64	92.05
2016 - 2017	64.45	23.55	2.62	0.04	5.85	96.51
2017 -2018	64.6	25.21	2.55	0.21	4.43	97
2018 -2019	65.93	26.27	2.38	0.07	3.78	98.43

Source: KSEB

There are no areas of frequent power cuts or low voltage. The distribution of power is only by overhead lines and underground lines are not used causing various inconveniences in the town center.

9.5.2 Non – Conventional Energy Sources

Biomass fuel being sourced from their homestead garden lands; the consumption details is not available. The non-conventional sources of energy are not being used except for a few roofs top solar water heaters. Studies are on for making use of wind energy and wave energy.

9.5.3 Problems and Potentials

Alappuzha town does not have major energy problems. But it has to depend on other districts for the energy requirement especially in the case of electrical energy. Alappuzha district does not contribute much to the generation of electrical energy. The source of power generation within the district is NTPC thermal plant and it produces 2158 MU annually and supplied to the state grid for distribution.

No other nonconventional energy sources except solar energy are being utilized. Even in the case of solar energy, the use is limited to a few roof top solar water heaters. There is a tremendous potential for the development of harnessing solar energy. The distribution of petroleum products is at a satisfactory level.

9.5.4 Inferences

The distribution of electrical energy is sufficient. There is an immediate need for tapping solar energy and promoting bio-gas in order to reduce spiraling consumption of fossil fuels.

10 SOCIAL INFRASTRUCTURE

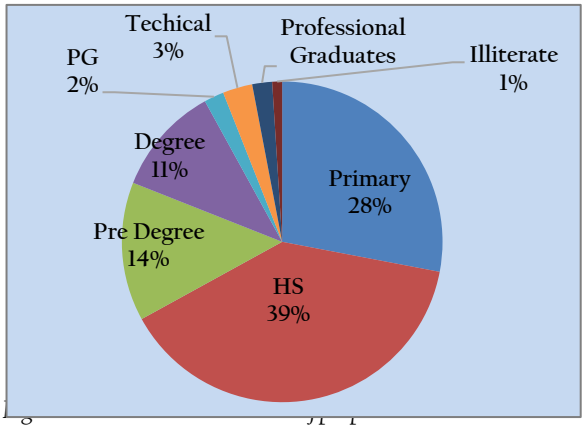
10.1 Education

The Alappuzha district as a whole is considered to be educationally forward. With new found riches and exposure to urban cultures from the Middle East, the people of the district has become very eager in providing quality education to their offspring lately. Among the students in self-financing colleges both within the state and outside, the share of the district is considerable. The case is not different in Alappuzha town also.

10.1.1 Existing Facilities

The literacy rate of Alappuzha Municipality is 93.87% as per census 2001 which is greater than the literacy rate of Alappuzha district. The literacy rate of Cherthala, Chengannur and Mavelikkara municipalities are higher than that of Alappuzha Municipality. In Alappuzha Municipality the male literacy rate is 96.6% and female literacy rate is 91.35%.

As per socio economic survey, 39% of the people are having high school level education. 2% of people are post graduates, 2% have professional education and 3% are technical hands. Figure 10-1 shows the percentage of educational status of people in the Municipality.



There are 61 schools in Alappuzha Municipality, in which 32 are primary, 16 are high schools, 12 are higher secondary schools and 1 is vocational higher secondary school. The number and type of schools is given in Table 10-1.

Table 10-1: Number of Schools in Alappuzha Town

Sl. No	Type	Number
1	Primary	32
2	High School	16
3	Higher secondary	12
4	Vocational higher secondary	1

Source: Secondary Data

The total number of students studying in 61 schools is 33014 and the number of teachers is 1113. The total population to be served within the age group of 0-15 is 43612. Total number of students in schools up to 10th standard is 27532. This means nearly 63.13% of the students

depend on schools within the Municipality. Considering the nature of schools, majority of schools are aided. Table 10-2 shows the total number of schools under each category. There are total 19 schools under government ownership, 34 aided and 8 unaided schools.

Table 10-2: Number of schools in various categories

Sl. No	Type	Govt	Aided	Unaided	Total
1	Primary	12	15	5	32
2	High school		9	3	16
3	Higher secondary	2	10		12
4	Vocational higher secondary	1			1

Source: Secondary Data

Table 10-3 shows the total number of students in each category. At higher secondary level, high school level and primary level most of the students are studying in aided schools. This may be an indication of the academic quality of government aided schools.

Table 10-3: Number of students in various categories

Sl. No	Type	Govt	Aided	Unaided	Total
1	Primary	2560	10553	4642	17755
2	High school		7275	1730	9777
3	Higher secondary	719	4114	540	5373
4	Vocational higher secondary	109			109

Table 10-4: Number of Teachers in various categories

Sl. No	Type	Govt	Aided	Unaided	Total
1	Primary	90	245	170	505
2	High school		262	58	360
3	Higher secondary	38	158	44	240
4	Vocational higher secondary	8			8

Table 10-4 show the total number of teachers in each category of schools. Analyzing the teacher - student ratio, 20 out of 32 primary schools have a ratio below 1:40. In the same manner 15 out of 16 high schools have a ratio below 1:40. St. Mary's Residential Central School has a ratio of 1:51 which is far above the standard value. All higher secondary institutions have a teacher student ratio below 1:30. The teacher student ratio in the Vocational Higher Secondary institution also falls within the standard limit.

The educational facilities are adequate for higher education institutions. There are 16 HS, 12 HSS and 1 VHSS in Alappuzha Municipality. All of them have separate toilets for girls,

water availability and connectivity. As per secondary data only VHSS have computer lab and internet facility.

Even though there are sufficient number of schools in the town there is concentration in certain part of the town. The selection of school is based on the standard and the syllabus followed in the schools. This may the reason for increase in travelling distance.

10.1.2 Higher and Professional Education

There are two Arts & Science colleges, one B.Ed centre and an ITC in Alappuzha Municipality. For higher studies there are two major institutions in the town. One of them is the SD College which is under the management of Sanathana Dharma Vidyasala Trust and the other is the St. Joseph's College for Women, an affiliated college established exclusively for women. Both these colleges are affiliated to Kerala University. These colleges have PG courses. It has nearly 2785 seats for B. A, B.Sc & B.Com and nearly 226 seats for PG courses.

Students who are unable to get admission in the colleges mentioned above depend on various parallel colleges available within the town and in the outgrowth areas. The Post graduate courses are limited to a few courses. In SD college post graduate courses offered are for literature, economics, malayalam, physics, chemistry, zoology, botany, etc. and in St. Joseph's for physics and english literature.

The Aryad Teachers Education Center is another feather in the cap of this town. This Institution was brought under the Kerala University in 1990 –1991. Training is given to students in teaching subjects like malayalam, english, science subjects, hindi, arabic, mathematics, natural science, commerce and social studies. Merit and the selection criteria stipulated by the government, form the basis for admission of students to this course.

There are only a few centers within the town that cater to the need for technical education. Compared to the increasing demands of the times in specialized education the numbers are very limited and insufficient. One of the leading centers in Alappuzha is the Carmel Polytechnic which is outside the municipal area. The Alappuzha Thirumala Dewaswam Medical College and an Engineering college are professional colleges associated with the City. These are outside the town area.

10.1.3 Other Educational Institutions

Apart from the above mentioned colleges there are educational institutions which are offering specialized courses. They include institutes which offer computer courses, technical training, driving schools, spoken English centers and parallel colleges. Spatial distribution of major educational institutions in the Municipality are shown in the Figure 10-2.

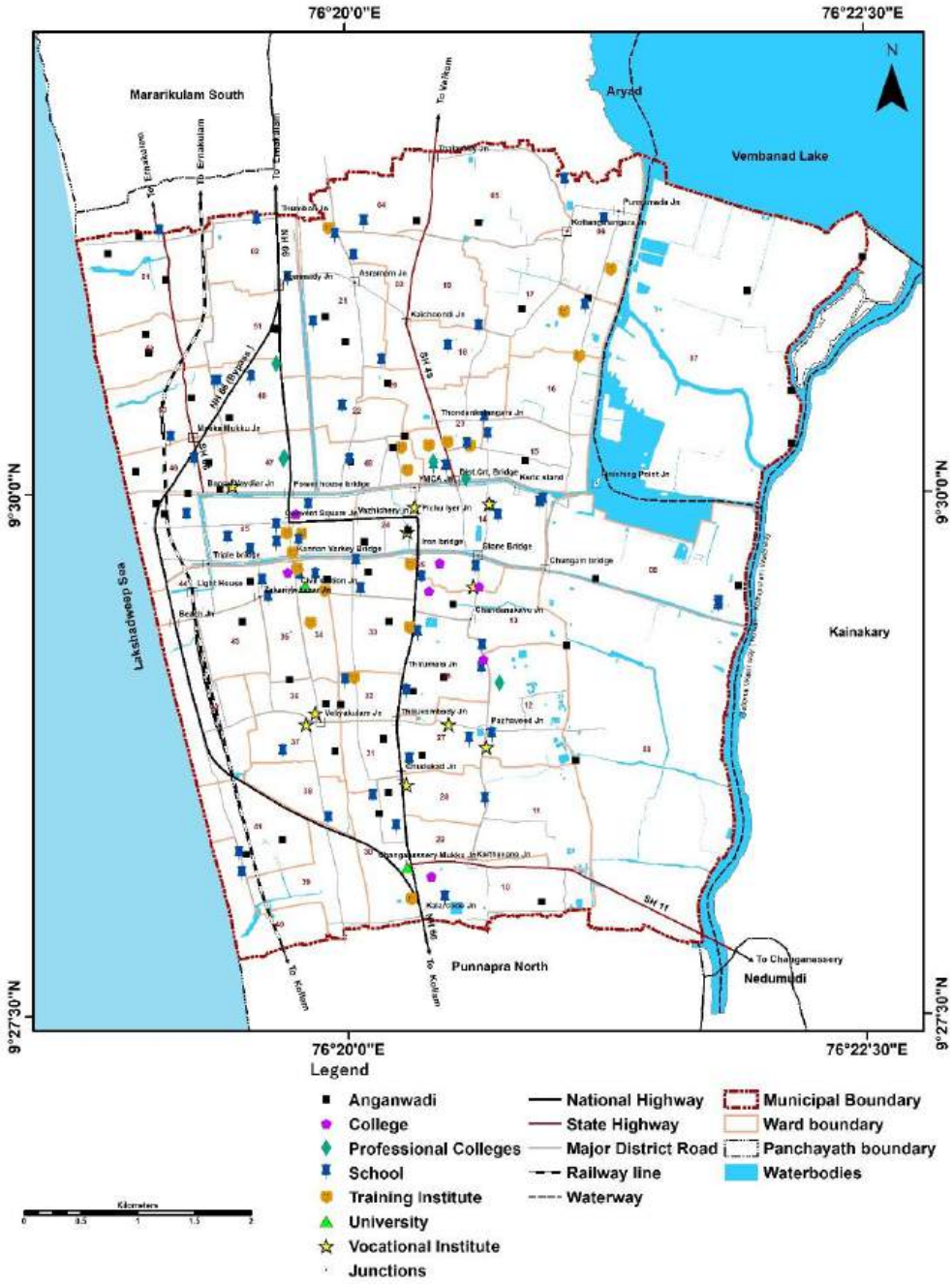


Figure 10-2: Major educational institutions in the town

Source: Generated from database

10.1.4 Comparison with Planning Standards

As per standards, the existing facilities are sufficient to cater the present needs.

10.1.5 Problems and Potentials

The conventional educational facilities in the town, especially at the school level are commensurate with the population of the town. There is no professional college or polytechnic in the town. One Medical College, 1 Engineering College and a Polytechnic function in the neighboring Panchayat.

Most of the colleges are offering only the conventional course which is one of the reasons for the increasing demand for colleges outside the district. Basic educational facilities available in the Municipality are sufficient in quantitative terms. But in Qualitative terms the facilities have to be improved more.

10.1.6 Inferences

The literacy rate of Alappuzha town is high as compared to the district. The teacher-student ratio is satisfactory except one high school and 12 primary schools. Most of the colleges are offering only conventional courses, and there are no professional colleges or higher centers of learning in the Municipality. However, the Govt TD Medical College Alappuzha, Sagara Hospital (a unit of the Cooperative Medical College) and the Cooperative Engineering College are functioning in the immediate vicinity of the town catering the needs of the town.

10.2 Health

In many respects, Kerala's health status is almost on a par with that of developed economies. The state has succeeded in increasing life expectancy as well as reducing infant and maternal mortalities. In 2011, Kerala attained the highest Human Development Index of all Indian states based on its performance in key measures such as lower infant mortality rate, lower maternal mortality ratio, higher literacy rate etc.

During pandemic of Covid-19 & Nipah, how Kerala cope with these epidemics is widely lauded. BBC channel interviewed K.K. Shailaja, former health minister of Kerala on the basis of this merit. International medias such as Guardian and others appreciated the Kerala model of covid resistance which seemed more effective than the methods followed in other places. In general, Kerala attained remarkable progress in health sector which is comparable to that of developed countries However, at micro level certain problems like quality of services, reach and affordability do exist. Alappuzha Municipality also follows the general pattern of development of health care institutions elsewhere in the state.

10.2.1 Existing Scenario

There are 11 government hospitals and 4 private hospitals in Alappuzha Municipality. Government hospitals include Woman and Children near beach, General Hospital, District TB centre near medical college junction, MCH PP unit, District Ayurveda Hospital near Vellakinar, Panchakarma near Kalarcode, Govt Homeo Hospital at Kaichoondy junction etc.

There are 9 Allopathic health institutions, 6 Ayurvedic institutions and 1 Homeopathic institution in the Municipality. Among the Allopathic medical institutions, there is only one hospital under private ownership. Considering the facilities available in hospitals, there is no referral hospital or hospitals having advanced diagnostic facility like CT scan and ECG in Govt sector. The only hospital having facility like CT scan and ECG is in private sector. And there are no super specialty hospitals in Alappuzha Municipality and any such cases have to be rushed to the nearest city Kochi which is approximately 60 kms away. Category wise hospitals, doctors and bed in Allopathic system of medicine is shown in Figure 10-3.

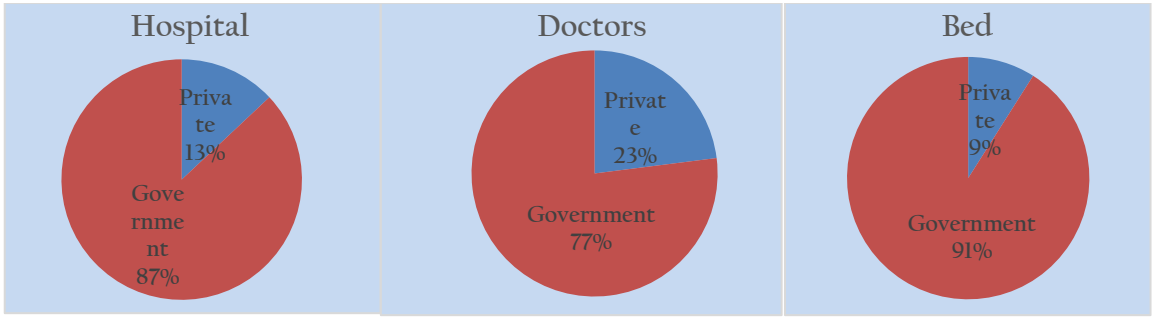


Figure 10-3: Details of hospital, doctors & bed in allopathic hospitals

There are 6 institutions practicing Ayurvedic system of medicine. District Ayurveda hospital at Vellakkinar, Panchakarma at Kalarcode and ANO- Rectal clinic near Vellakkinar is under government ownership. AVP Ayurveda Pharmacy at Pazhaveedu, Govinda Vilasom Arya vaidya Pharmacy at Mullackal and AVP Ayurveda Pharmacy Near Alukkas jewellers are under private ownership. Category wise hospital and doctors in Ayurvedic system of medicine is shown in Figure 10-4.

In Homeopathic system of medicine there is only one institution. That is Govt Homeo hospital at Kaichoondy junction. The details of hospitals, its location and category, number of beds and doctors, ownership are given in Table 10-5. Location of major health institutions in the town are shown in Figure 10-5.

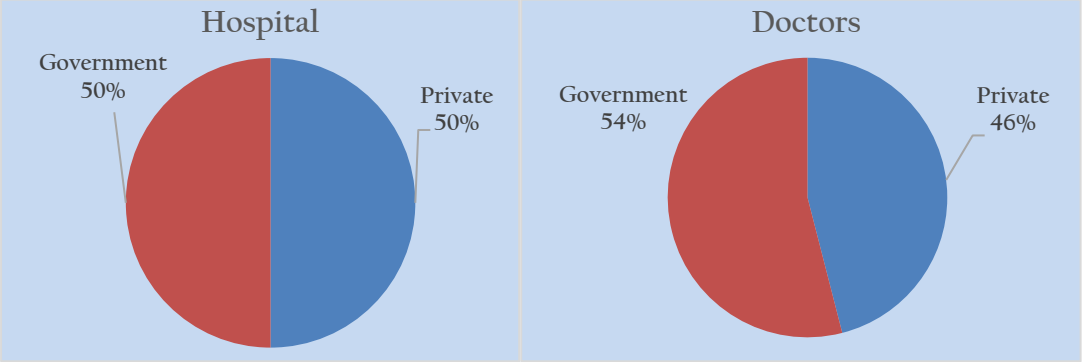


Figure 10-4: Details of hospitals & doctors in ayurvedic hospitals

Table 10-5: Healthcare institutions in the Town

Sl. No	Name of Hospital	Location	Beds	Doctors	Type
	Allopathic System of Medicine				
1	W&C ALAPPUZHA	Near Beach	308	18	Govt
2	General. Hospital Alappuzha	Medical College Jn.	400	26	Govt
3	Dist. T.B. Center	Near Medical College Jn.	24	2	Govt
4	MCH PP Unit, Alappuzha	Near Medical College Jn.	-	2	Govt
5	Sahrudaya Hospital	Thathampally	80	20	Pvt.
6	ESI Dispensary	Factory Ward	-	5	Govt
7	ESI Hospital	Near Railway station	55	12	Govt
8	ESI Dispensary		-	2	Govt
	Ayurvedic System of Medicine				
1	Dist.Ayurveda Hospital	Near Vellakinnar	50	4	Govt
2	Panchakarma	Kalarcode	20	1	Govt
3	ANO-Rectal Clinic	Near Vellakinnar	-	2	Govt
4	AVP Ayurveda Pharmacy	Pazhaveedu	-	2	Private
5	AVP Ayurveda Pharmacy	Near Alukkas jewellers	-	2	Private
6	Govinda Vilasom Arya vaidya Pharmacy	Mullackal	-	2	Private
	Homeopathic System of Medicine				
1	Govt. Homoeo Hospital	Kaichoondy Jn.	24	3	Govt

Only common symptoms and not severe cases are reported during 2016-2017 years in psychiatric and also shows an increase in the number of cardio vascular diseases and liver cancer. On contrary only 3% of the doctor population is specialized in psychiatric wing. When taking the case of communicable diseases more number is reported under fever. The most shocking count is Japanese encephalitis which on the higher side when taking the whole state. There is almost an increase of 10000 cases of communicable disease reported in one year. Children's are mostly treated for diarrhea, dehydration and respiratory diseases. Malaria cases have also reported.

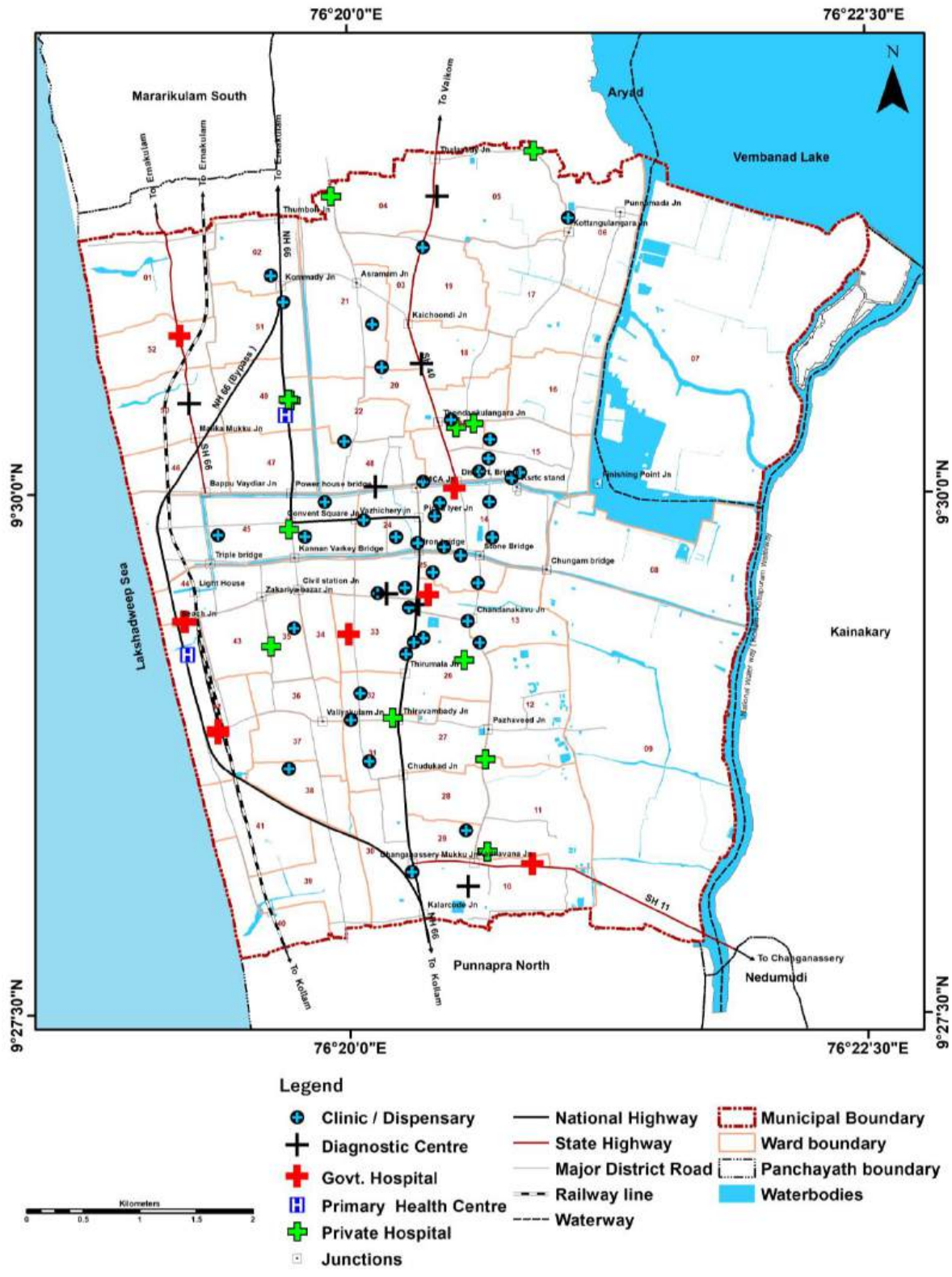


Figure 10-5: Major health institutions in the Town

Source: Generated from database

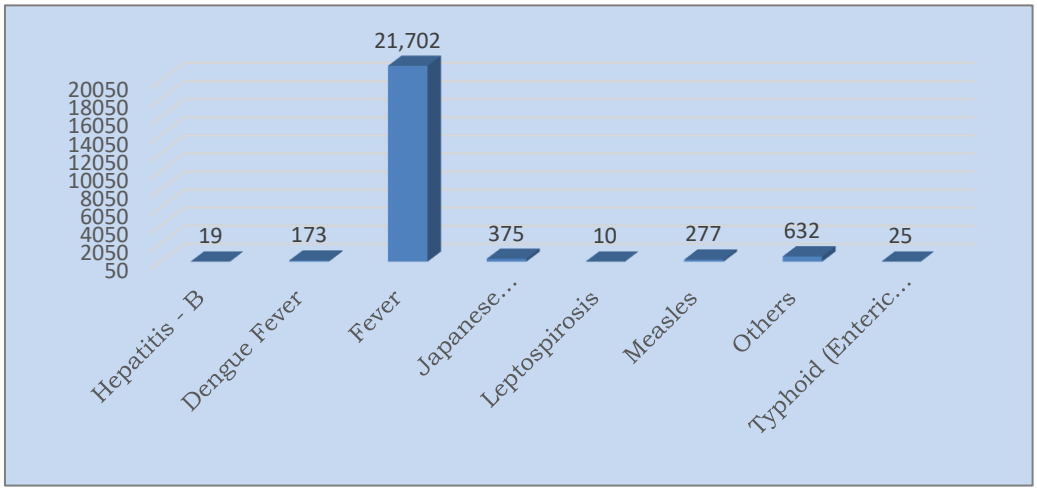


Figure 10-6: Communicable disease count of 2016-17 reported in Allopathic hospitals (BSLLD Web Portal , 2016-2017)

10.2.2 Comparison with planning standards

As per standards one PHC is required for a population of 20000 with 24 beds. The General Hospital caters to this need also. As per standards one nursing home, child welfare and maternity center is required for a population of 45000 to 1 lakh. Alappuzha Municipality has a population of 177029 as per 2001 census. There is one such hospital available in the town, one more hospital is required according to cater the population as per the standards.

There are 8 Allopathic hospitals in Alappuzha Municipality. These hospitals altogether have beds sufficient to serve the people in Alappuzha Municipality.

10.2.3 Problems and Potentials

Major problem in the health sector is the insufficiency of facilities in the hospital. There are no super specialty hospitals in Municipality. The only hospital having facility like CT scan and ECG is in private sector. Though the number of general hospitals and intermediate hospitals is adequate to meet the needs of the present population, the lacunae lie in the absence of nursing homes and small clinics and dispensaries.

10.2.4 Inferences

There is no super specialty hospital in Alappuzha town. Hence the people have to depend on hospitals outside the town. Major problem in the health sector is the inadequacy of facilities in the hospitals. The infra structure facilities are to be upgraded in the hospitals for Ayurvedic and Homeopathic systems. With the increasing number of lifestyle diseases like cancer, diabetes as well as heart ailments and extremely painful situations that these diseases bring about, a Pain and Palliative center is of utmost priority in the town.

10.3 Recreational Facilities

Recreation is an essential part of human life and it is found in many different forms i.e. either it is natural or it is manmade. Places of recreation, specialized institutes, and clubs will provide new avenues for the residents to spend their leisure time for productive purposes enhancing their capabilities as well as for specific occasions. Figure 10-8 shows the spatial distribution of various recreational facilities within the Municipality.

10.3.1 Parks & Playgrounds

Vijay Park and Raja Kesavadas Park are the two parks situated in Alappuzha Municipality.

Table 10-6: Comparison with planning standards

Category	Population Served per Unit	Existing	Required
Housing Area Park	5000	2	34
Neighbourhood Park	15000	0	11
Community Park	1 Lakh	0	1

Source: URDPFI Guidelines

There are 5 ongoing and committed projects for developing parks and green spaces within the Municipality under AMRUT. The projects are:

1) Development of Children's park in Chathanadu
2) Development of Green Space and park in Valiyachudukadu.
3) Development of Recreation facilities & park in General Hospital
4) Renovation and Development of park in Town Square.
5) Development of park in Rly station ward at Alappuzha beach

10.3.2 Play Grounds / Stadium

There are 3 playgrounds/ open grounds in Alappuzha Municipality.

1. Recreational ground at civil station ward which is having an extend of 2.21 hectare
2. Municipal Maidanam at Zilla Court ward with an area of 0.26 hectare and
3. SDV School ground with an area of 0.37 hectare

Municipal stadium with an area of 0.855Ha is used for conducting various sports and games.



Figure 10-7: Municipal Stadium

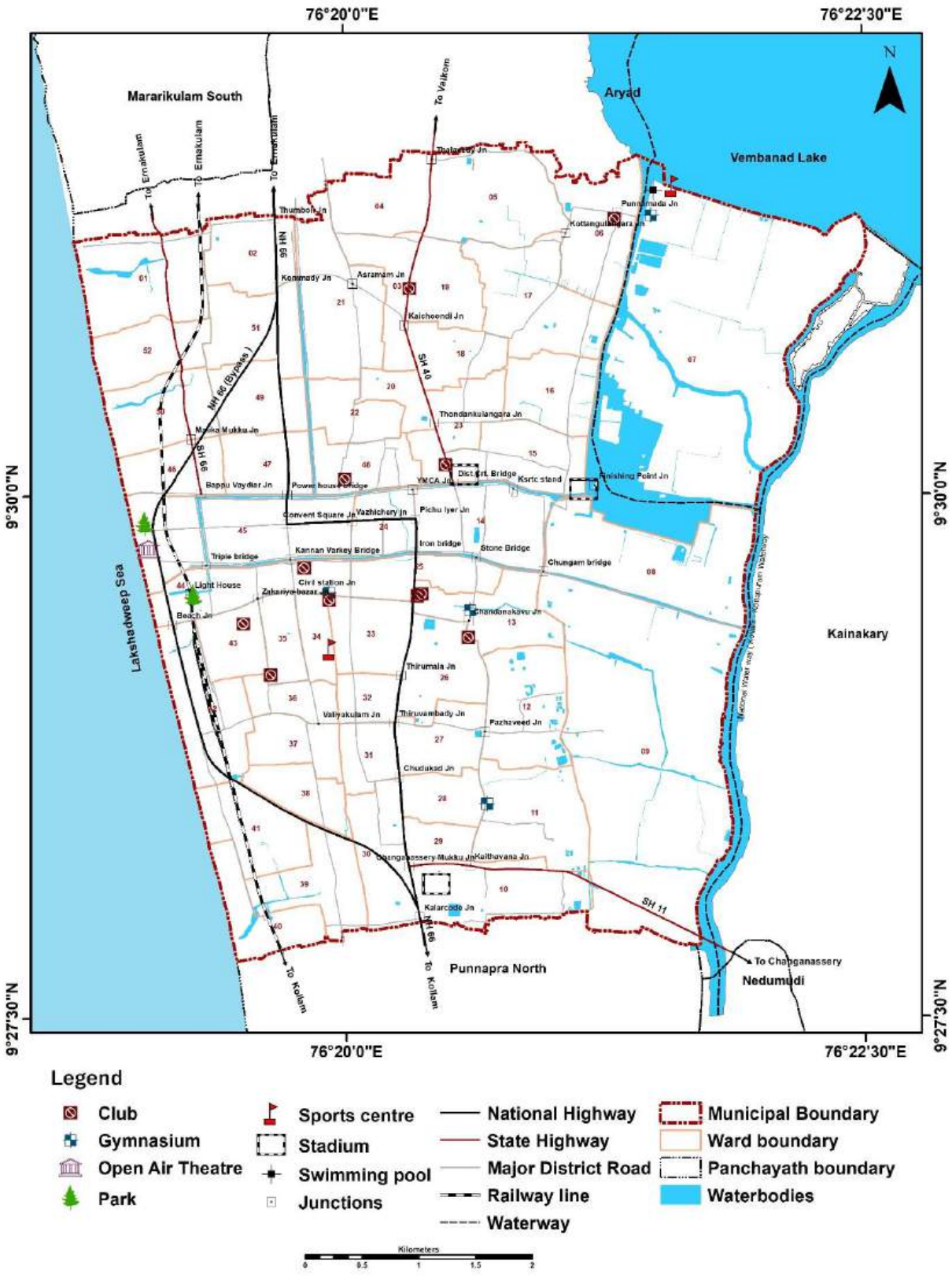


Figure 10-8: Map showing major recreational facilities within the town

Source: Generated from database

10.3.3 Theaters & Auditoriums

There is one open air theatre at beach and one Art Gallery at Vazhicherry ward. There are 7 Cinema Halls in Alappuzha Municipality with a total capacity of 4651 seats. Details of Cinema Halls in the town are listed in Table 10-7.



Figure 10-9: Art Gallery

There are 20 Auditoriums in Alappuzha town. Among them 6 are having an average capacity of 500 or more. They are Aishwarya, Sree Rama Mandir, St. George, Anjali, Raiban and Nandavanam.

Table 10-7: Details of Cinema Halls

Sl No	Name	Location/ward	Capacity
1	Pankaj Theatre	Power House ward	852
2	Vidya Theatre	Karukayil ward	500
3	Seematti Theatre	Mullackal ward	600
4	Veeriah Theatre	Mullackal ward	700
5	Sas Shanthi Theatre	Mullackal ward	751
6	Raiban Cini House	Municipal Stadium ward	648
7	Seethas Theatre	Palace ward	600

Source: Secondary Data, 2019

10.3.4 Problems & Potentials

The extent of open space within the town is very low. But the water bodies available can solve this deficiency by opening up small parks and rest places along the canals and by promoting leisure facilities. Residential level park is not available. With the fragmentation of residential properties, people have lesser open land attached to their houses and hence need for public open space for recreation is on the rise. As per URDPFI guidelines 18% area is needed for recreational purpose. Only 1.5% is available in the town. But vast extend of water bodies like canals, beach and lake can compensate the deficiency.

10.3.5 Inferences

The recreational facilities in the town are not adequate to cater to the present population. Besides, spatial distribution of recreational facilities is not uniform. Residents from many of the wards do not have recreational facilities in a walking distance. Recreational facilities can be provided along the sides of the canal.

10.4 Other Civic Amenities

The other civic amenities in the Municipality include Town Halls/Community halls, Reading Rooms and Library, Crematorium or Burial Grounds, Police Station etc. Figure 10-12 shows the spatial distribution of various Civic Amenities within the Municipality.

10.4.1 Town Hall

There are 20 community halls in Alappuzha town. These are used for various public gatherings. The details of halls, their locations and capacity are given in Table 10-8.

Table 10-8: Details of Town Halls / Auditoriums

Sl No	Name	Location/ward	Capacity
1	Municipal Town Hall	Palace ward	450 persons
2	Aiswarya Auditorium	Mullakkal ward	500 persons
3	Sakthi Auditorium	Powerhouse ward	400 persons
4	Meluvally Auditorium	Powerhouse ward	400 persons
5	SreeRama Mandir Auditorium	Mullakkal ward	650 persons
6	Kalyani Auditorium	Alissery ward	450 persons
7	St.George Auditorium	Vazhicherry ward	500 persons
8	Anjali Auditorium	Kalarkodu ward	850 persons
9	Uduppi Auditorium	Zillacourt ward	300 persons
10	Mutharamman Kovil	Zillacourt ward	200 persons
11	Carmel Hall	Mullakkal ward	400 persons
12	Vanaja Bhima Pattar Hall	Mullakkal ward	200 persons
13	Narasimhapuram Auditorium	Mullakkal ward	300 persons
14	Parish Hall, Thathampally	Thathampally ward	400 persons
15	Raiban Auditorium	Municipal Stadium ward	600 persons
16	Mini Raiban Hall	Municipal Stadium ward	150 persons
17	Kidangamparampu Auditorium	Zillacourt ward	300 persons
18	Nandavanam Auditorium	A.N.Puram	800 persons
19	Arayajanasangom Auditorium	Zakkariya bazzar ward	300 persons
20	SN Auditorium	Kommady ward	300 persons

Source: Secondary Data, 2019

10.4.2 Reading Rooms & Library

There are 3 Public Libraries in the municipal area. They are

- Municipal library, District Court ward
- Ananda Pradayini, Thirumala ward
- Public library, Managalam ward



Figure 10-10: Public Library

10.4.3 Creamatorium or Burial Grounds

There are 3 Crematorium/Burial grounds in Alappuzha town. The details of the burial grounds are given in the Table 10-9.

Table 10-9: Details of Crematorium or Burial Grounds

Sl No	Name	Location/ward
1	Municipal Burial Ground	Chathanad ward
2	Kongini Chudukadu	Valiyamaram ward
3	Municipal Burial Ground	Eravukad ward

Source: Secondary Data, 2019



Figure10-11: Gas Crematorium, Alappuzha Municipality

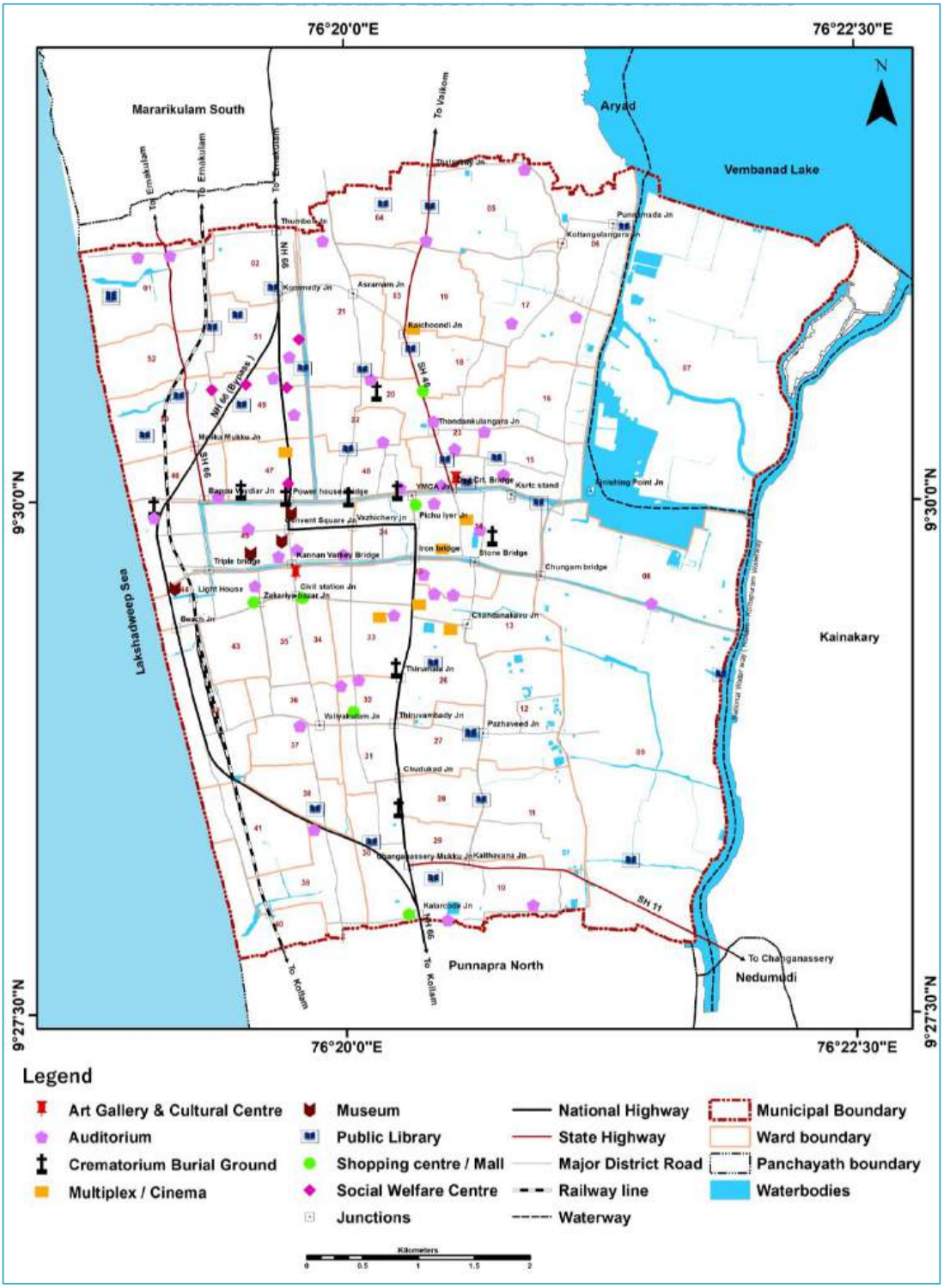


Figure 10-12: Spatial distribution of Civic Amenities within the Municipality

10.4.4 Inferences

The civic amenities in the town are not met with the present population. Also, the future additional demands due to increase in population have to be met.

10.5 Housing

Housing is the basic human requirement that needs to be met on priority basis. Housing sector is employment intensive; it generates employment during its construction period and also during its life for proper maintenance. The demand for housing increases due to growth of population, rapid pace of industrialization and urbanization. There are 52 wards in Alappuzha Municipality. Almost 50.15% of the total land in the Municipality is under residential use. The details regarding the present condition of housing is dealt in this section.

10.5.1 Housing Stock and Housing Shortage

As per census 2011 there are 41655 households in Alappuzha Municipality. The total number of houses in the Municipality is 43638 and number of apartments is 20 as per the data collected in land use survey conducted by LSGD Planning. According to the socio economic survey conducted by LSGD Planning it is evident that majority of the houses are self-owned. 90% are owned by themselves, while only 10% homes are under rent/lease agreements. A very few were seen to be under family property. Wards numbers 1,2,10,50 shows maximum percent of self-owned houses. Ward numbers 18 and 32 have maximum percentage of rent/lease type owned house and wards 11 and 48 have maximum percentage of other category. More details regarding the ward wise ownership details are shown in the Figure 10-13.

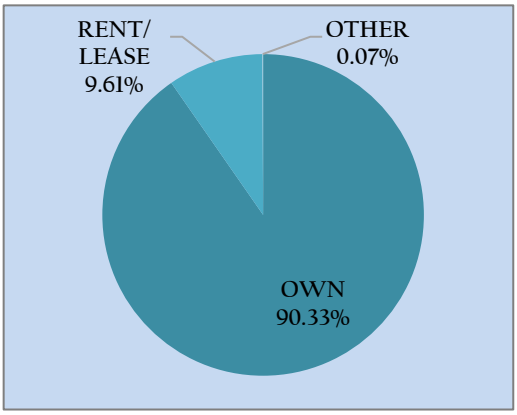


Figure 10-13: Ownership details

Housing condition sometimes reflects the economic status and the living standard of people. And the house structure is an indicator of the economic background of the people who live in it. In Municipal area, mainly three types of houses are found. These are, 'Kutcha', 'Medium' and 'Pucca'. A house with a thatch or tiles and mud walls is generally known as 'Kutcha' house. In 'Medium' house, walls are made of bricks but the roof is covered by tiles or asbestos, and in some cases, bamboo is also used to cover the roof. Ward 8 has maximum number of Kutcha houses whereas

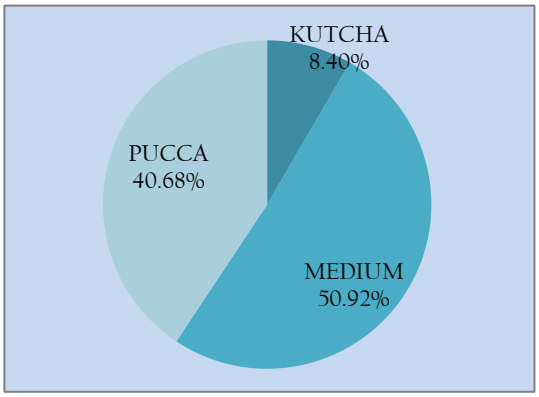


Figure 10-14: Type of Houses

Ward 36 has maximum number of 'Medium' homes. Ward 17 has maximum 'Pucca' houses and lowest number of 'Medium' houses.

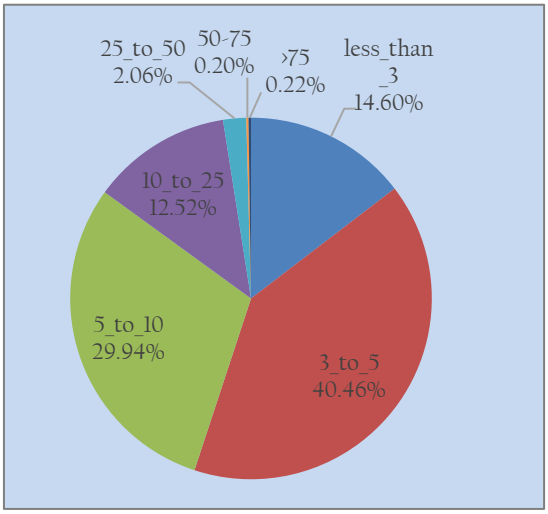


Figure 10-15: Plot area (in cents)

According to the socio-economic survey, 40% of the households belong to the plot area division of 3-5 cents. Only a few houses fall under the category of above 75 cents. Ward 3 has the maximum number of houses with less than 3 cents plot area and the lowest in that division is in ward 28. This shows that there are no large plots under single ownership within the Municipality limits and that most of the area is used solely for building construction (Figure 10-15).

37% of the houses lie between 20-50 square meter in built up area. 35% of the sample population has a built-up area of 50-75 sq.m whereas in case of built-up area greater than 250m^2 is only around 1 % (Figure 10-17).

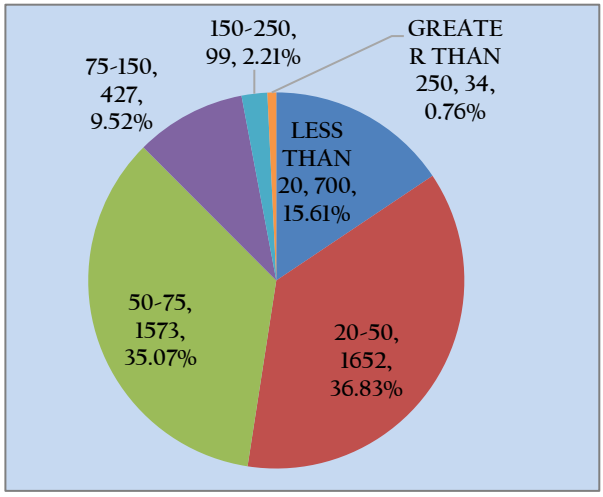


Figure 10-16 Builtup Area

40% of the population resides in houses build about 10-25 years ago, Ward 6 has the maximum number of houses build less than 5 years ago, and Wards 23,26 show the maximum number of old buildings, that is of more than 100 years. There is a total of 17 such old buildings according to the socioeconomic data. The socio- economic survey was conducted for various material classification in the roof, floor and walls of the buildings. 47% of houses are constructed using burnt hollow bricks, 54% used cement on the floors and 34% used asbestos in their roofing. Palm leaf

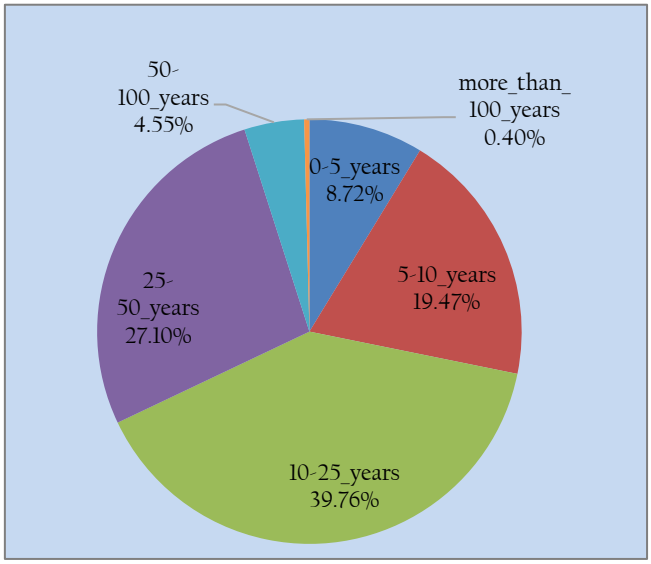


Figure 10-17: Age of House

walled houses were also present in the Municipality. Moreover, majority of the roof is made up of concrete.

According to the survey, majority of houses has 4 rooms, that is 43% and only 18 households has just 1 room. Most residence, 87% have 1 floor and only 13% buildings have 2 floors. There are a very few buildings with higher floors.

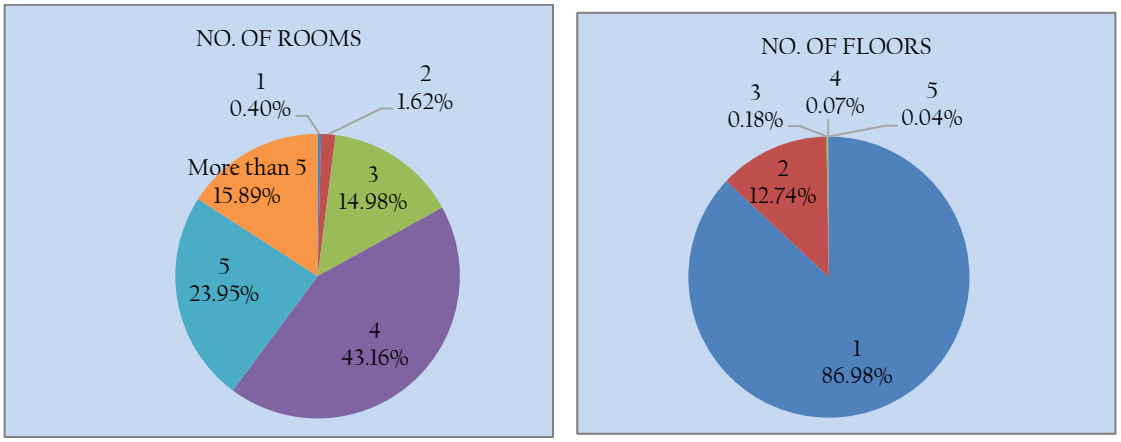


Figure 10-18: Number of rooms and Floors

According to an interview conducted with an official from Municipality from LIFE mission by state government, there are 1600 households without land and house in the municipal area and 300 are applied for renovation of dilapidated houses.

10.5.2 Slums in the Municipal Area

As per the secondary data there are 12 slums in the municipal area. The details of slums are given in Table 10-10 . Actually, the listed slums are really not slums but they are slum like human settlements. Although they are not notified slums, they lack basic infrastructure facilities while compared to the present standard of living of a normal settlement in the region.

Table 10-10: Details of Slums in the Municipality

Sl.No.	Name of the Slum	Ward(s)	listed/ non-listed slum
1	Vadackal-palliparambil, fisherman	Vadackal	listed
2	Kuthiraparnthi Cheri	Kuthirapanthy	listed
3	Ayyamparambu	Sanathanapuram	listed
4	Illikkalpuraidom	Vattayal	listed
5	Mullathuvalappu	Mullathuvalappu	listed
6	Pallathuruthy	Chungam	listed

7	H.B.Padam	Alisserry	listed
8	Lajanath-NM Kambivalappu	Lajanath	listed
9	Chungam Palace	Chungam	listed
10	Methran Colony	Mangalam	listed
11	Avalookkunnu Colony	Avalookunnu	listed
12	Ettukadu Colony	Kottamkulangara	listed

Source: City Development Plan

10.5.3 Spatial Distribution of Slums

Slums in the planning area are found in Vadakkal, Kuthirapanthy, Sanathanapuram, Vattayal, Chungam, Alissery, Lajnath, Mangalam, Avalookunnu and Kottamkulangara wards. Two slums are located in Chungam ward. Figure 10-19 shows the location of slums in the Municipality. Apart from listed slums in Municipality there are housing clusters with slum like conditions.

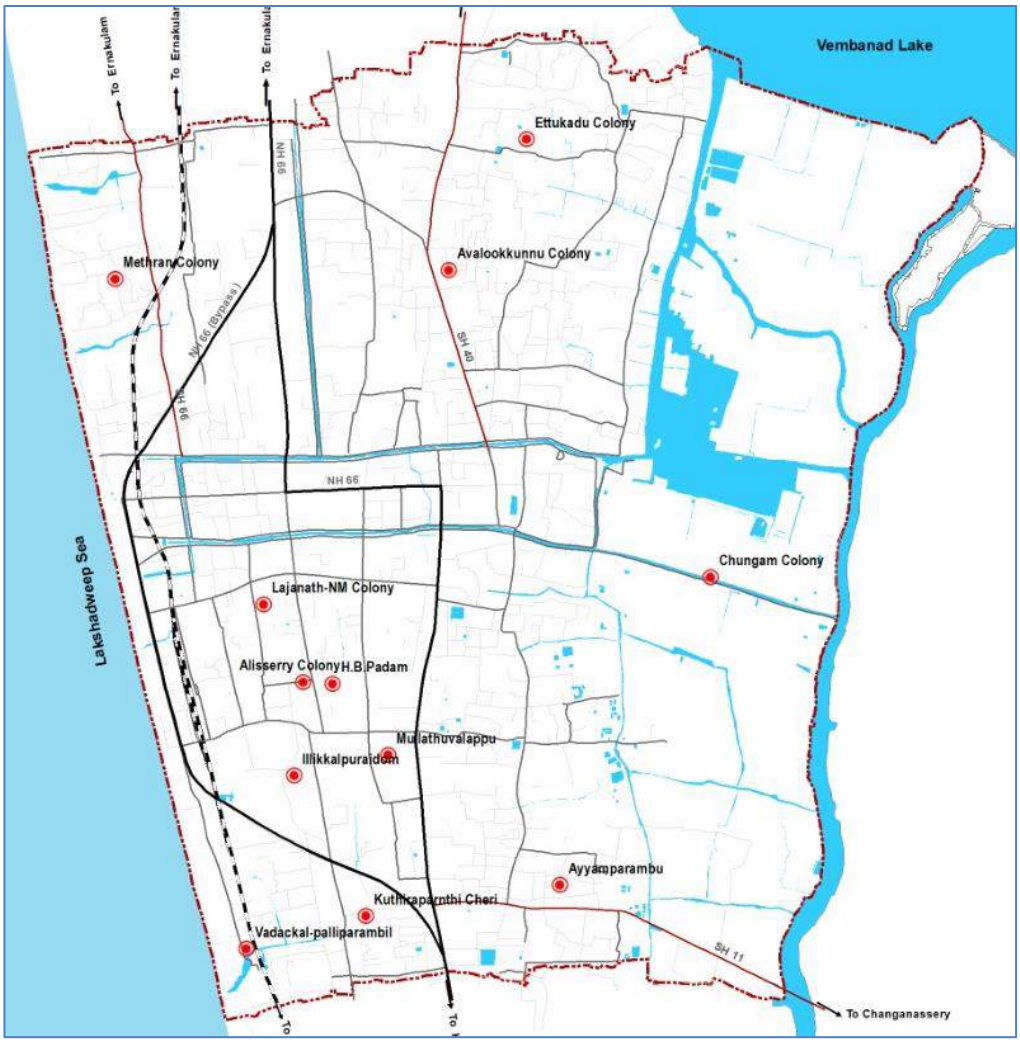


Figure 10-19: Location of Slums in the Municipality

As per the site visit conducted by the LSGD Planning department in the 12 listed slum, the following points could observe.

Vadackal-Palliparambil, Fisherman colony lacks infrastructure facility especially in waste management sector. The housing condition is comparatively moderate, i.e. neither pucca nor a kutcha condition. They are still settled as a cluster. All the listed colonies are in the same condition as aforementioned. However, all colonies need attention for renovation, some are improved in hosing condition as well as infrastructure facilities. Methran colony in Mangalam ward, Avalookkunnu colony in Avalookunnu ward and Ettukadu colony in Kottamkulangara wards are seems to be in better condition.

Colonies named Kuthiraparnthi Cheri, Ayyamparambu colony and Chumgam Palace colony are facing water logging issue at the time of heavy rainy season. Most of the colonies are situated nearer to canals, since the waste disposal and other facilities are less, they forcefully tend to depend canal to meet the disposing purposes. So that this becomes one of the reason for degradation of canal and its environment. Some of the colonies, named Chumgam Palace, Vadackal-Palliparambil, Fisherman, Alissery colony are still existing as cluster, so this area can be developed as cluster. Apart from the concern of physical aspects in the colonies, it is important to intervene their social aspects. One of the unnoticed advantages of slum like colonies or clustered human settlements is their social attachment and sense of security. Since family and home is the basic unit for nurturing social attachments and interactions. While considering the present situation of new generation, majority seem to have a self-centred mentality with lack of social mingling and attachments. So, some slum like settlements colonies or clustered communities are still maintaining this kind of social structures. Subsequently the colonies and clustered settlements have to be maintained as such without breaking their social and economic backups while developing besides improving their basic infrastructure facilities as well as living standards. Figure 10-20 Shows the images of slums in Alappuzha town.



Figure 10-20 Slums in Alappuzha Town

Most of the Households in the slum area are developed with the arrival of new housing schemes by the government. Moreover, ULB has interfered very well in upgrading the pathetic living condition of habitants in the slums. Many HHs have utilized LIFE mission housing scheme sponsored by the state government. The scheme helps in giving well-conditioned shelter homes for both land less as well as land possessed HHs by different schemes. Even though the road accessibility has developed sufficiently, the sanitation, sewerage and drainage facilities are yet to be developed more and addressed in the future interventions. The quality of drinking water availability is also a major concern.

10.5.4 Problems and Potentials

Almost 50.15% of the total land in the Municipality is of residential use. The demand for housing is increasing with time, which is clearly reflected in the change of habitation pattern. Urban amenities like water and sanitation are found to be inadequate in quality and quantity. Electricity is almost adequate.

Most of the slums are still in worst condition especially in their basic infrastructure facilities. Some of the slum area have the potential to develop as cluster homes or develop by using land/house pooling technique.

10.5.5 Inferences

In Alappuzha municipal area the housing sector as such do not show any serious problems. Only 4.27% of the houses in the Municipality are kutcha/huts. 95.73% of houses are in pucca or in moderate condition. 90.05% of people reside in their own land. 9.95% of people live in rented or lease buildings. Present housing shortage in the town is 1155 houses. These shortages can be covered by the housing projects by government for the economically weaker sections. But in slums and other backward settlements, infrastructural facilities are very acute. There are 12 listed slums in Alappuzha. Lack of drinking water facilities, lack of sanitation facilities and absence of internal roads are major problems in slums.

11 SPECIAL CONCERN AREAS

Each planning area is unique in it and has got areas of special concern that demands attention; physically, economically and socially. In this chapter the special areas of concern for the planned socio-economic development of the town is discussed.

11.1 Social Backwardness and Poverty

Poverty is a social phenomenon in which a section of the society is unable to fulfill even its basic necessities of life. Poverty continues to prevail among the downtrodden and depressed sections of the people. It is often concentrated in certain segments of the society, generally defined by region age or social group. Socio economic inequalities between place and people have sharpened over the years. In fact, poverty amid plenty is the world's greatest challenge.

11.1.1 BPL Household

Below Poverty Line (BPL) is an economic benchmark and poverty threshold used by Government of India to indicate the economic backwardness and to identify individuals and households in need of government assistance. Kerala is one of the states that had formulated its own criteria. In Kerala, there are nine parameters taken, and a family that lacks to four or more parameters is classified as BPL (Table 11-1).

Table 11-1: List of Parameters for Classification of BPL

Sl.No:	Parameter
1	No land or < 5 cents of land
2	No house or dilapidated house
3	No Sanitation Latrine
4	Family without Colour television
5	No regular employed person in the family
6	No access to safe drinking water
7	Women-headed HH or presence of widows or divorcee
8	SC and ST
9	Mentally retarded or disabled member in the family

Source: BPL Survey, 2009

In Alappuzha Municipality, 21822 households are categorized as BPL families spreading over many wards of the Municipality. Table 11-2 shows the ward wise number of BPL HHs and Figure 11-1 shows the ward wise concentration index of BPL HHs. The concentration of BPL families is more in Vadackanal ward (40), Thumboly ward (1), Poonthopu ward (3), Kanjiramchira ward (50).

Table 11-2: Ward wise number of BPL Households

Sl.No:	Ward Name	BPL HHs	Sl.No:	Ward Name	BPL HHs
1	THUMBOLY	767	27	THIRUVAMPADY	294
2	KOMMADY	456	28	HOUSING COLONY	187
3	POONTHOPPU	725	29	SANATHANAPURAM	201
4	KALATH	454	30	ERAVUKADU	448
5	KOTTAMKULANGARA	536	31	MULLATHUVALAPPU	451
6	PUNNAMADA	399	32	VALIYAMARAM	409
7	NEHRU TROPHY	486	33	MUNICIPAL STADIUM	385
8	THIRUMALA	458	34	ALISSERY	465
9	PALLATHURUTHY	491	35	LAJNATH	503
10	KALARKODE	229	36	VALIYAKULAM	347
11	KAITHAVANA	249	37	VATTAYAL	541
12	PAZHAVEEDU	395	38	KUTHIRAPANTHI	535
13	PALACE	475	39	GURUMANDIRAM	292
14	MULLACKAL	250	40	VADACKANAL	997
15	DISTRICT COURT	341	41	BEACH	663
16	THATHAMPALLY	500	42	RAILWAY STATION	356
17	KARALAKAM	351	43	ZACHARIAH BAZAR	576
18	AVALUKUNNU	437	44	CIVIL STATION	345
19	KARUKAYIL	327	45	SEA VIEW	369
20	THONDANKULANGARA	388	46	VADACKAL	292
21	ASRAMAM	485	47	POWER HOUSE	370
22	MANNATH	189	48	CHATHANADU	301
23	KIDANGANPARAMBU	181	49	ARATTUVAZHI	418
24	VAZHICHERRY	380	50	KANJIRAMCHIRA	742
25	MUNICIPAL OFFICE	258	51	KALAPPURA	291
26	A N PURAM	343	52	MANGALAM	494

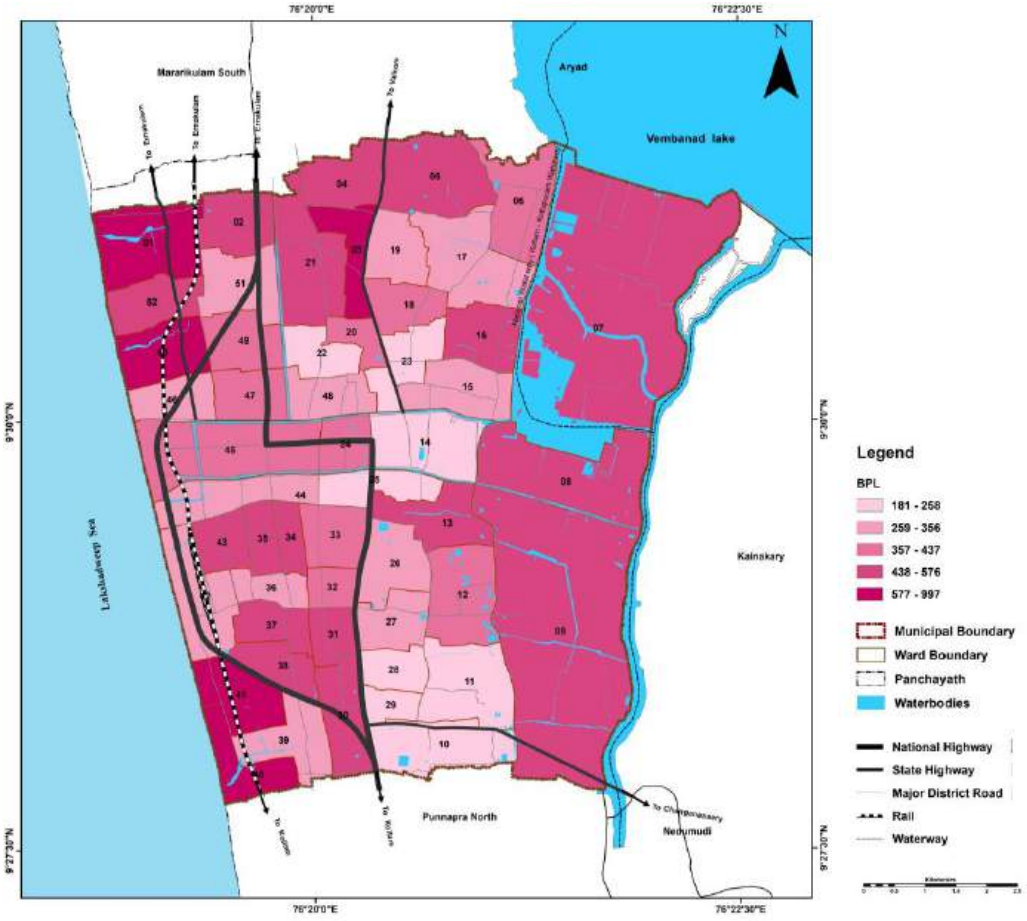


Figure 11-1: Ward wise concentration of BPL Households

11.1.2 SC/ST Population Index

According to 2011 Census SC population constitutes nearly 2.1 % of the total population in the Municipality whereas ST population is very low (nearly 0.18 %) in Alappuzha Municipality. Percentage of SC population of the district is 9.45. Table 11-3 shows the temporal variation of SC population in the Municipality. More SC Population is concentrated in Nehrutrophy, Chunkam, Pallathuruthy, Avalukkunnu, Kottamkulangara wards. There are 3 SC colonies, the details are shown in Table 11-4.

Table 11-3: Temporal Variation of SC Population

	1991	2001	2011
SC Population	3978	3713	3436

(Census Data, 2011)

Table 11-4: Details of SC Colonies

NAME OF WARD	WARD NO	NAME OF COLONY	SC HH
Nehrutrophy	7	Ambedkar	36
Pallathurathy	9	M R Thoduchira	36
Pallathurathy	9	Gandhivilasam	32

Source: Alappuzha Municipality, 2019

ST population is residing in only one ward namely Avalukkunnu. As per 2011 Census there are 72 ST households. It constitutes total 165 numbers out of which 88 are male and 77 females. *(PadhathiRekha, 2018-2019)*

11.2 Social Security and social welfare programmes

Social security is primarily a social insurance program providing social protection or protection against socially recognized conditions, including poverty, old age, disability, unemployment and others. Women, children, disabled and the aged are the most vulnerable sections of our society for historic and social reasons. Accident and crime data of Alappuzha Municipality over the last five years are shown in Figure 11-2. More number of crimes reported during 2017 after it gradually decreased until 2019. Also, accident records are gradually increasing slightly.

Social welfare schemes are introduced with the objective of benefiting various marginalized sections of the society. There are many schemes in place with central and state assistance. These schemes give ample support for aged, handicapped or orphan people, by way of pension provisions, insurance coverage and other benefits. For securing the lives of the

poorest of the poor families, the Government of Kerala has introduced the Social Security Pension Schemes. Currently, seven types of social security pensions are being distributed through local bodies. The types of pension are agricultural labor pension, destitute pension, widow pension, old age pension, disability pension etc.

11.3 Women & Child Development

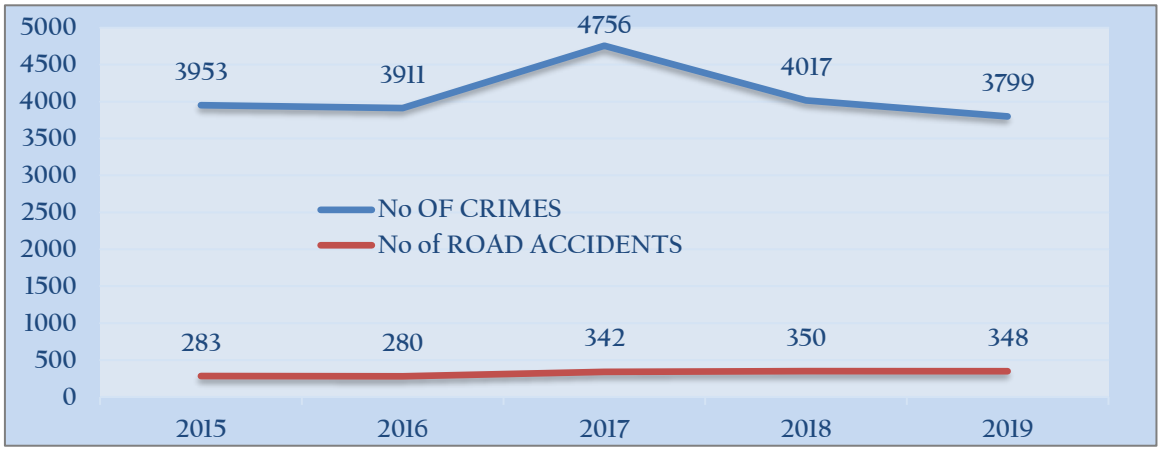


Figure 11-2: Accident & Crime data of Alappuzha Municipality

In Kerala, population of women is more than half of the total population. Literacy rate of women is higher in Kerala state. Regarding the women participation in development activities in Alappuzha Municipality, it is very less in almost all sectors. Government had taken many proposals for bringing women into the main stream. For the welfare and advancement of women life, labor enterprises and special labor training programme have to be encouraged. 'Kudumbasree' plays a major role for establishing labour enterprises. In unorganized sector the minimum wages of women should be ensured.

In Alappuzha Municipality women are involved in various kind of works such as building construction, tailoring, printing, agriculture, fish vending, teaching, cleaning town etc. and some of them are in Government service too. There is no wage difference in Government service on gender basis. But in other sectors wages of women is lesser than that of men.

Absence of proper accommodation facilities is the major problem being faced by the working women. Immediate steps have to be taken to provide accommodation facilities and measures to ensure their safety. Another problem is the lack of basic facilities like toilets at public places.

11.3.1 ICDS Projects

I.C.D.S. is an integrated approach for the development of women and children from disadvantaged sections across the life cycle. ICDS Programme was conceived in Kerala since 1975 with an integrated delivery package of early child hood services so that their synergistic effect can be taken full advantage of the schemes. The Scheme targets the most vulnerable groups of population including children up to 6 years of age, pregnant women and nursing mothers belonging to poorest of the poor families and living in disadvantaged areas including backward rural areas, tribal areas and urban slums. The identification of beneficiaries is done through surveying the community and identifying the families living below the poverty line.

The scheme envisages the holistic development of women and children. A package of services is being rendered to women and children through ICDS Projects. The grass root level service delivery points are anganwadi centers. In each Anganwadi there is an anganwadi worker and helper to look after the activities. ICDS projects provide supplementary nutrition, NHED, immunization and awareness on different subjects etc. to women. These projects also provide a package of service for the development of children such as non formal preschool education, supplementary nutrition, immunization, health check-up, referral services, health and nutrition education. Various welfare schemes ICDS programmes are under SNP, the supplementary nutrition programme for children and SABALA scheme for adolescent girls (11-18), for their empowerment, especially in the tribal areas. Under this scheme training is accorded to the adolescent girls regarding education, personal hygiene and other skill development programmes.

11.3.2 Status of Anganawadis

Aganwadi's are the grass root level service delivery point of social welfare activities. Anganwadi center is the focal point for delivery of services which is managed by an anganwadi worker, assisted by a helper. Both are honorary workers selected from local community. As per the criteria, there should be one anganwadi for 1000 population. There are a total of 148 anganwadis within the Municipality. As per *PadhathiRekha, (2018-2019)* all these anganawadis don't have its own land and buildings and are lacking the basic infrastructural facilities.

11.4 Inferences

The distribution of SC/ST population or concentration of BPL families does not show any relation to the distribution of agriculture laborers and cultivators. For the welfare of weaker section of the town more facilities are to be provided. In the changed social structure

more attention is needed for the welfare of old age people. Projects have to be evolved for the economic development of women, Scheduled Caste and Scheduled Tribe people.

12 ENVIRONMENT

For a livable and healthy town, it is imperative that its planners address environmental concerns, which have deep and long-standing influence on its people and land. Environment fatigue is a natural corollary to bad environment management caused by environmental degradation and biodiversity loss by developmental activities across the world. It is not different in the case of Alappuzha town. Unplanned developmental activities and apathetic policies that lack ecological sensitivity relegate Alappuzha to the status of an environmentally endangered city. Protection, conservation and sustainable environmental practices are the essential functions of a desirable integrated urban approach.

12.1 Existing Scenario

The entire environment impact zone around Alappuzha is in a critical state now, due to various factors that impact it detrimentally. The polluted canals, houseboats not following the procedures laid down by the Tourism Department, lack of proper sewerage system, absence of an efficient solid waste management system are some of them. It is the natural beauty and the quality of the town that brings in tourists who are the main backbone of the economy of this town. If immediate measures are not taken to arrest the environmental decline of the town, it will adversely affect the resurging economic scenario of the town. Alappuzha has to be nursed and nurtured back to health for the forward movement in livelihood and productivity of its people. Hence the first and foremost challenge is to restore the ecology of the place with due weightage to economic and livelihood building measures. Environment sensitive indices are:

- It is one of the most densely populated towns in Kerala.
- The Vembanad lake binds Alappuzha on the East, which is a Ramsar site and the West by the Arabian Sea.
- The Kuttanad (Rice bowl of Kerala) agricultural zone adjacent to the town covers vast expanse of paddy fields, which follow modern agricultural practices of cultivation using pesticides and fertilizers. This region has the distinction of being one of the few areas in the world where farming is carried out below sea level. This zone forms a continuum with Alappuzha town.
- The canals, which boast of being the main factor, that has earned it the sobriquet of Venice of the East has become cesspools of the wastes of the city.

- Development initiatives needs to be 'streamlined giving due respect to the geological and ecological fingerprints of this region'

Of the above, the issues associated with water are the most important, which are given below:

- Choked waterways and consequent problems in water availability and drainage has adversely affected human health, sanitation and clean drinking water.
- Pollution of water body due to many factors including alien invasive species.
- Declining ecosystem services and goods like water recharge, pollution control, fishery and loss of habitats and biodiversity.

Integrated and well calibrated approach to mitigate all these and related problems are essential to achieve ecological revival and restoration of the lost livelihoods of the poorest of this region.

12.2 Ecologically Important Areas

Alappuzha is primarily a waterlogged area. 4.91 % of the area is covered by lakes, rivers canals, wells and ponds constituting. Figure 12-1 shows the ecologically important areas within the town.

12.2.1 Canals

Alappuzha town was planned and built at a time when the science of modern town planning was unknown. The sense of beauty and imagination that founded the layout of the town is really commendable. A canal opening at both ends into the backwaters runs as the two-prolonged artery of the town that affords excellent facilities for transport of goods into and out of the town by inland waterways.

The Vadai canal and the Commercial canal lie parallel to each other beginning from the Vembanad lake on the Eastern boundary of the town and ending very close to the beach on the Western end of the town. The two main canals have linking canals at three places, the first at Chungom, and the second on the Eastern side of the town's main market and the third on the Western side of the District Police Superintendent's Office. The dead end of the canal network is at the pier of Alappuzha's defunct port and this dead end is just about 150 meters away from the shoreline.

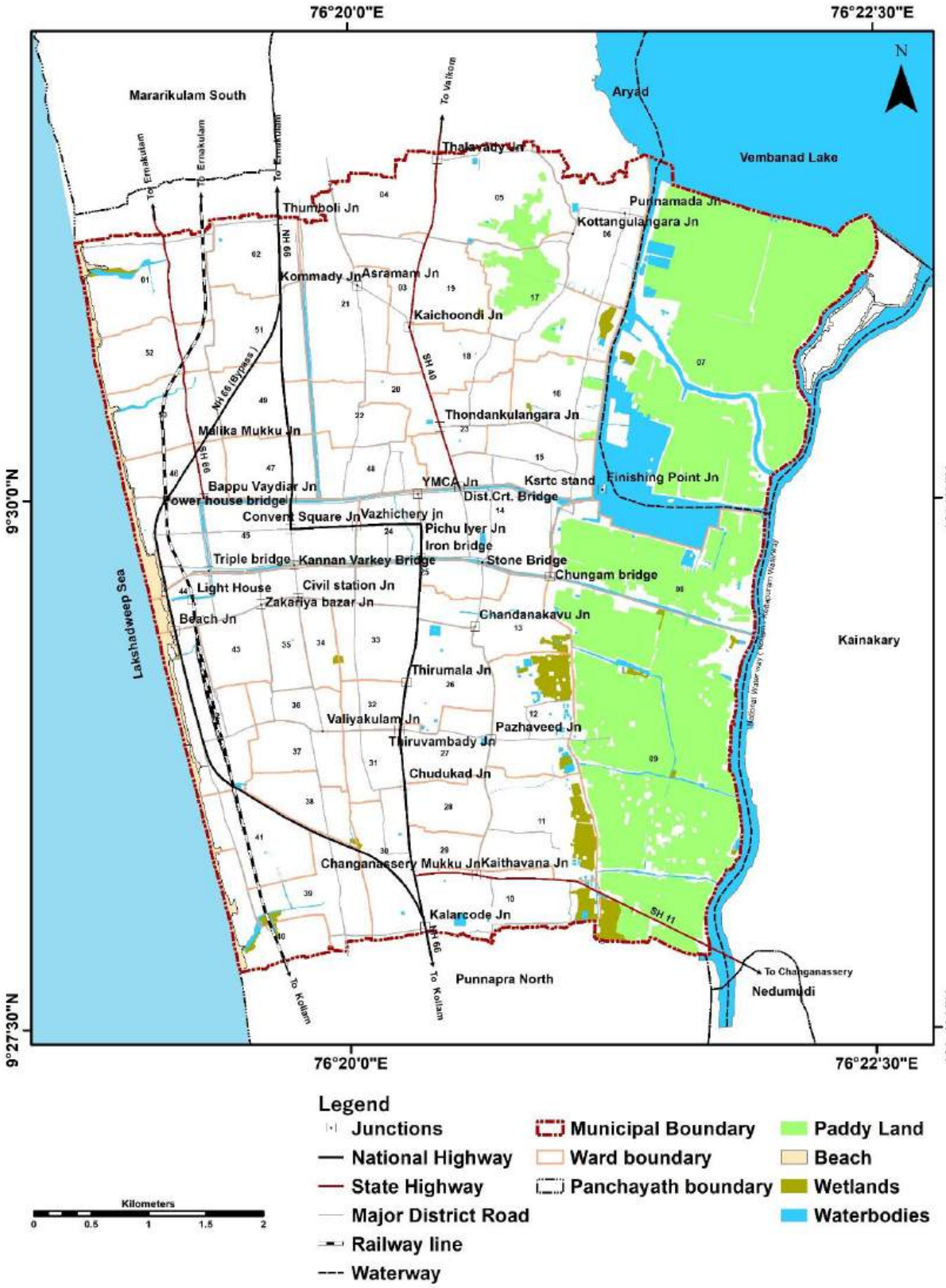


Figure 12-1: Ecologically important areas in the town

The Alappuzha town canals afford excellent facilities for the transport of goods into and out of the town to inland waterways. The major canals of the area are

- Vadai Canal – length 3.265 km. and average width 18m.
- Commercial Canal – length 3.70 km. and average width 18m.
- West Junction Canal – length 0.585 km.and average width 15m.
- East Junction Canal – length 0.575 km. and average width 20m.
- Murinjapuzha Canal

Besides this, there are around 33 smaller canals crisscrossing the town. Of these two major canals that connect Alappuzha to Ambalapuzha and Cherthala towns are the Alappuzha Cherthala canal (AS canal) and Alappuzha Changanasserry canal [AC canal]. The major factors affecting the canals now are:

- Blocked waterways
- Aggressive waterweeds
- Siltation
- Industrial pollution
- General pollution
- Encroachments
- Loss of biodiversity
- Renovation of drainage systems

12.2.2 Vembanad Lake and Vembanad Wetland System

The Vembanad lake, an integral part of Alappuzha town, surrounding the Eastern borders of the city, is part of the Vembanad Wetland System (VWS), one of the largest wetland systems in the West coast. The ecological character of the wetland is capacity to provide a wide range of naturally occurring ecosystem services.

Being a water body, which is in continuum with that of the town, any change that takes place with respect to the lake directly and indirectly alters the ecological condition of Alappuzha. The majority of the population being on the shoreline of the lake, rivers and canals, the people in this area meet their daily needs for water from these water bodies. Washing

clothes, cleaning vessels and bathing is part of the use. At places, toilets are let out into the same canals from which water for drinking and cooking is collected. Many households have toilets built with direct outlets into the canals and streams of the backwater system.

The depletion of the size of the lake area, changes in land use pattern, transformation of the lake by low saline water mixing, increased pollution, aggressive growth of water weed and other developmental interventions have led to substantial decline in the species diversity of flora and fauna. The reclamation has almost decimated the mangrove and associated species diversity, which was once very diverse and luxuriant. The cascading effect is on fish particularly prawn population and bird diversity.' *(M.S. Swaminathan Science for Sustainable Development Research Foundation (MSSRF Report))*



Figure 12-2: Vembanad Lake and its Surroundings

One of the causes for the depletion in the size of the lake has been attributed to unchecked encroachments, reclamation of lake area and the lakebed rising due to siltation. Paddy cultivation was accountable for land reclamation during the 1980's but now it is the flourishing tourism trade that is the reasoning for the current decline in lake area.

The estuaries (pozhi) along the Western part of the town used to be the point controlling salinity intrusion in the town. This used to keep the canals clean and prevent the aggressive growth of weeds in it. As it used to affect paddy cultivation temporary barriers were raised to prevent salinity intrusion. The Thaneermukkom Barrage (TMB) was built to regulate the flow of sea water but its closure disconnecting Vembanad lake from its Northern half has impacted the ecology and ecosystem. The operation of the barrage was through the coordination of various government departments which has very often failed in meeting the time schedules drawn for it regarding the opening and closing of the barrage.

12.2.3 Sea Coast

The coastal zone of Alappuzha is under intensive use. Extremely high population pressure, intense human activities, indiscriminate mechanization of fishing, urbanization, industrialization, inappropriate resource use and absence of proper integrated management practices internalizing conservation combined contribute in reduction of productivity of coastal waters, quality deterioration, reduction in marine fish catch and finally posing hardship for livelihood to the local community.

The coastal erosion in this stretch is one of the recurring natural hazards occurring as part of an erosion accretion cycle at the land-sea interface. Beach is the best protection for coast and is the habitat for many marine and inter-tidal organisms. It is also an open space available to the coastal communities for different activities. There are periodic encroachments in the beaches and other coastal lands for settlement even when their susceptibility to erosion is well known. Systematic planning for habitat development is a felt need of the coastal area. A very important development in the coastal sector is in the name of tourism.

Water pollution is gradually emerging as an important issue. Domestic wastes, industrial wastes, fertilizers and pesticide residues reach coastal and marine waters through rivers, creeks, bays etc.

12.2.4 Low lying Lands

The low lying paddy areas and marshy lands are considered as environmentally sensitive areas. These areas absorb flood water and recharge the ground water reserve. Paddy areas also provide a cool feeling to urban people while all other areas are covered with concrete buildings. Kuttanad agricultural zone known as the rice bowl of Kerala forms part of the town. It is the only place in the world where farming is done 1.5-2 m below sea level. This area which covers vast expanse of paddy fields follows modern agricultural practices of cultivation using



Figure 12-4: Low lying Areas

pesticides and fertilizers. The uses of pesticides not only affect the Kuttanad region but even Alappuzha town which lies adjacent to it.

12.3 Pollution

12.3.1 Air Pollution

Air pollution is the introduction of chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms, or cause damage to the natural environment or built environment, into the atmosphere.

Particulate matter includes dust, smoke, fumes, mist, fog, aerosol etc. generated due to mechanical grinding of materials, vehicular traffic, combustion, chemical/metallurgical processes, industrial activities, certain natural causes etc. The factors that affect the dispersion and hence concentration of air pollutants include atmospheric stability (related to the temperature of the air), wind velocity and turbulence, topographical effects etc. The decrease in particulate matter can be attributed to precipitation.

Some of the data regarding pollutants like SO2, NO, SPM, and CO of residential and industrial areas are given in Figure and Table 12-1 respectively. All the parameters other than SPM (Suspended Particulate matter) is undoubtedly far below the standard values. Whereas in case of SPM nearly reaches the standard value in case of industrial area, so a mere care should be given to the industrial pollutants. All the present values are below the permissible standard values; hence it is satisfactory right now.

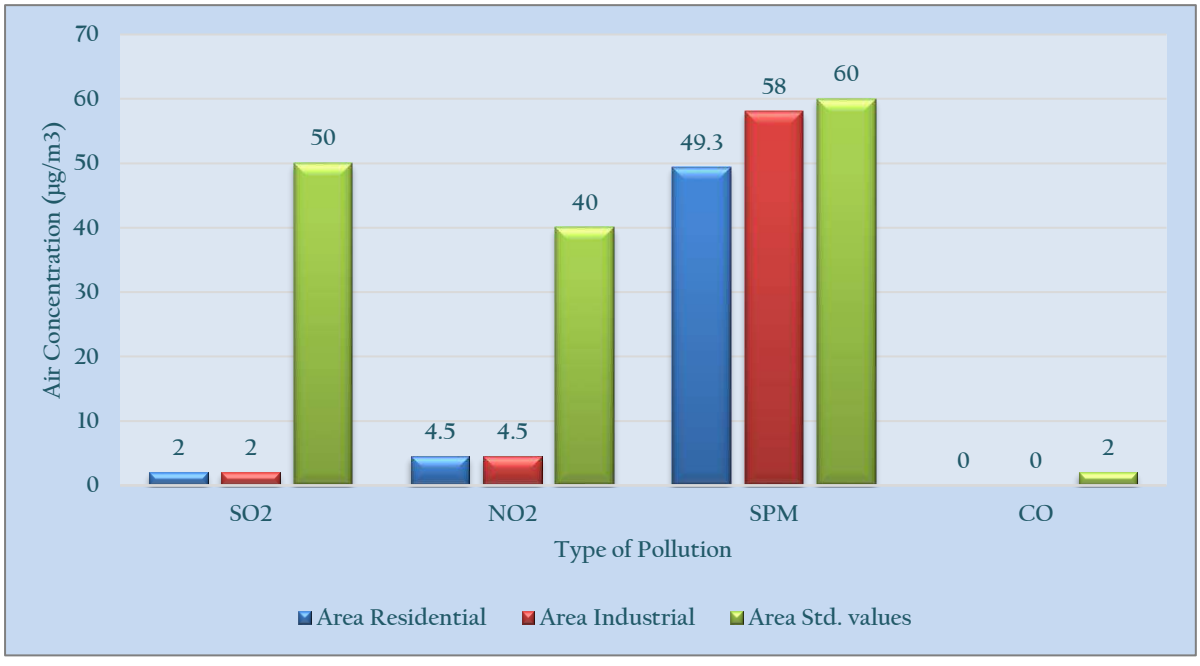


Figure 12-5: Ambient Air Qualities in Alappuzha Municipality (Source: Pollution Control Board)

Table 12-1: Air Concentration (µg/m3)

Type of Pollutant	Area		National Ambient Air quality Standards
	Residential	Industrial	
SO2	2	2	50
NO2	4.5	4.5	40
SPM	49.3	58	60
CO	0	0	2

Source: Pollution Control Board – 2018-2019

12.3.2 Noise Pollution

Community noise (also called environmental noise, residential noise or domestic noise) is defined as noise emitted from all sources except noise at the industrial workplace. Main sources of community noise include road, rail and air traffic; industries; construction and public work; and the neighborhood. The main indoor noise sources are ventilation systems, office machines, home appliances and neighbors.

The increasing ambient noise levels in public places from various sources, inter-alia, industrial activity, construction activity, fire crackers, sound producing instruments, generator sets, loud speakers, public address systems, music systems, vehicular horns and other mechanical devices have deleterious effects on human health and the psychological wellbeing of the people. The noise level of Alappuzha Municipal area is shown in the Table 12-2. the noise level of day and night of residential, commercial, industrial and silent zones are shown in the table is within the permissible standard limits as per the noise pollution (regulation and control) rules, 2000.

Table 12-2: Level of Noise Pollution (Db)

	Residential	Commercial	Industrial	Silent Zone
Day	55	65	75	50
Night	45	55	70	40

Source: Pollution Control Board (2018-2019)

12.3.3 Water Pollution

Water pollution has been assessed through the secondary data collected from Summer school and winter school reports done by Canalpy (A joint initiative of Centre for Policy Studies (CPS) and Centre for Technology Alternatives for Rural Areas (CTARA), Indian Institute of Technology, Bombay and Kerala Institute of Local Administration (KILA). One is

dealing with the water quality assessment of canals whereas the other report deals with the assessment of wells.

Quality of the water in the canal is an indicator of its aquatic health and extent of waste water contamination. Preliminary investigation of the canals revealed absence of aquatic animals, increased eutrophication and dumping of solid wastes on various stretches of main and sub canals. According to the report "Participatory Water and Sanitation Assessment for Alappuzha Town" (Centre for Policy Studies (CPS)), 17 sampling points were selected for water quality assessment. Water quality was determined by assessing three classes of attributes: physical, chemical, and biological. Various surface water quality parameters were analyzed in the study at mentioned locations along Commercial Canal and Vadai Canal.

In general, the Dissolved Oxygen (DO) concentration was observed to be very low in most of the samples collected all along the canal. Out of the 17 samples collected, 13 samples had DO concentration below the desirable limit of 4ppm. The electrical conductivity (EC) of the samples collected from Vadai Canal and Commercial Canal does not show much variation with values in the range of 495- 626 μ S, which is within the permissible limits. The total dissolved solids concentrations as expected shows similar variation as EC. pH of all the samples collected falls within the range of 6.5 – 8.5. Since the samples were taken from the top layer, the information on variation of pH with depth of canal is not available. There is a chance that canal water is acidic at the bottom due to decomposing algae at the bottom of the canal. The pH normally increases in the top layers with the photosynthesis process that happen due to algae floating on the canal water surface. The iron concentrations show variation among the samples. In general, high iron concentration was observed in the samples collected from drain opening to commercial canal and sub-canal opening to Vadai canal. High phosphate concentration was observed in all water samples collected from commercial canals. All the samples collected reported the presence of ammonia in varying concentrations indicating fresh source of sewage into the canal water. All the samples tested for the presence of coliform bacteria showed a positive result, indicating the presence of septage contamination all through the canal.

Many studies have found that the groundwater in coastal district of Alappuzha is vulnerable to bacteriological contamination due to shallow water levels and the existing sanitary practices (CGWB, 2013) (IISc, 2010).

Fecal contamination is present in 90% of drinking water wells in Kerala, with the open character of wells, conventional maintenance habits; soak pits/septic tanks at a distance less than the prescribed distance of at least 7.5m contribute to the bacteriological contamination (CWRDM, 2013) (KSCSTE, 2005). High population density (Alappuzha is one of the densest districts in Kerala), high well density and with unscientific black and grey water disposal are considered to be the major reasons for the widespread bacteriological contamination of the groundwater aquifers (Karthick et al., 2010).

According to "Comprehensive Water and Sanitation Assessment for Alappuzha Town" (Centre for Policy Studies (CPS)) , found some results regarding the water quality of wells and public taps by analyzing a socio economic survey of water samples of 503 wells and 124 public taps to assess bacteriological contamination using H2S vials. Bacteriological contamination in wells was tested to understand the extent of the problem and also to concretized households on the quality of water they are using. Very high percentages (97%) of dug wells were found to be contaminated. Secondary data was collected from the District Medical Office and interview with the District Medical Officer.

The major findings of the aforementioned report are:

Alappuzha town has a high number of wells and a very high population density. One of the major observations is the inability of certain households with a low per capita availability of land to maintain a safe distance between the wells and septic tanks due to the small plot sizes. The secondary data analysis of incidence of diseases showed a high and increasing trend of water borne diseases in Alappuzha.

Out of the wells surveyed, 503 well samples were tested for the presence or absence of biological contamination out of which 261 were dug well samples, 243 were bore well samples. 123 KWA public tap water samples were also tested for checking the biological contamination of the treated water supply. It was found that after 3 days, 93% of dug wells (243 samples), 82% of bore wells (200 samples) and 39% of KWA water samples (48 samples) were found to have bacteriological contamination. While the contamination of groundwater sources of dug well and bore well could be due to the unscientific waste disposal mechanisms, the contamination of the treated KWA water samples could be linked to leakages in the water supply as well as due to pressure differences in the network, which allows the contaminated water to enter into the network.

Potability of water, as well as its suitability for other domestic purposes, is affected by its microbiological and chemical qualities. Hence ensuring a particular standard for this is essential to public health. While poor quality of water due to microbiological contamination can lead to disease outbreaks which results in serious epidemics. Deterioration of water quality due to chemical contamination of water is slower but could harm the human health significantly.

With high density of population and environmental pollution, Alappuzha district faces severe drinking water shortages. Many of the farther areas do not get water in adequate quantities and there is contamination of the water supply network due to leakages and pipe bursts. This results in people relying upon other sources which includes wells which are also contaminated and poses a public health issue. Moreover, during the monsoon, flooding occurs in many parts of the district which further decreases the accessibility to safe drinking water and causes unsafe sanitation thus resulting in outbreaks of various types of water related diseases.

12.4 Coastal Regulation Zones

To conserve and protect the unique environment of coastal stretches and marine areas, besides livelihood security to the fisher communities and other local communities in the coastal areas and to promote sustainable development based on scientific principles taking into account the dangers of natural hazards, sea level rise due to global warming, Ministry of Enviornment, Forest and Climate Change(MoEF) had declared the coastal stretches of the country and the water area up to its territorial water limit, excluding the islands of Andaman and Nicobar and Lakshadweep and the marine areas surrounding these islands, as Coastal Regulation Zone as under:-

- The land area from High Tide Line (HTL) to 500 meters on the landward side along the sea front.
- CRZ shall apply to the land area between HTL to 50 meters or width of the creek, whichever is less on the landward side along the tidal influenced water bodies that are connected to the sea.

For the purpose of conserving and protecting the coastal areas and marine water, the CRZ area shall be classified as follows, namely:

- **CRZ-I:** Areas that are environmentally most critical.

- **CRZ-I A**: Mangroves (in case mangrove area is more than 1000 square meters, a buffer of 50 meters along the mangroves shall be provided and such area shall also constitute CRZ–I A); Corals and Coral reefs; Sand dunes; Biologically active mudflats; National parks, Marine Parks, Sanctuaries, Reserve Forests, Wildlife habitats and other protected areas under the provisions of Wild Life (Protection) Act, 1972 (53 of 1972), Forest (Conservation) Act, 1980 (69 of 1980) or Environment (Protection) Act, 1986 (29 0f 1986), including Biosphere Reserves; Salt marshes; Turtle nesting grounds; Horse shoe crabs' habitats; Sea grass beds; Nesting grounds of birds; Areas or structures of archaeological importance and heritage sites.
- **CRZ-I B**: The intertidal zone i.e. the area between Low Tide Line and High Tide Line shall constitute the CRZ-I B.

- **CRZ-II:** The developed land areas up to or close to the shoreline, within the existing municipal limits or in other existing legally designated urban areas, which are substantially built-up with a ratio of built-up plots to that of total plots being more than 50 per cent and have been provided with drainage and approach roads and other infrastructural facilities, such as water supply, sewerage mains, etc.
- **CRZ-III:** Land areas that are relatively undisturbed (viz. rural areas, etc.) and those which do not fall under CRZ-II
  - CRZ-III A: Such densely populated CRZ-III areas, where the population density is more than 2161 per square kilometer as per 2011 census base.
  - CRZ-III B: All other CRZ-III areas with population density of less than 2161 per square kilometer, as per 2011 census base, shall be designated as CRZ-III B.
- **CRZ- IV**: It constitute the water area.
  - CRZ- IVA: The water area and the sea bed area between the Low Tide Line up to twelve nautical miles on the seaward side shall constitute CRZ-IV A.
  - CRZ- IVB: CRZ-IV B areas shall include the water area and the bed area between LTL at the bank of the tidal influenced water body to the LTL on the opposite side of the bank.

The Municipality fall within CRZ I, II and IV. The Figure 12-6 shows the CRZ within the Municipality.

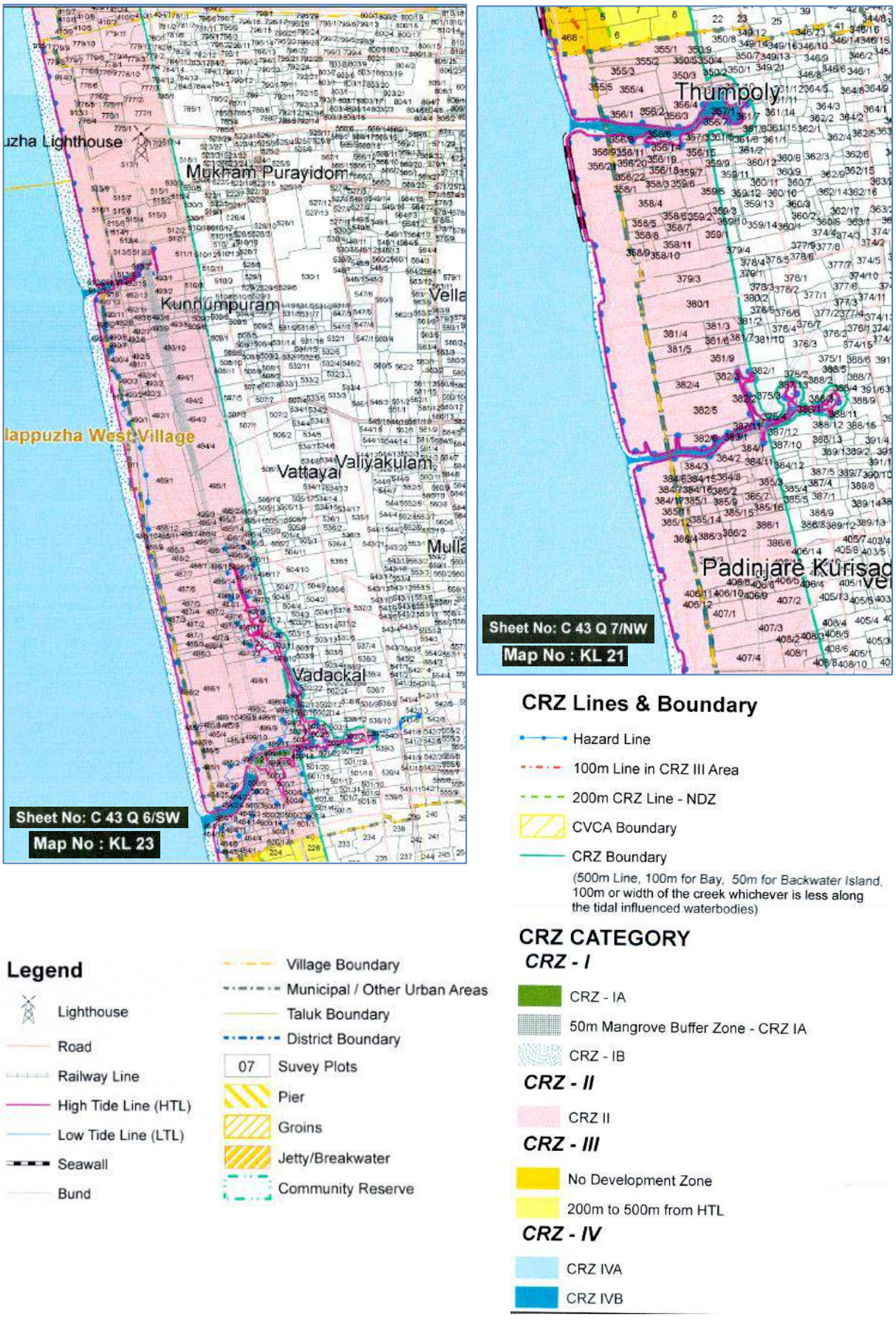


Figure 12-6: Coastal Regulation Zones within the Municipality (Coastal Zone Management Plan)

12.5 Inferences

All the canal stretches were found to have the presence of fecal coliforms indicating sewage contamination. The water quality parameters indicate that commercial canal receives comparatively higher waste water contamination than Vadai canal. Rejuvenation of the canals would require control of sewage inflow, reduction of sewage concentration through pre-treatment and aeration of canals to increase dissolved oxygen to the safe levels for aquatic animals. One of the major observations is the inability of households to keep the safe distance between wells and septic tanks due to the small plots of households with a low per capita availability of land. Bacteriological contamination in wells was tested to understand the extent of the problem and also to conscientize households on the quality of water they are using.

Even though the Municipality has a serene environmental quality, some problems do exist and hence the authorities need to be vigilant to mitigate the present problems as well as to conserve the environmental quality.

13 HAZARD PROFILE & RISK ASSESSMENT

13.1 Introduction

The Disaster Management Act, 2005 (Central Act 53 of 2005) of India in its Section 2 (d) defines disaster as 'a catastrophe, mishap, calamity or grave occurrence affecting any area from natural and manmade causes, or by accident or negligence, which results in substantial loss of life or human suffering or damage to, and destruction of property, or damage to, or degradation of environment and is of such a nature and magnitude as to be beyond the capacity of the community of the affected area'. Primarily disasters are triggered by natural hazards or human-induced or result from a combination of both. The human-induced factors can greatly aggravate the adverse impacts of a natural disaster. Even at a larger scale, globally, the UN Inter-Governmental Panel on Climate Change (IPCC) has shown that human-induced climate change has significantly increased both the frequency and intensity of extreme weather events. While heavy rains, cyclones, or earthquakes are all natural, the impacts may, and are usually, worsened by many factors related to human activity. The extensive industrialization and urbanization increase both the probability of human induced disasters, and the extent of potential damage to life and property from both natural and human induced disasters. The human society is also vulnerable to chemical, Biological, Radiological and Nuclear threats and events that might escalate to disasters. (National Disaster Management Plan, 2016)

13.2 Climate Change and its Implications

Climate change happens when the earth's climate system adjusts and displays new weather patterns. Climate change refers to long-term shifts in temperatures and weather patterns. These shifts may be natural whereas human activities have been the main driver of climate change. Greenhouse gas emissions act like a blanket wrapped around the Earth, trapping the sun's heat and raising temperatures and results in climate change. Climate change can affect our health, ability to grow food, housing, safety and work. Some of us are already more vulnerable to climate impacts. (United Nations, n.d.). Climate change will have wide-ranging effects on the environment, and on socioeconomic and related sectors, including water resources, agriculture and food security, human health, terrestrial ecosystems and biodiversity and coastal zones. Changes in rainfall pattern are likely to lead to severe water shortages and/or flooding. Rising temperatures will cause shifts in crop growing seasons which affects food security and changes in the distribution of disease vectors putting more people at risk from diseases. Increasing sea levels mean greater risk of storm surge, inundation and wave damage to coastlines. A rise in extreme events will have effects on health and lives as well as associated

environmental and economic impacts. (Climate Change: Impacts, Vulnerabilities and Adaptation in developing countries).

According to the Kerala State Action Plan on Climate Change, published by the Department of Environment and Climate Change in 2014, mention that the coastal region of the state is particularly vulnerable to climate change. The high dependency of climate sensitive sectors like agriculture, fisheries, forest, water resources and health increase the vulnerability of the region. As per the action plan, Alappuzha is one of the most vulnerable districts in Kerala, because of the network of environmentally sensitive wetlands, lagoons and sandy beaches. The directorate of Environment and Climate Change (Govt. of India, 2017) indicates that the shoreline changes in Kerala have become prevalent over the years. The average height of Kerala's coastal plain is less than 8 meters and especially the districts of Alappuzha and Kottayam are below the mean sea level. Inundation and flooding induced as a result of climate change, coupled with increased storm surges could lead to massive destruction through habitat loss and infrastructural damage. State of Kerala is highly vulnerable to natural disasters and changing climatic dynamics given its location between the Western coast and steep slopes of the Western Ghats.

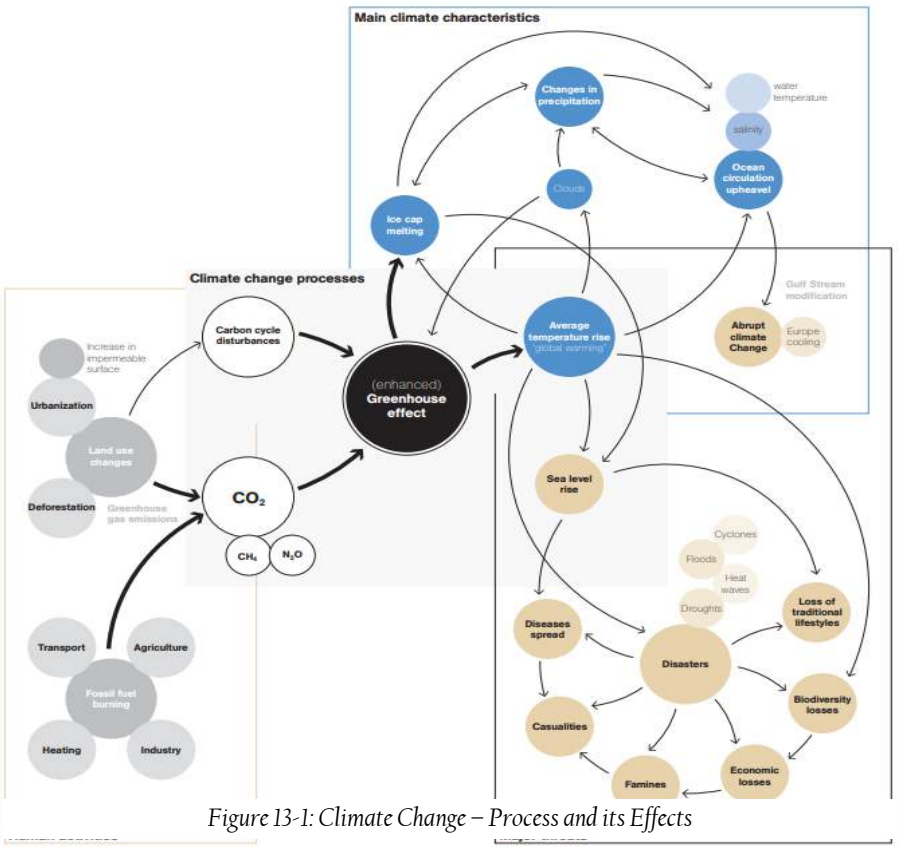


Figure 13-1: Climate Change – Process and its Effects

The state has seen several such adverse events one after the other, starting with Cyclone Ockhi in 2017, floods and landslides in 2018, 2019 and 2020, Nipah virus in 2019 and COVID-

19 pandemic. The 2018 floods led to widespread loss of life, property, and habitats, affecting several millions and leading to economic losses. These events and their impacts highlighted the level of under preparedness of the State to deal with these natural disasters and climate change shocks. (Resilient Kerala Program for Results, 2021)

Climate change can affect our everyday lives in many ways:

- Climate change can lead to higher levels of river and surface flooding in developed areas.
- Climate change can cause more frequent and severe weather events that can disrupt communication systems.
- Increasing temperatures and heavy precipitation events can overwhelm the energy grid.
- Higher maximum temperatures, more freeze-thaw cycles, more rain on average, and more frequent heavy rains will increase the likelihood of impacts to transportation networks.
- Climate change creates uncertainty for waste and wastewater treatment facilities due to increased flooding and other extreme weather events.
- Increasing temperatures and precipitation changes impact inland bodies of water. Increasing average temperatures and changes in seasonal precipitation amounts pose threats to urban landscapes and ecosystems.
- Drought, higher temperatures and changing precipitation patterns affect the health and beneficial functionality of wetlands.
- Low-income households are more likely to live in areas that are expected to be harder hit by extreme weather events.
- Agriculture sector and food supply system are vulnerable to extreme weather events and flooding.

Alappuzha being a coastal town and located in the Manimala- Pamba-Achankovil river basin, is highly prone to hazards and the effects of climate change increase the severity and recurrence.

13.3 Hazard Profile

As per the report on "Impact of climate change in four regions of the country" submitted to the Government of India by the Indian Network for Climate Change Assessment (INCCA); reduced rainfall, increased atmospheric temperature and flooding due to sea level are the expected climate change scenarios in Kerala for the next 20 years. The temperature is likely to increase by 2°C by 2050. During this period, South - Central districts of Kerala will have the tendency to increase the rainfall of 20 to 30cm deviation from the normal, which comprises Ernakulam, Alappuzha, Kottayam, Pathanamthitta and Idukki districts. Also, it is projected that if the sea level rises by one meter, 169sq. km of the coastal region surrounding Kochi will be inundated. It shows that the coastal region of Kerala is one of most vulnerable regions in the country due to projected sea level rise. Vulnerability to Sea Level Rise would be of alarming to the majority coastal communities. Backwater banks, islands and filtration paddy fields are other sections of the coastal zone which are highly susceptible to Sea Level Rise. As per the Kerala State Action Plan on Climate change, Alappuzha is one of the four major climate change hotspot districts in Kerala, which is most vulnerable to climate change exposure with higher values of composite vulnerability index. The district lacks adaptive capacity and shows higher sensitivity and exposure to climate change in terms of social and environmental variables due to the presence of wetlands, lagoons and sand beach.

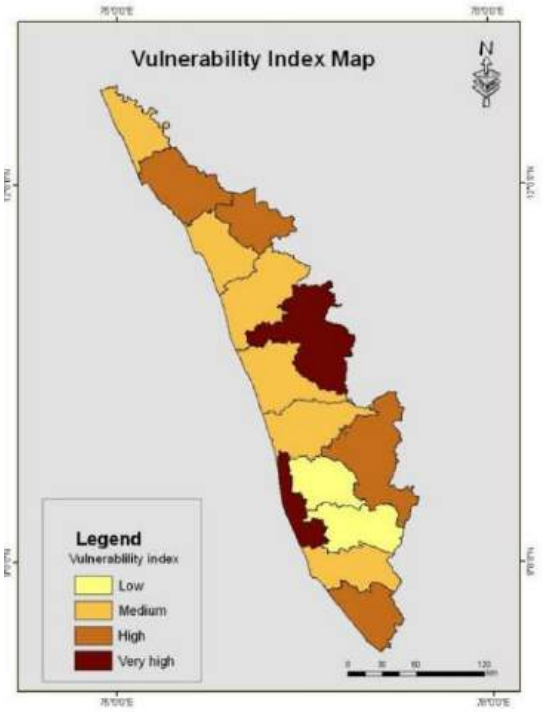


Figure 13-2: Vulnerability Index map of Kerala

Kerala state is frequently ravaged by the disastrous consequences of numerous hazards and hence it is a multi-hazard prone State. Within a short period of last 80 years, there has occurred a rapid socio-economic transformation from an agrarian society to a highly urbanized consumerist society. The population in Kerala is more or less widely distributed across all geomorphic units of the state, exposing them to multiple hazards. The geographical location, weather pattern and the nature of population density makes the state prone to severe natural as well as manmade disasters. The high density of population of 860 people/km2 (2011 Census), narrow roads, high density of road network, density of coastal population and the general

higher standard of living of the public are factors that increase the vulnerability of the population to disasters.

The Kerala State Disaster Management Plan (KSDMP) 2016 identifies thirty-nine phenomena with potential to cause disasters requiring attention that the state is susceptible to and they are grouped under two categories based on the major triggering factors, they being Naturally Triggered Hazards (Natural Hazards) and Anthropogenically Triggered Hazards (Anthropogenic Hazards). Kerala is mainly prone to natural hazards such as flood, coastal erosion, drought, lightening, land slide, cyclone and earthquake. Almost all the districts are multi-hazard prone. Kerala is the 8th most densely populated in the country, 14.5% of the state is flood prone, 14.4% of the state is landslide prone, 55.5% of the coastline prone to coastal hazards, the state falls in zone 3 in the national seismic zonation map.

Floods are the most commonly occurring natural hazards, while 'the great flood' of 1924 AD was one of the major floods which caused large scale destruction to the state. Then after a long while 2018 and 2019 victimized a large-scale destructive disaster which occurred almost all over the areas of state. These dark memories brought to think about a different perspective in planning to develop an ideology that focused on eco-restoration, sustainability and mitigation of disasters. The Tsunami of 26 December 2004 added a new dimension to the disaster profile of the state. Kerala is prone to high incidence of lightning, especially during the months of April, May, October and November. Droughts and minor earth tremors also occur occasionally. Apart from floods the mountain regions of the state experience several landslides during the monsoon season. The 570 km long coast line of Kerala is prone to erosion, monsoon storm surges and sea level rise. Land subsidence due to tunnel erosion or soil piping which is a slow hazard, is recently noticed to be affecting the hilly areas in the state. This often goes unnoticed and is a hazard with potential of causing landslides, infrastructural damages and crop loss covering vast areas in the high land regions of the state.

13.3.1 Hazard Profile of the District

Alappuzha is one of the coastal districts of Kerala. About 80% of the district comes under low land region; there are areas in Kuttanad where land level comes below sea level. Alappuzha has been traditionally vulnerable to natural disasters on account of its unique geoclimatic conditions & vast coastline. Floods and droughts have been recurrent phenomena. Table 13-1 shows the hazard profile of the district as per District Disaster Management Plan (DDMP).

Table 13-1: Types of Disasters *(District Disaster Management Plan Alappuzha, 2015)*

Sl. No.	Category	Type
1	Natural Hazards	Flood
		Drought
		Coastal hazards (Kallakadal, Tsunami, Salt Water Intrusion, Coastal erosion)
		Cyclone
		Thunder & Lightning
	Geological	Earthquakes
		Landslides
	Biological	Epidemics
		Cattle Epidemics
		Food Poisoning
		Avian epidemics
		Animal epidemics
		Pest attack , Bird Flue
	Anthropogenically / Technologically Triggered	Industrial explosions Petro - chemical Transportation Accidents
		Fire works accidents
		Road accidents
		Human Triggered Forest Fire
		Stampede
		Short circuit and related fire
		Building Collapse
		Boat Capsizing
		Tourism related drowning
		Rail Accident
		Hooch accident

The hazard seasonality mapping of the district is shown in Table 13-2. It shows that drought occurs mainly during the month's March to May. Storm surge happens during June and July and lighting occurs in the months of April, May, October and November. Flood happens during the months from June to November.

Table 13-2: Hazard Seasonality Mapping of the District

Disaster	J	F	M	A	M	J	J	A	S	O	N	D
Drought												
Storm surge												
Lightning												
Flood												

13.3.2 Hazards identified in Alappuzha Town

The main sources of hazard information of any town are the Disaster management plans published by agencies like Kerala State Disaster Management Authority, District Disaster

Management Authority and Local authority. Another source is the data from past events which had been documented.

As per the hazard maps available in State Disaster Management Plan and District Disaster Management Plan(DDMP), the most probable hazards in Alappuzha town are: flood, coastal hazards, drought and lightning. On review, it was seen that the Local Disaster Management Plan prepared after the 2018 floods do not have information related to hazards and their proneness with in the town.

The hazards particular to the town are detailed below.

1. **Coastal Hazards**

Coastal hazards are physical phenomena that expose a coastal area to risk of property damage, loss of life and environmental degradation. The population that lives along or near our coastlines are an extremely vulnerable population. There are numerous issues facing our coastlines. Natural hazards and extreme events in the coastal zone are becoming more frequent and energetic, and in future scenarios this tendency will remain or even increase due to climate changes. Coastal areas may be more vulnerable to severe storms, erosion, and coastal flooding. Sea level rise, changes in storms and wave as a consequence of global climate change are expected to increase the size and magnitude of flooded and eroding coastal areas, thus having profound impacts on coastal communities and ecosystems. The Western side of Alappuzha district is bounded by Lakshadweep Sea. Thus, the district has got a long stretch of coastal area with 80km of length. Sea as a major weathering agent plays a vital role in carving the beaches of Alappuzha.

Figure 13-3 shows the Coastal Hazard Susceptibility map of Alappuzha district and Alappuzha town as per DDMP 2015. The three types of hazard events considered in DDMP are coastal erosion, storm surge and Tsunami. Though sea-level rise has not been considered in DDMP, owing to the climate change scenario, that aspect also is mentioned briefly.

a) Coastal Erosion

Coastal erosion is one of the grave natural hazards affecting the Alappuzha district. The coastal erosion observed in Alappuzha Town is less compared to other parts in the district, though the erosion is steadily increasing. As per DDMP, the coastal erosion vulnerability is shown as low.

b) Cyclones/Tsunami

The Indian Ocean Tsunami of 2004, was one of the major natural calamities in the country. Alappuzha was one of the most heavily damaged districts in terms of life and material. (Disaster, Disaster Management and Livelihood of Fishermen: A study on selected areas of Kerala, 2018). During the Tsunami of December, 2004 about 30.47km of Karthikapally Taluk got affected. In the case of Alappuzha Town, the effect of Tsunami was quite less. The cyclone Ockhi experienced in 2017 was one of its kind in the last 100 years in Kerala and caused damages to Alappuzha coast also. The cyclones in Arabian Sea had increased in recent times causing damages all along the coastal region. Recently, cyclone Tauktae in 2021 caused damages in Alappuzha Town due to uprooting of trees and branches to buildings, roofs being blown away and power supply line damages.

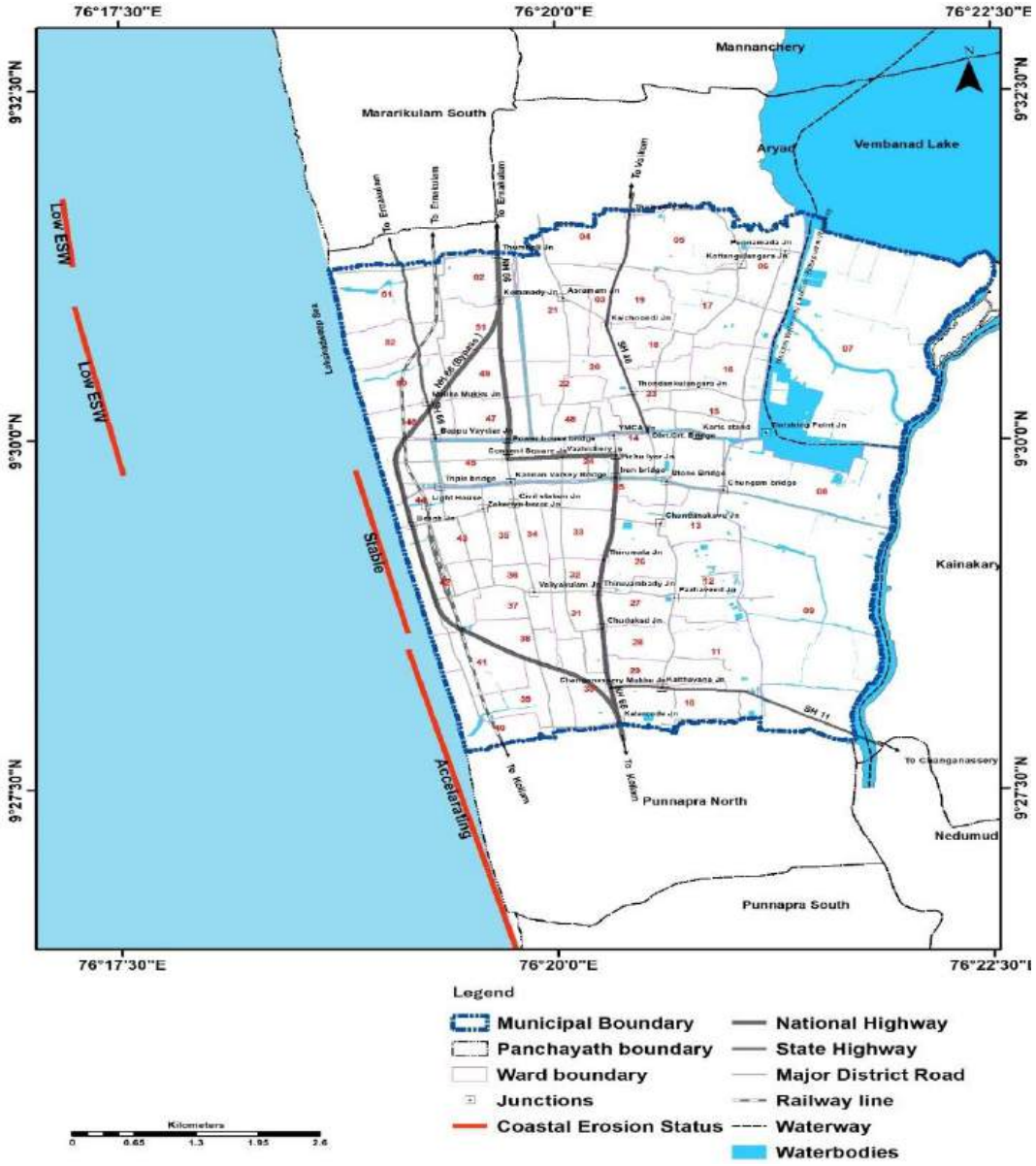


Figure 13-3: Coastal Hazard Susceptibility map of Alappuzha Town

c) Salt Water Intrusion

Salt water intrusion is a major issue along the coastal areas. Salt water intrusion is expected to become a more serious issue as our climate changes. Sea-level rise, extreme weather events, coastal erosion, changing precipitation patterns, warmer temperatures, and the potential for increased freshwater demand could all increase the risks of saltwater intrusion. Over exploitation of groundwater resources may also result increased risk of saltwater intrusion.

The ground water source dependency for drinking water is negligible in Alappuzha Town as people depends majorly on piped water supply.

d) Sea Level Rise

Sea level rise is one of the mostly known of climate change's many dangers. As humanity pollutes the atmosphere with greenhouse gases, the planet warms. And as it does so, ice sheets and glaciers melt and warming sea water expands, increasing the volume of the world's oceans. Sea level rise poses numerous risks to residences, buildings and infrastructure located in vulnerable areas. The risk of sea level rise to coastal water utility infrastructure varies based upon the rate of sea level rise relative to land elevation in a particular location. For coastal regions, no change is likely to have a greater impact than that of sea-level rise.

Where relative sea level rise occurs, it amplifies near-term vulnerability to storm surge and increases long-term flood and inundation risk. Rising sea levels amplify the threat and magnitude of storm surges in coastal areas. Higher water levels during tides can reverse or reduce efficiency of storm water drainage and wastewater outfall operations. Sea level-rise can also threaten the long-term operation of drinking water, wastewater and storm water utilities. It also increases saltwater intrusion into freshwater resources. (Environmental Resilience Institute, n.d.)

The effect of sea level rise in Alappuzha may aggravate as the back flow towards mainland can submerge many parts of Kuttanad region that lie below mean sea level. The areas adjoining to Vembanad lake and eastern part of the town can be the primarily affected by sea level rise.

2. Lightning

There are incidents of lightning in the South Eastern and Northern part of the district. As per the hazard seasonality study lighting occurs in the months of April, May, October and November. As per the lightning frequency map of the district, the South-West side of Alappuzha Municipality comes under lighting susceptible area. The lighting frequency map of the district is shown in Figure 13-4.

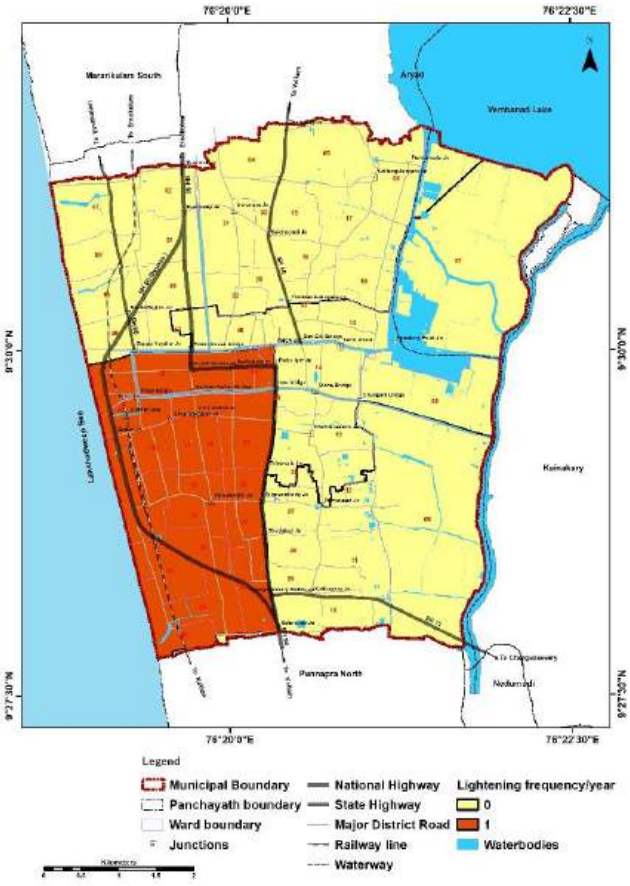


Figure 13-4: Lightning frequency map of Alappuzha

3. Drought

Alappuzha municipal area comes under moderate drought prone area as per DDMP 2015. Drinking water shortage occurring due to rainfall deficit is generally represented as drought prone in maps published by KSDMA. Until now there is no severe drought hazard noticed. The drought prone area of Alappuzha District and Alappuzha town is shown in Figure 13-5.

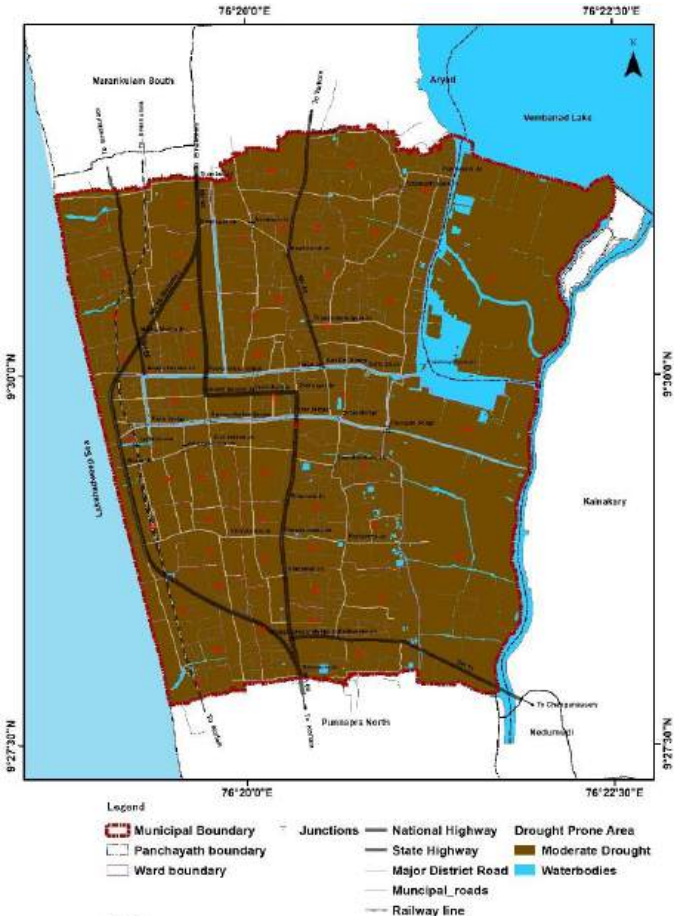


Figure 13-5: Drought prone area map of Alappuzha Town

4. Epidemics

Changes in mean climatic conditions and climate variability also can affect human health through indirect pathways, particularly via changes in biological and ecological processes that influence infectious disease transmission and food yields. Alappuzha district had witnessed a disturbing spread of epidemics during the last years. Dengue fever and Leptospirosis are the most commonly reported diseases.

Figure 13-6 shows the number of cases of Dengue fever and Leptospirosis reported during 2016 to 2018 in Alappuzha Municipality. Apart from this, some cases of H1N1, Chickenguniya, Hepatitis has also been reported during the last years.

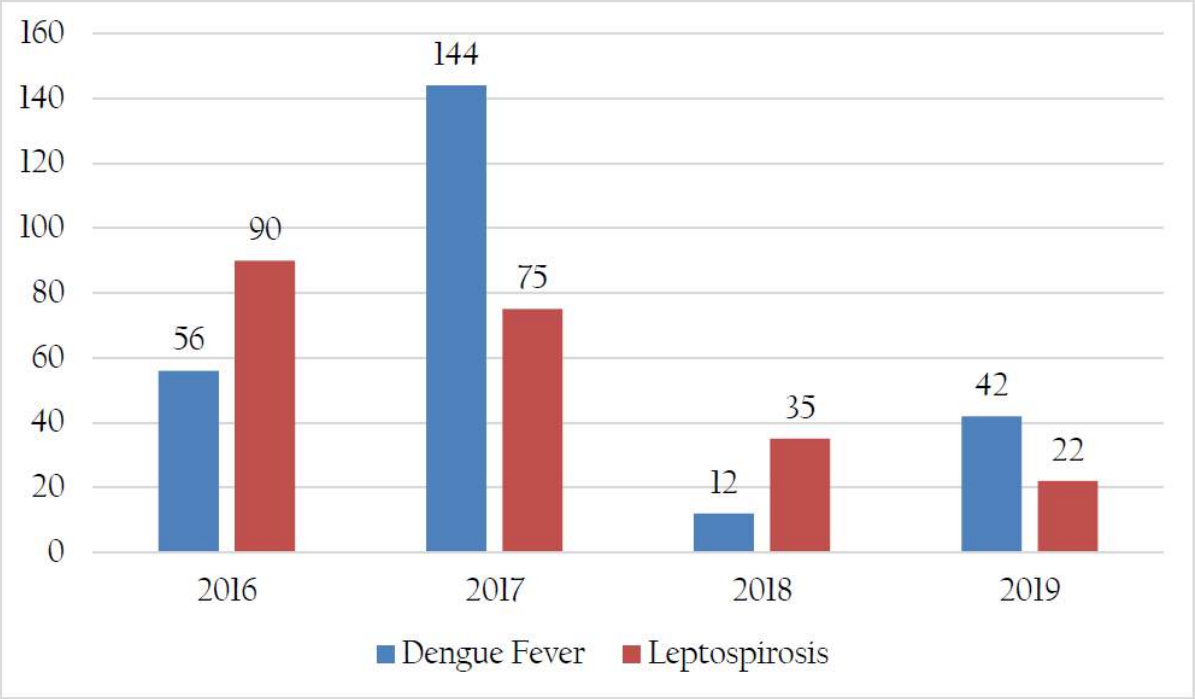


Figure 13-6: Number of Cases reported – Dengue Fever & Leptospirosis (2016 – 2019)

Source: Health Department, Alappuzha

5. **Flood**

Flood is the major disaster happened previously in Alappuzha District. Figure 13-7 shows the flood susceptibility map of Alappuzha District as per the District Disaster Management Plan 2015. In case of Alappuzha Municipality Eastern side comes under low lying area. As per NCESS, 37% of total area in Municipality is susceptible to flood.

KSDMA has published flood hazard probability maps for different return periods based on historic data and RCP 8.5 climate change scenario. Flood return probability of 10, 50 & 500 years in each case is considered here for analysis. In case of 1 in 10 year return probability based on historic data 8.08 sqkm of the town will be under flood. 9155 persons and 1503 buildings in that area may be affected. 10.93 sqkm of the town, 14894 people and 2798 buildings can be affected if the 10 year return probability map based on RCP 8.5 climate change scenario is considered.

Area under flood in both these cases is shown in Figure 13-8. In the case of 1 in 50 year return probability based on historic data 10.47 sqkm of the town, 13077 persons and 2025

buildings in the town may be affected. But in case of RCP 8.5 climate change scenario, 11.28 sqkm of the town, 17282 people and 3368 buildings may be affected for 1 in 50 year return probability flood. 1 in 50-year flood return probability map is shown in Figure 13-9.

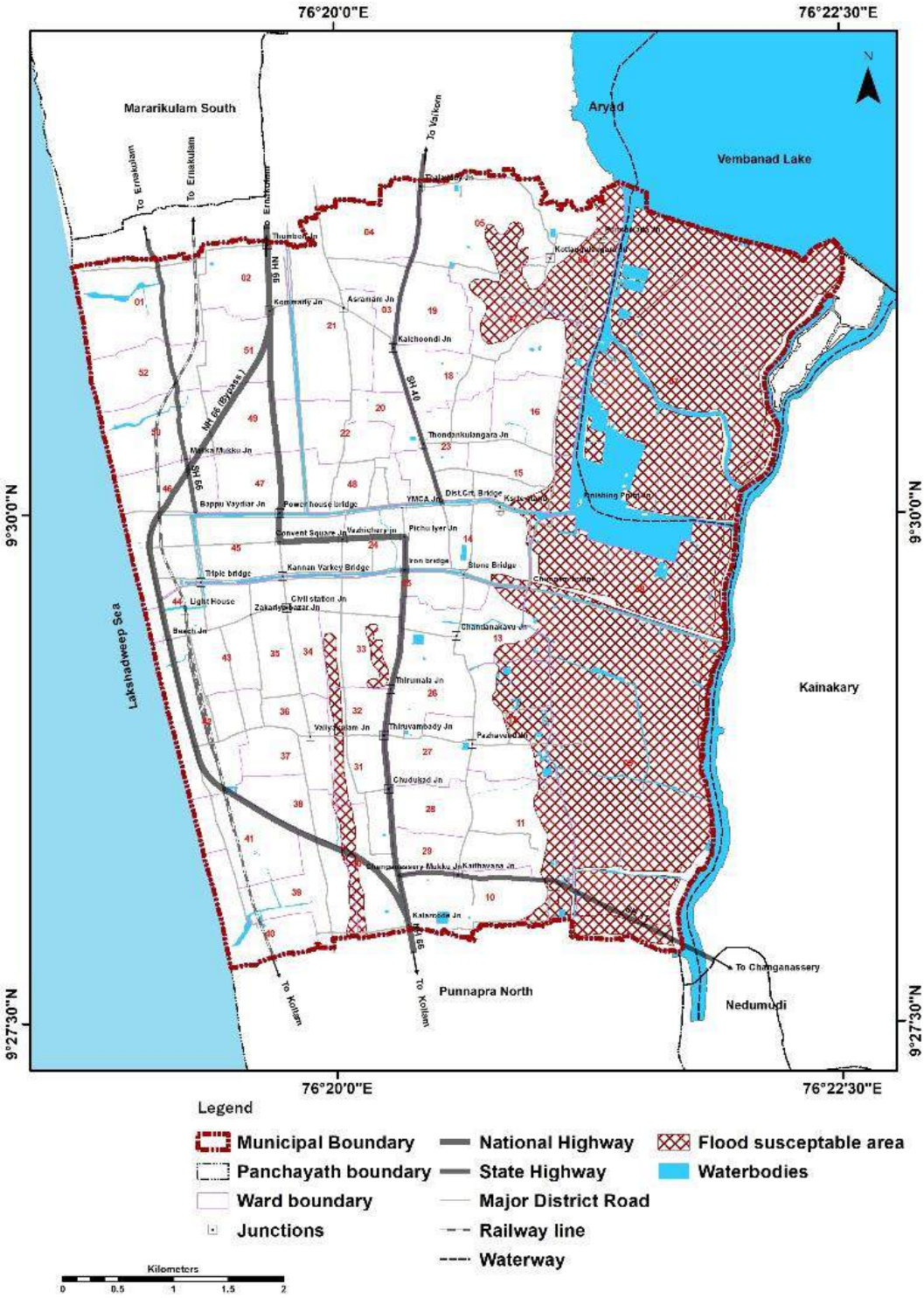


Figure 13-7: Flood Susceptibility Map of Alappuzha District
Source: DDMP Alappuzha, 2015

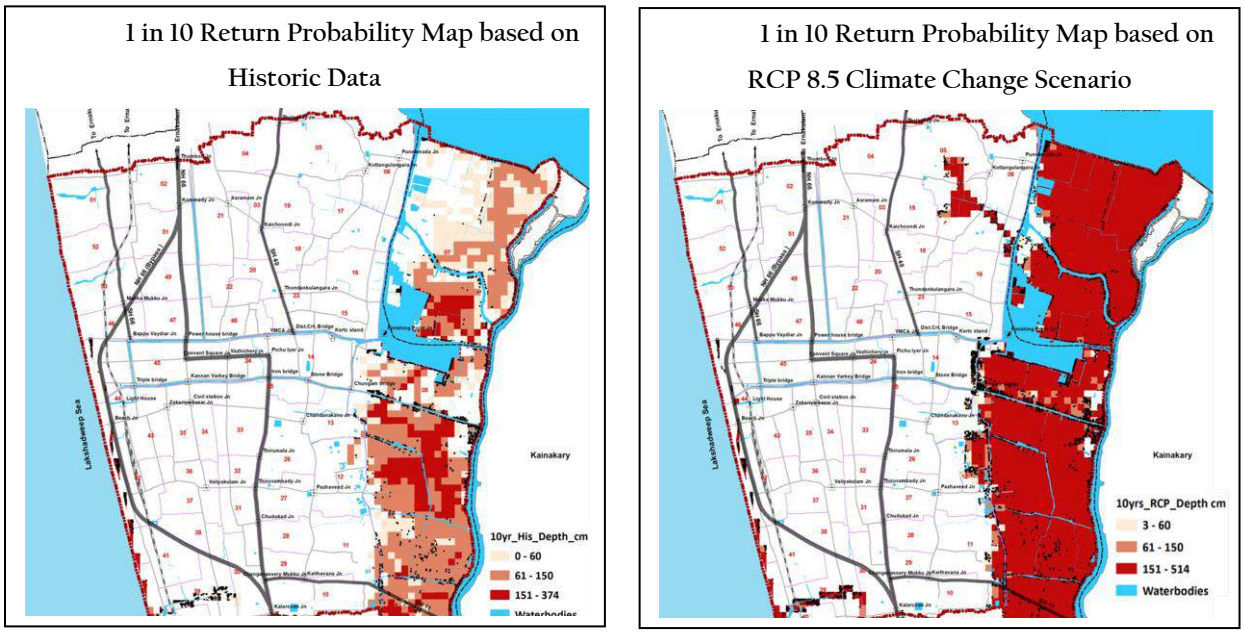


Figure 13-8: 1 in 10 year Flood Return Probability map
Source: Generated using data from KSDMA

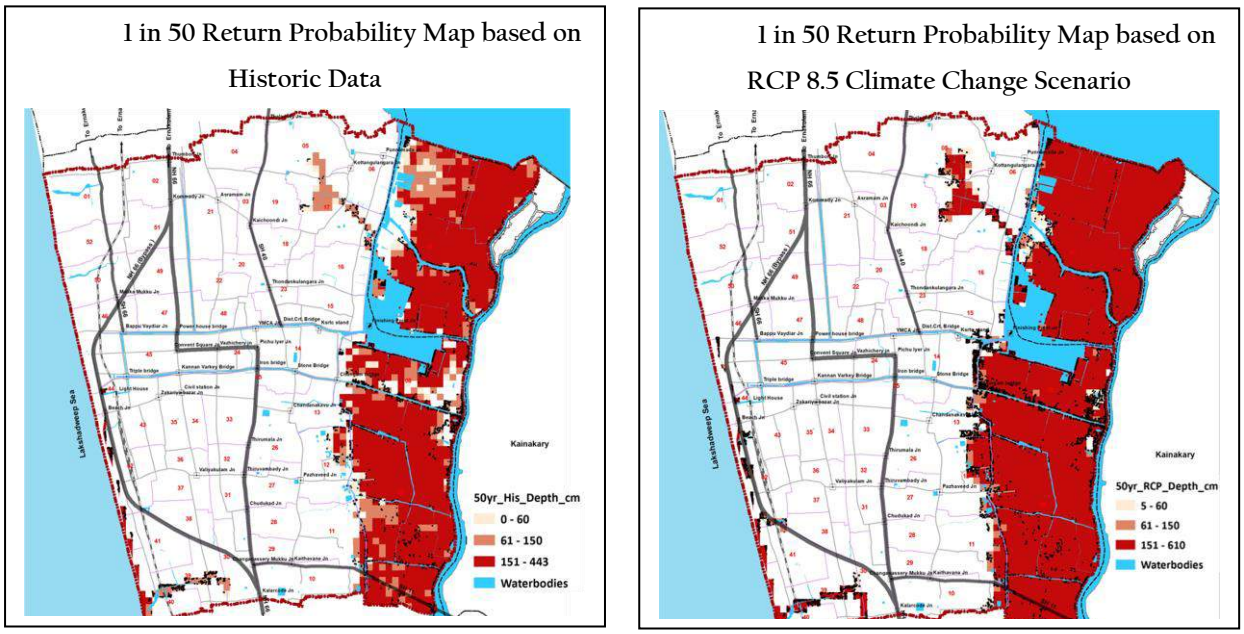
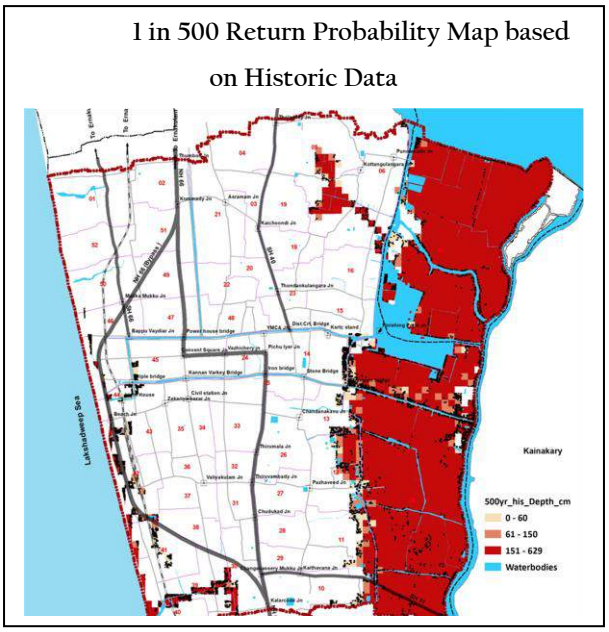


Figure 13-9: 1 in 50 year Flood Return Probability map
Source: Generated using data from KSDMA

For 1 in 500 return probability based on historic data, area under inundation will be 11.42 sqkm, people likely to be affected will be 15042 and buildings likely to be affected will be 3427. For the same return probability based on RCP 8.5 climate change scenario area under inundation will be 12.12 sqkm, people likely to be affected will be 20263 and buildings likely to be affected will be 4170 and it is shown in Figure 13-10.



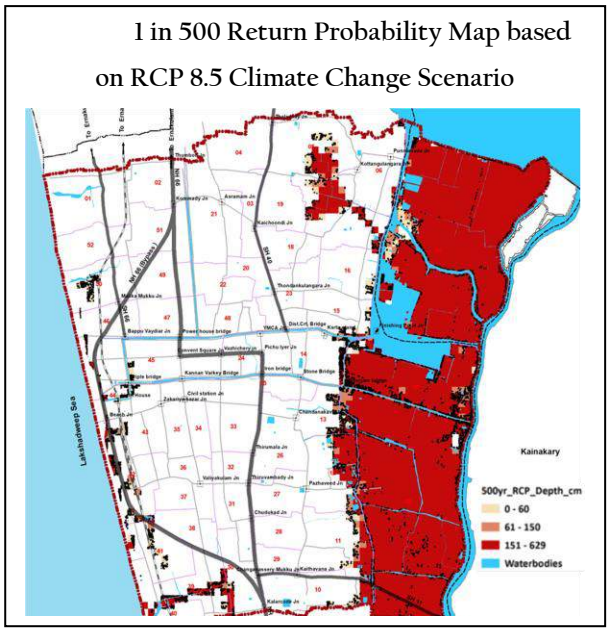


Figure 13-10: 1 in 500 year Flood Return Probability map
Source: Generated using data from KSDMA

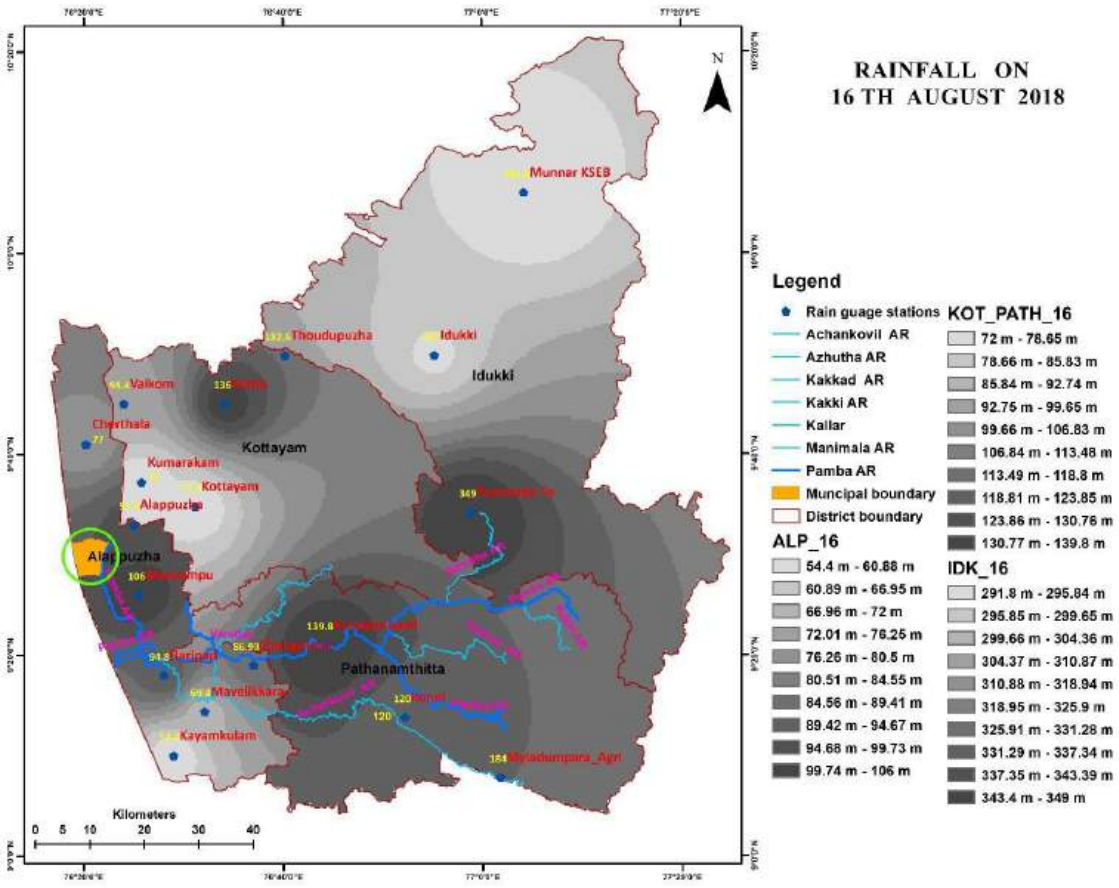


Figure 13-11 Rainfall on 16th August 2018

During the time of mega flood happened in 2018, abnormally high rainfall was experienced from 1st June 2018 to 19th August 2018 all over Kerala. As per the report of Central Water Commission (CWC), the runoff generated from Pamba, Manimala, Achankovil and Meenachil rivers during 15-17 August rainfall was about 1.63 BCM, out of which only about 0.605 BCM runoff was possible to drain out of the Vembanad lake. The remaining runoff volume of about 1 BCM created the rise of the water level in the lake and nearby areas. Considering the high rainfall during 15-17, August 2018, the absence of appreciable storage reservoirs in the upstream on the above rivers, shrinkage of carrying capacity of Vembanad Lake and reduction of the capacity of Thottappally spillway may have worsened the flooding in the Kuttanad region and the backwater flows to the low-lying areas in the upper reaches of the lake. It resulted in heavy flooding experienced in the low-lying areas closer to the Vembanad Lake in the Pathnamthitta, Kottayam and Alappuzha districts. The flash flood created during this time mostly affected the Kuttanad and Chengannur regions of the district. Figure 13-11 shows the rainfall data on 16th August 2018.

As per the Disaster Management Plan prepared by Alappuzha Municipality, 2930 peoples lost their livelihoods in 2018 and 1560 in 2019 flood. The prime importance of Alappuzha Municipality is to act as a feeder for the victims of surrounding areas prominently like Kuttannad area for rescue camping.

Flood affected areas in Alappuzha town during 2018 were surveyed by a team from district office of LSGD planning and inundation levels during 2018 flood were collected. These measurements were then mapped to understand the flood level rise which is shown in Figure 13-12. The extent of area affected in the town is more in 2018 flood than that in the different return probability maps published by KSDMA. But the inundation levels are low. 12.7 sqkm of the area were inundated and nearly 7553 buildings and 27464 people were affected. Nehru Trophy, Thirumala and Pallathuruthy, wards are completely affected by flood.

Further study of flooding in the town indicated that the cause/reason for flooding in different wards are not the same. There were 3 types of floods observed in the municipal area viz. Coastal Flooding, Riverine flooding and Urban Flooding. Details of wards affected are given in Table 13-3.

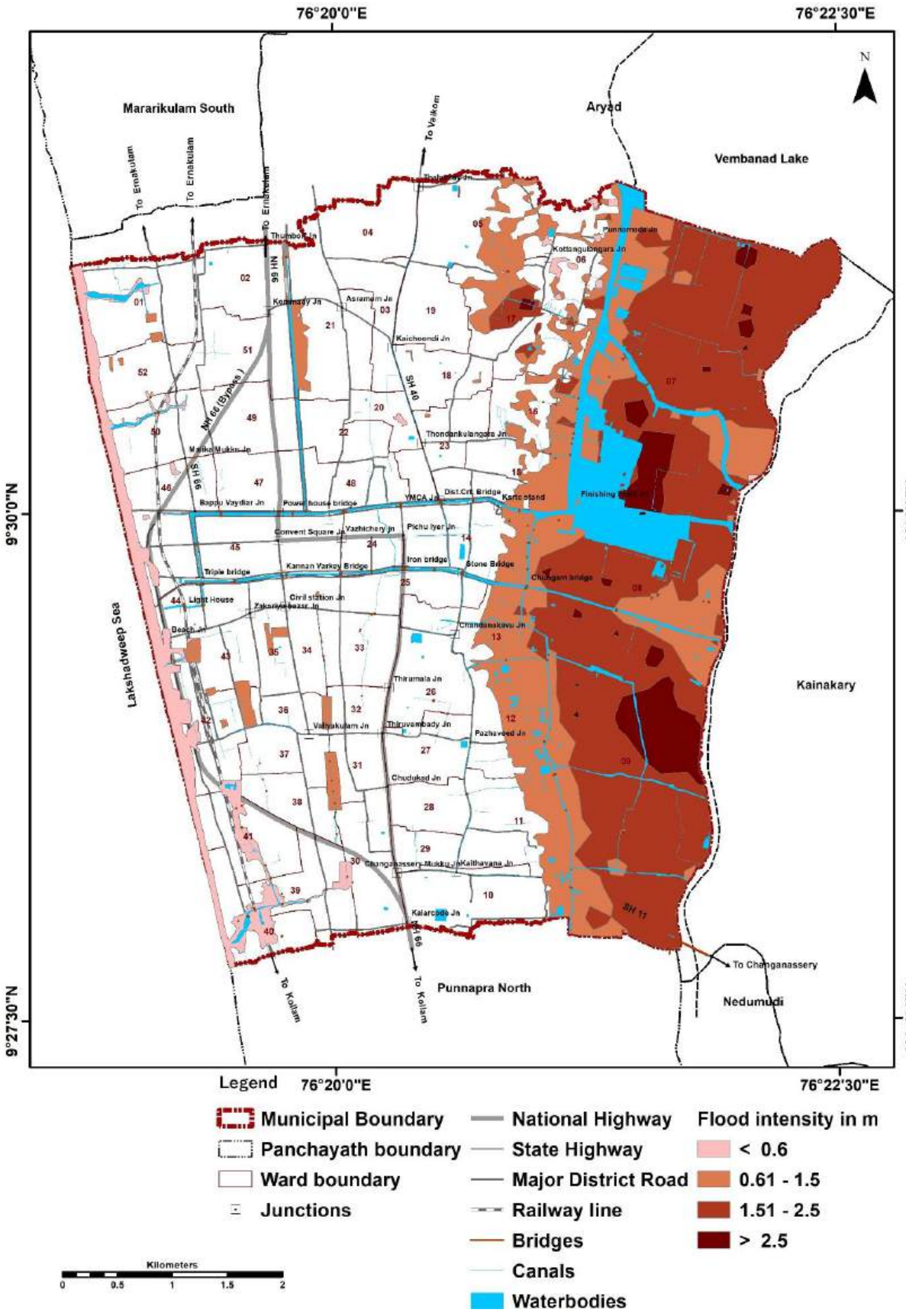


Figure 13-12: Flood level mapping, 2018
Source: Generated from database

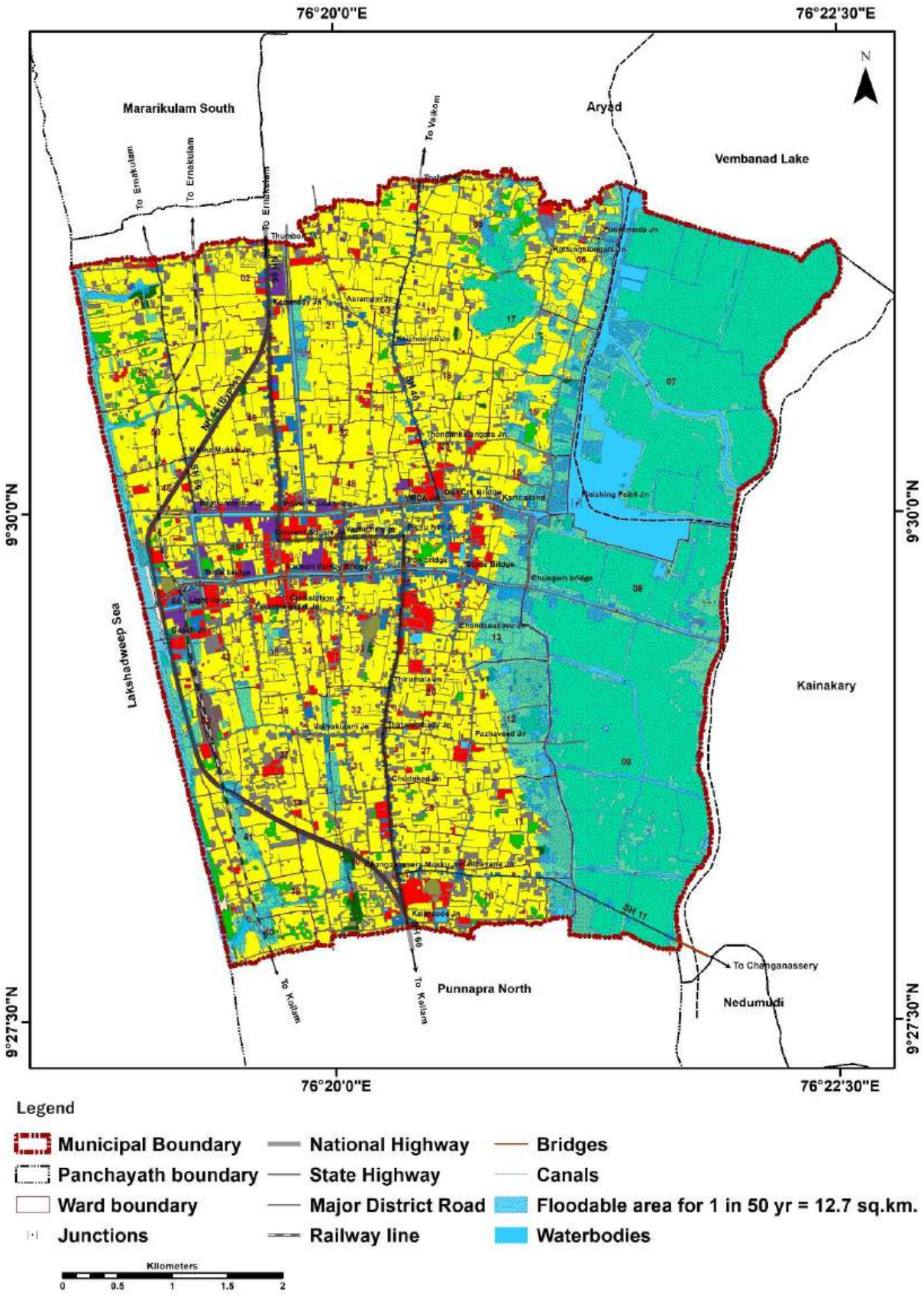


Figure 13-13: Land use in flood affected region
Source: Generated from database

Table 13-3: Flood Affected wards and percentage of area affected

WARD NO	WARD NAME	% OF AFFECTED AREA
	COASTAL FLOODING	
1	THUMPOLY	11.4
39	GURUMANDIRAM	15.2
40	VADACKAL	25.5
41	BEACH	18.8
42	RAILWAY STATION	35.4
44	CIVILSTATION	6.4
45	SEA VIEW	9.7
46	VADACANAL	9.5
50	KANJIRAMCHIRA	12.4
52	MANGALAM	10.5
	RIVERINE FLOODING	
7	NEHRUTROPHY	100.0
8	THIRUMALA	100.0
9	PALLATHURUTHY	100.0
17	KARALAKAM	44.9
	URBAN FLOODING	
2	KOMMADY	2.2
5	KOTTAMKULANGARA	23.1
6	PUNNAMADA	37.4
10	KALARCODE	9.6
11	KAITHAVANA	32.4
12	PAZHAVEEDU	61.7
13	PALACE	52.0
14	MULLACKAL	22.0
15	DISTRICT COURT	35.7
16	THATHAMPALLY	47.3
18	AVALOOKUNNU	1.0
20	THONDANKULANGARA	2.9
21	ASRAMAM	10.2
23	KIDANGAMPARAMBU	0.3
30	ERAVUKADU	1.9
31	MULLATHUVALAPPU	11.0
32	VALIYAMARAM	5.0
35	LAJANETH	10.3
36	VALIYAKULAM	21.4
37	VATTAYAL	4.5
38	KUTHIRAPPANTHI	4.4
43	ZACHARIA BAZAR	7.9

The percentage of various land use types that are in the flood affected region are listed in the Table 13-4 and shown in Figure 13-14. The major affected land use is Paddy followed by residential use. The residential areas affected constitute 17% of the total residential areas in town. 8.93 % of total area under commercial use in town was affected even though it constituted only 0.69% of flood prone area and 7.91% of the total area under public use of the town was affected by flood which constituted only 0.81% of the total flood affected area.

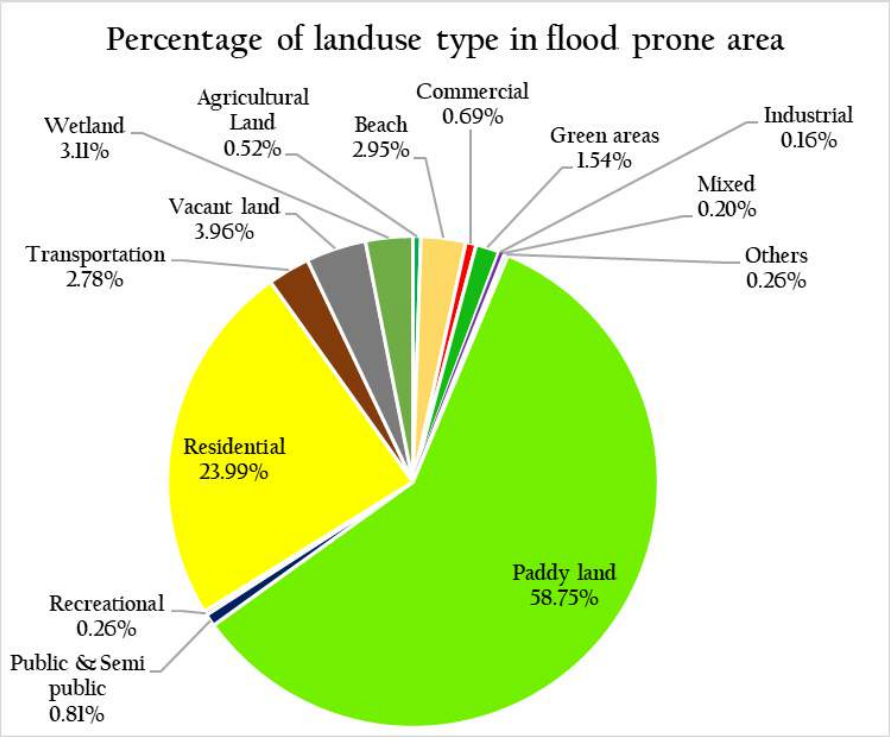


Figure 13-14: Percentage of land use type in flood prone area

Table 13-4: Area and percentage of land use type in flood affected area

Type of Land use affected	Area affected in sqkm	% of affected land use to total flood prone area	% of affected land use to that particular land use in town
Agricultural Land	0.07	0.52	39.48
Beach	0.37	2.95	90.55
Commercial	0.09	0.69	8.93
Green areas	0.20	1.54	26.93
Industrial	0.02	0.16	5.24
Mixed	0.03	0.20	11.68
Others	0.03	0.26	84.38
Paddy land	7.44	58.75	99.64
Public & Semi public	0.10	0.81	7.91
Recreational	0.03	0.26	17.34
Residential	3.04	23.99	17.00
Transportation	0.35	2.78	16.73
Vacant land	0.50	3.96	31.43
Wetland	0.39	3.11	93.77

13.4 Risk Assessment

As per Government Order (Ms.) No. 120/2022/LSGD, Guidelines for the Preparation of Risk Informed Master Plans was issued by the Local Self Government (EWB) Department, with the express purpose of supporting Local Self Governments across the State to prepare Risk Informed Master Plans (RIMPs) in a structured manner, starting with the 10

Municipalities in the Manimala–Pampa–Achenkovil river basin. Though hazards cannot be completely avoided, the vulnerability of people and assets to various hazards can be substantially and sustainably reduced through planned prevention, mitigation and preparedness measures. The focus is on risk reduction at the interface between societies and the natural environment, and integrating risk reduction into the land use planning process. It is part of this structured process that a methodology was adopted for Risk Assessment in Alappuzha Municipality.

13.4.1 Flood Hazard in Alappuzha

Flood hazard probability map for different return periods have been prepared by KSDMA; these include 1 in 10, 1 in 25, 1 in 50, 1 in 100, 1 in 200, and 1 in 500 scenarios. From the raster file available, inundation depths were reclassified into ‹60 cm, 60-150 cm and ›150 cm; based on this, estimates of inundated area and affected population were calculated for each return period, under the Historic and RCP 8.5 scenarios. In addition to the available SDMA/DDMA maps (for historic and RCP 8.5 scenarios), field-level data collected post floods (2018) and AMRUT (2021) were used to generate flood extents. As per the guideline, 1 in 50-year return probability event is considered as the design event for assessing hazard impact.

However, based on discussions with the KSDMA, it was decided to incorporate field-level data (based on past events) for finalizing the flood extent. This dataset had been ground-trothed, and contain data at a much greater resolution than currently available data from SDMA/DDMA maps.

13.4.2 Assessing flood risk in Alappuzha

For Alappuzha, risk assessment was conducted based on the published guidelines for preparation of Risk Informed Master Plan. It was deemed unfeasible to attempt to collect certain data banks, due to the granularity of certain parameters (for example, age of building at cadastral level), or the absence of KSDMA data for the hazard duration of floods. Such parameters have been removed, and their weightage redistributed to other parameters.

As per the Guidelines for preparation of Risk-Informed Master Plans, Risk Assessment consists of two major components:

Hazard Impact Assessment:

This component is developed using Flood map; the methodology assigns values to three sub-components, namely, Hazard Intensity, Hazard Return Probability, and Hazard Duration.

In Alappuzha's case, a complete dataset was unavailable for Hazard Duration (obtained though ground trothing during the 2018 floods). This sub-component was eliminated, and its weightage shifted to the other two sub-components.

Vulnerability Rating:

This component is developed using data obtained from AMRUT database, and other secondary sources, and modelled using GIS. Vulnerability is sub-divided into 6 sub-components, namely Social Vulnerability, Physical Vulnerability, Vulnerability of Basic Services, Economic Vulnerability, Environmental Sensitivity, and Coping Capacity. Each of these sub-components have their own parameters tabulated at ward- or cadastral–level (as specified in Table).

13.4.3 Hazard Impact Assessment

Hazard impact assessment is conducted using two parameters – Hazard Return Probability, and Hazard Intensity. Here, hazard return probability is used because flooding has been considered the primary hazard.

13.4.3.1 Hazard (Flood) Return Probability:

A return period probability map provides the estimated time interval between events of a similar size or intensity. Data for the same was taken from maps prepared by the Kerala State Disaster Management Authority (KSDMA), which takes historical rainfall trends into consideration. Return probabilities have been calculated for 10, 25, 50, 100, 200, and 500-year return periods, with 10-year return being assigned the highest value and 500-year return the least

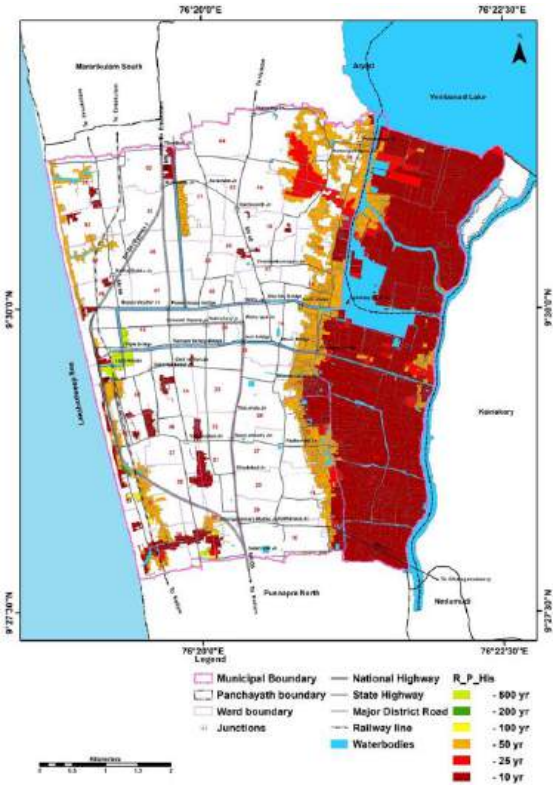


Figure 13-15: Return Probability Map

13.4.3.2 Hazard (Flood) Intensity:

Depth of flood inundation was taken to indicate the intensity of hazard. Flood inundation was classified under three categories. i.e. areas with inundation depth above 1.5m, 0.6 to 1.5m and below 0.6m map generated based on the intensity of flood is shown in Figure 13-16.

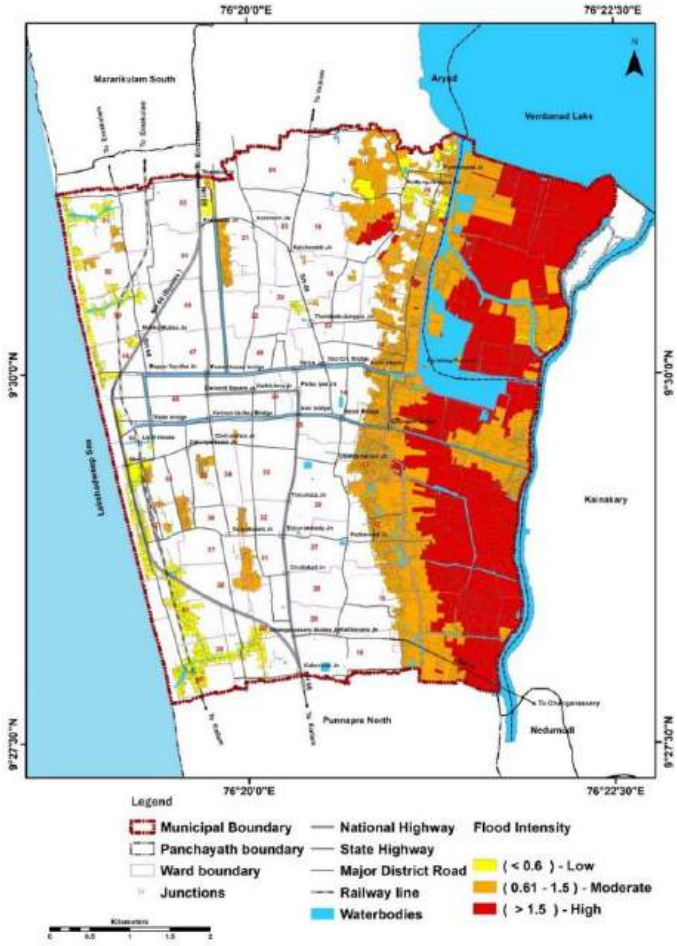


Figure 13-16: Flood Intensity Map

Based on the Return probability and Hazard intensity, Hazard Impact were assessed as per the guidelines and map generated is shown in Figure 13-17. These hazard zones shall help, direct and prioritize government investments in disaster reduction measures:

1. Priority 1 Very High Hazard Zone: Concentrated in the Eastern boundary of the Municipality and comprising of three wards.
2. Priority 2 High Hazard Zone: Distributed throughout the Municipality and comprising fringe zones to water bodies, mangroves, wetlands and paddy fields.
3. Priority 3 Moderate Hazard Zone: Concentrated on the Western side of the Municipality, comprising predominantly coastal wards.
4. Priority 4 Low Hazard Zone: Scattered within the town.

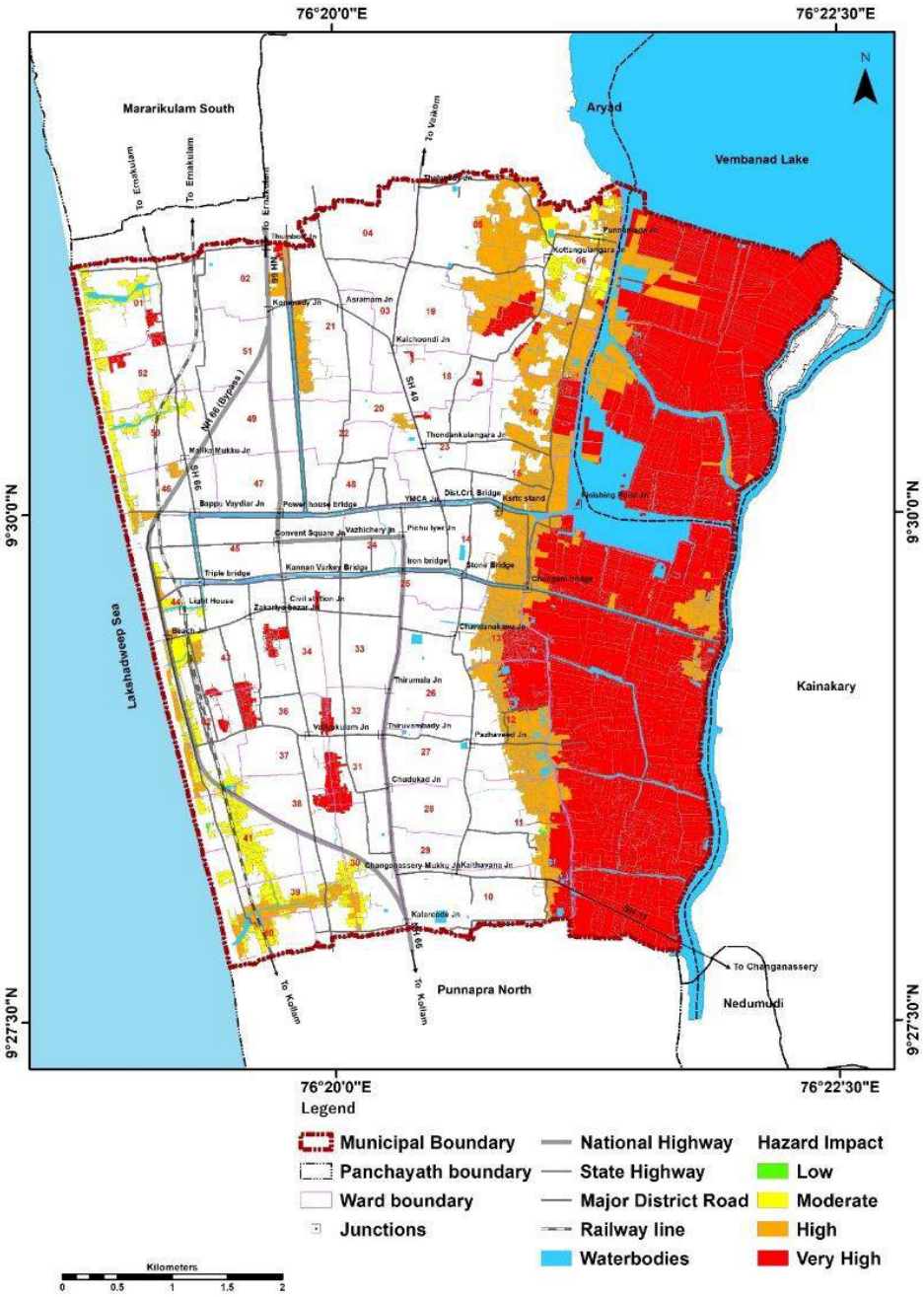


Figure 13-17 : Hazard Impact Map

13.4.4 Vulnerability Assessment

Vulnerability Assessment has been divided into 6 sub-components with their respective weightages, namely:

a) Social Vulnerability (30%)
b) Physical Vulnerability (20%)
c) Essential/Basic Services (20%)
d) Economic Vulnerability (15%)

e) Environment/Heritage (10%), and

f) Coping Capacity (5%)

Assessment has been restricted within the affected wards alone (specified under the Hazard Impact Assessment).

13.4.4.1 Social Vulnerability

Social vulnerability involves assessing demographic vulnerabilities within the Alappuzha Municipality; it contributes 30% to the overall vulnerability rating, and has been further sub-divided into eight sub-components. Data for social vulnerability are collected at the ward-level. Sub-parameters concern demographic data of affected population including women-headed HHs, and vulnerable sections of society including senior citizens, children below age 6, transgender people, and people with disabilities. These were collected from ICDS Office Alappuzha.

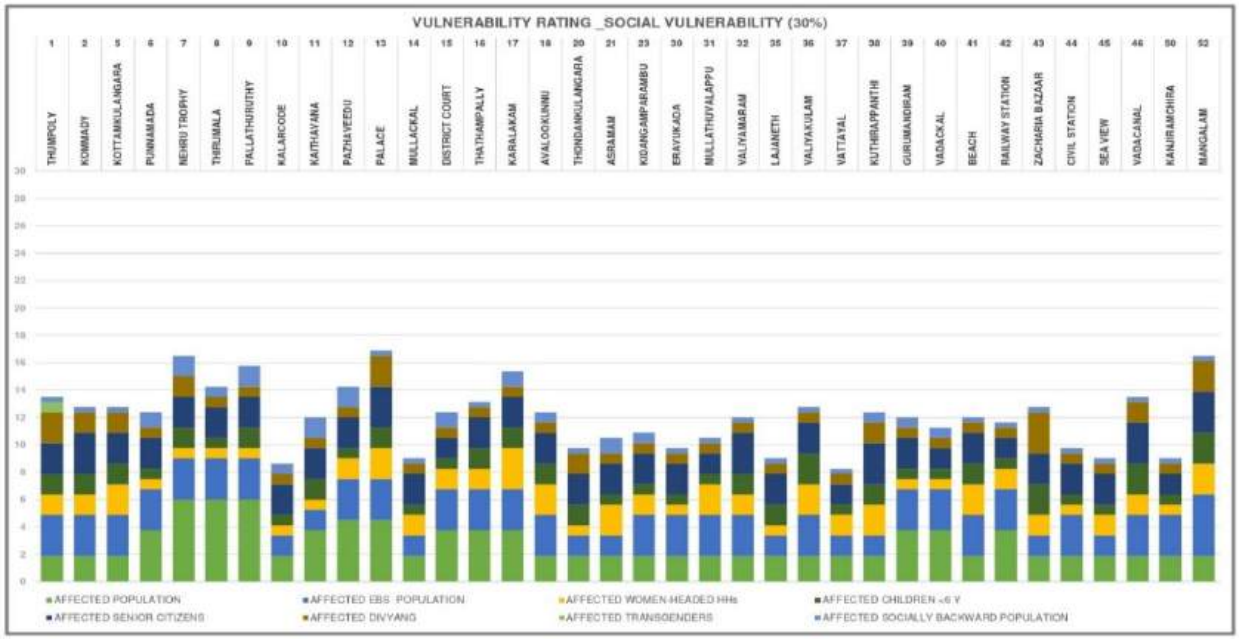


Figure 13-18: Social Vulnerability Analysis in flood prone area

Preliminary analysis of this sub-component indicates that wards Nehru Trophy (7), Pallathuruthy (9), Palace (13), Karalakam (17), and Mangalam (52) possess socio-economic vulnerability in excess of 50%. In the former three wards, vulnerability is driven by the total population affected by disaster, and the presence of economically backward sections, and senior citizens, within the hazard boundary. In the latter two wards, economically backward sections, woman-headed households, and senior citizens contribute to vulnerability. In

Mangalam, presence of children below 6 years of age, and Divyaang members, within the hazard area exacerbate social vulnerability.

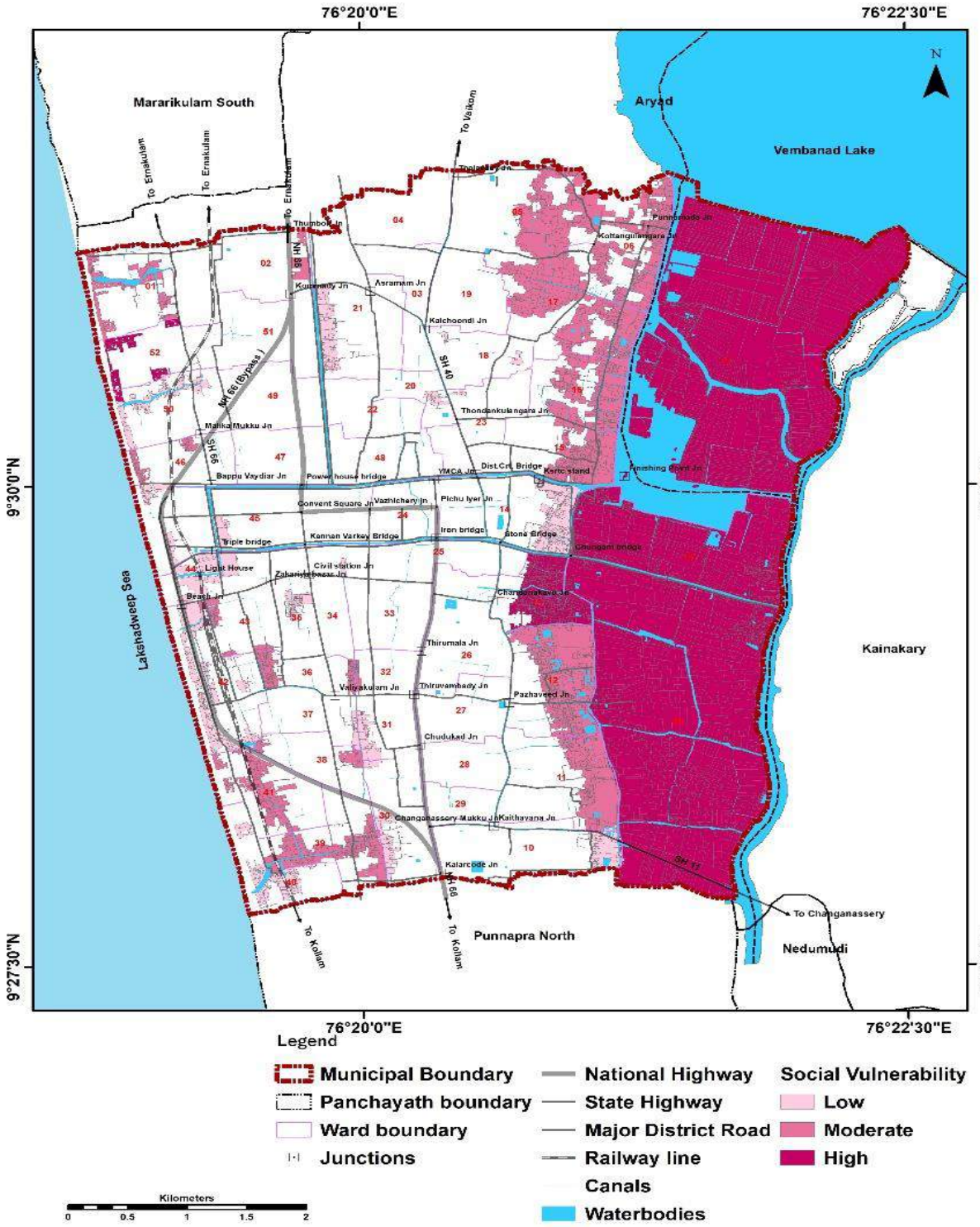


Figure 13-19: Social Vulnerability Map

13.4.4.2 Physical Vulnerability

Physical vulnerability involves vulnerability in built form, transportation infrastructure or land cover within the Alappuzha Municipality; it contributes 20% to the overall vulnerability rating, and has been further sub-divided into three sub-components. The three sub-components are Buildings (50%), Transportation (35%), and Land cover (15%), which have their own sub-parameters. Data for physical vulnerability are collected at both ward- and cadastral-level. The data was collected during field visits and ground-trothing conducted for AMRUT.

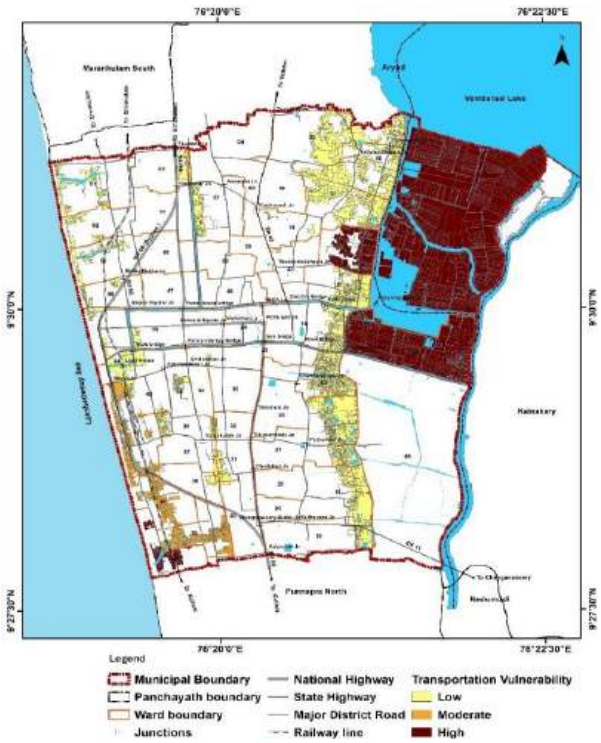


Figure 13-20: Transportation Vulnerability Map

An initial analysis of the results indicates that much of the vulnerability in transport is driven by road inundation. Road inundation can severely impact rehabilitation operations during a flood, and affect people's ability to evacuate from their homes safely. Submerged roads can also affect the operations of critical services like police, fire and ambulance services to provide emergency relief. Preliminary analysis of the physical vulnerability sub-component indicates that Nehru Trophy, Thirumala, Thathampally, and Vadackal wards are highly affected by road inundation. It is seen that the land use change from paddy/agriculture to built uses have contributed greatly in increasing the vulnerability of these wards.

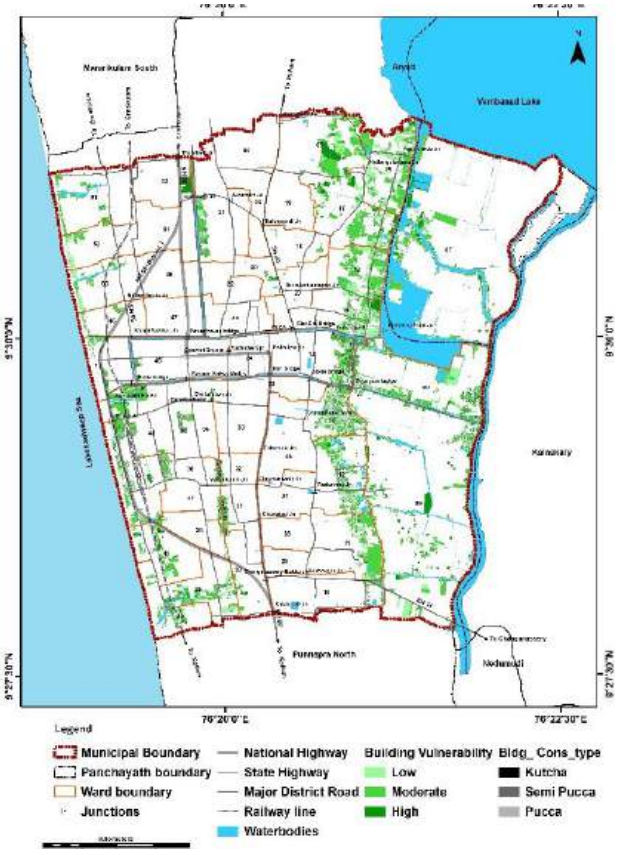


Figure 13-21: Building Vulnerability Map

Vulnerability of buildings was assessed at the cadastral level, in which highest rating has been assigned to single-story kutcha buildings with no road access; lowest building

vulnerability has been assigned to multistoried pucca buildings that have access road width of 7 m or more. As indicated in Figure 13-21, high building vulnerability is spread across the floodable area. Thus, all affected wards require retrofitting measures at building- and plot-level to minimize the impact of flood.

Land Cover vulnerability was also assessed at cadastral level, based on whether the land under consideration is already developed. While the Eastern wards in the Municipality are highly prone to flood hazard, much of this land falls under wetland, paddy, beach, or agricultural land categories (undevelopable land). Land cover vulnerability is distributed across the entire Municipality as seen in Figure 13-22.

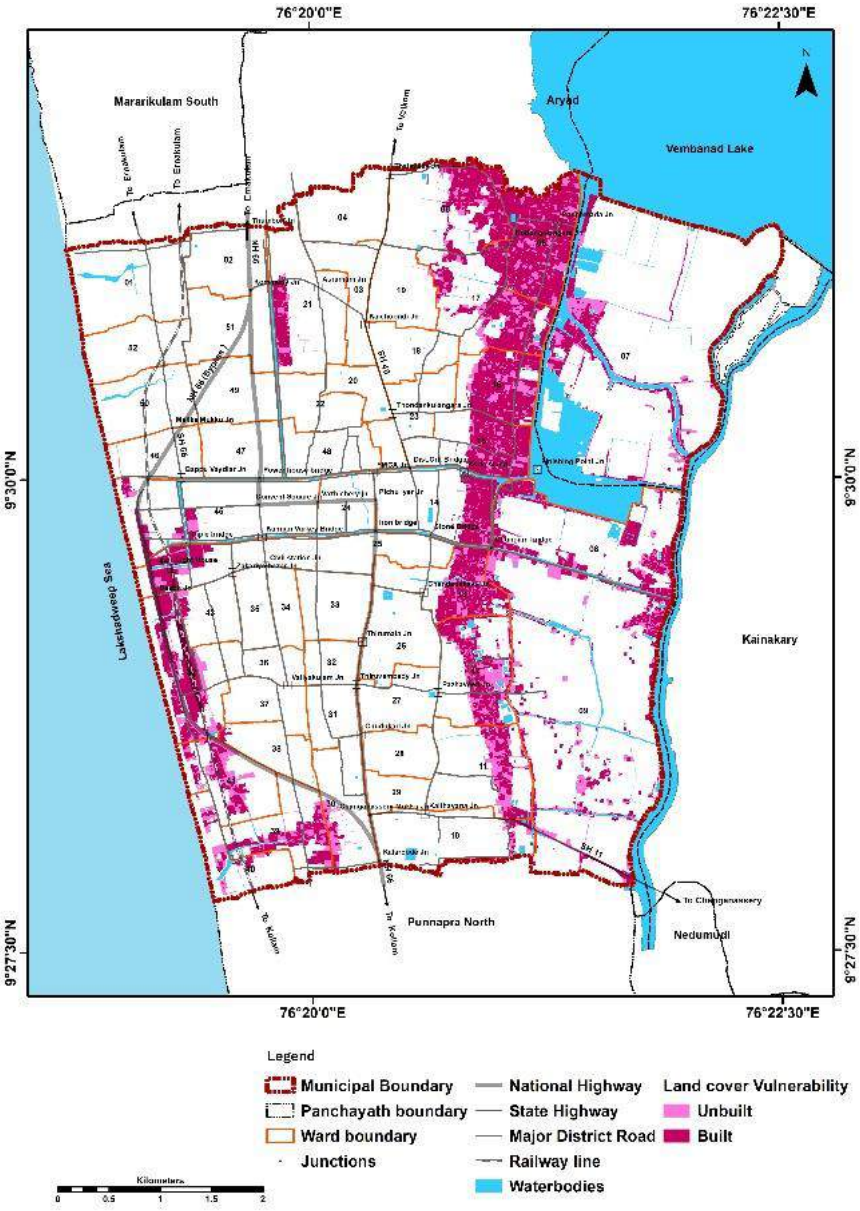


Figure 13-22: Land cover Vulnerability Map

Spatial assessment of cadastral-level data revealed that building, land cover and transportation vulnerabilities occur co-terminously in Punnamada, Nehru Trophy, Thirumala, Mullackal, Asramam, Gurumandiram, and Beach wards. Figure 13-23 indicates the weighted geographical distribution of total physical vulnerability within the flood hazard area. Physical vulnerability is driven by high land cover and transportation vulnerabilities. It will be instructive to understand how residential and commercial land cover can be retrofitted to minimize disaster vulnerability.

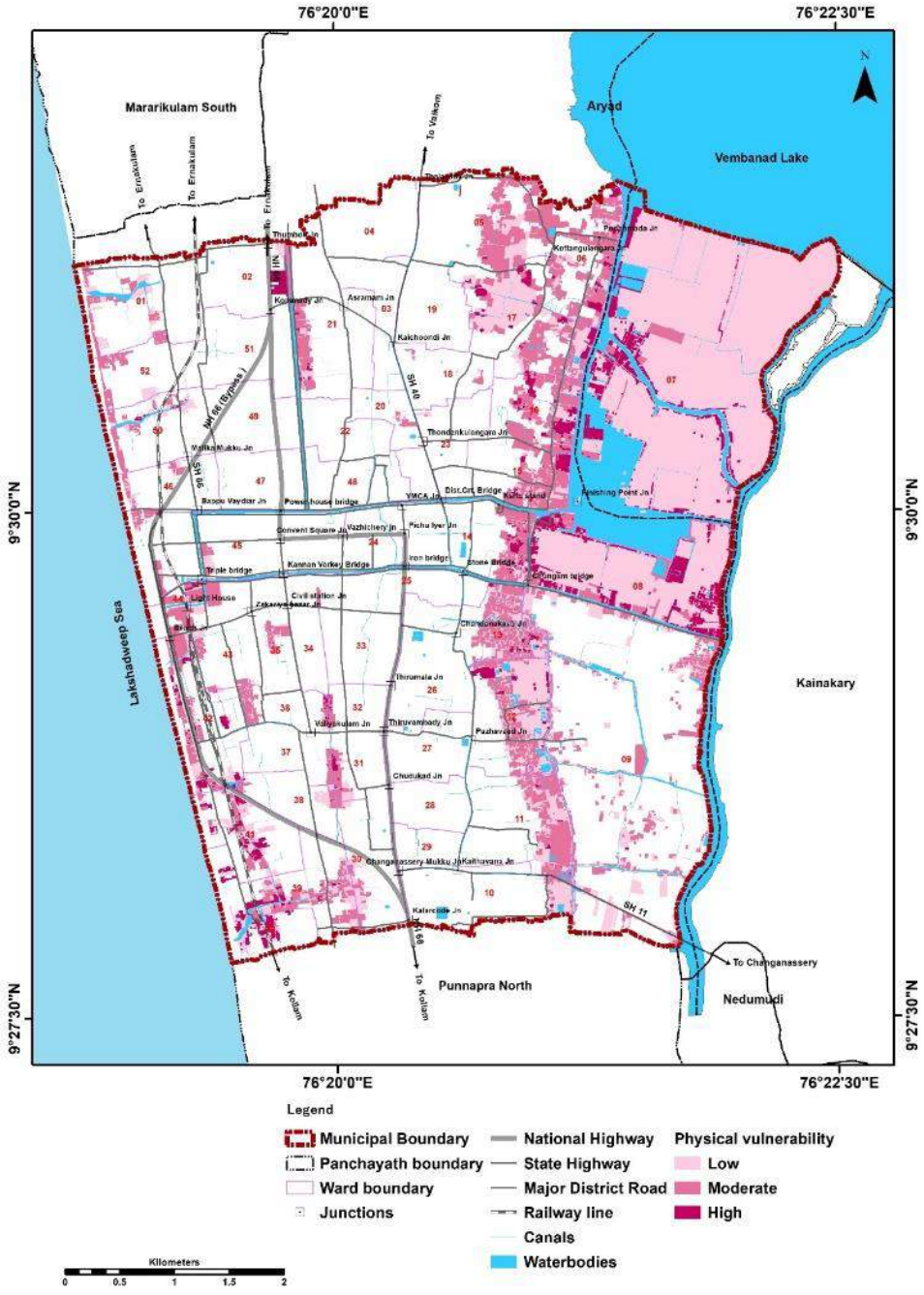


Figure 13-23: Physical Vulnerability Map

13.4.4.3 Vulnerability of Basic Services

Basic services and critical infrastructure are assets that are crucial to disaster response, mitigation and recovery. Of the total vulnerability, Basic Service Vulnerability contributes to 20 percent, and considers vulnerability of critical infrastructure, water supply, and sanitation facilities, which are aggregated at ward-level.

Water supply and sanitation data was collected through field surveys; water supply is considered affected if the resident depends on ground water (dug wells). Piped water supply is considered unaffected during floods. Wards Kalarcode (10), Kaithavana (11), Vattayal (37), and Beach (41) can be moderately affected by water supply concerns during a flood event.

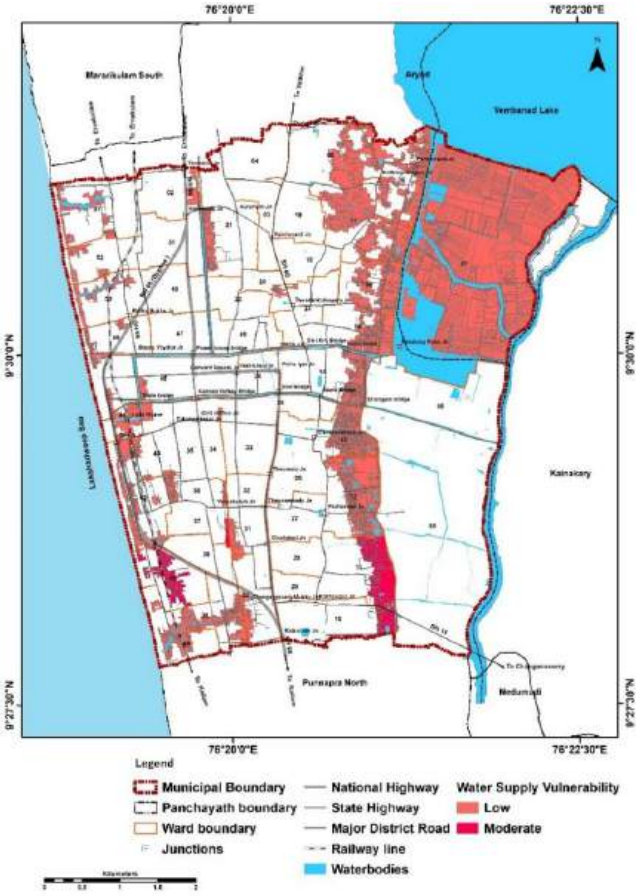


Figure 13-24: Water supply Vulnerability Map

The absence of a sewerage system in Alappuzha Municipality is reflected in the sanitation values; nearly all houses use septic tanks or soak pits. So, sanitation is considered to be affected within the entire flood inundated area.

The critical infrastructure analysis accounts for civic amenities such as Fire Station, Police station, Hospitals, Local Administration offices, Sub-Jail, Food Corporation, auditoriums, colleges, and schools that are present within the flood inundated area, and affect the disaster response of the entire Municipality.

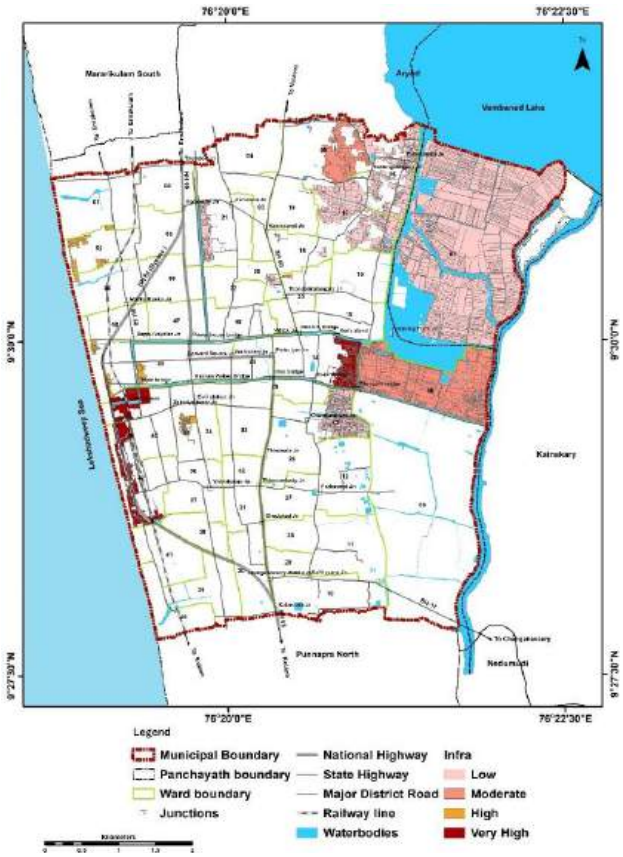


Figure 13-25: Critical Infrastructure Vulnerability Map

The geographical distribution of Basic Service Vulnerability aggregates above three parameters, and is indicated in Figure. Highest values are indicated by Mullackal (14), Railway Station (42), Civil Station (44), Sea View (45), and Mangalam (52). These wards indicate moderate to high population density, and are in close proximity to the proposed beach-agro-tourism circuit; safety of critical infrastructure, sewage and sanitation works must be undertaken on priority.

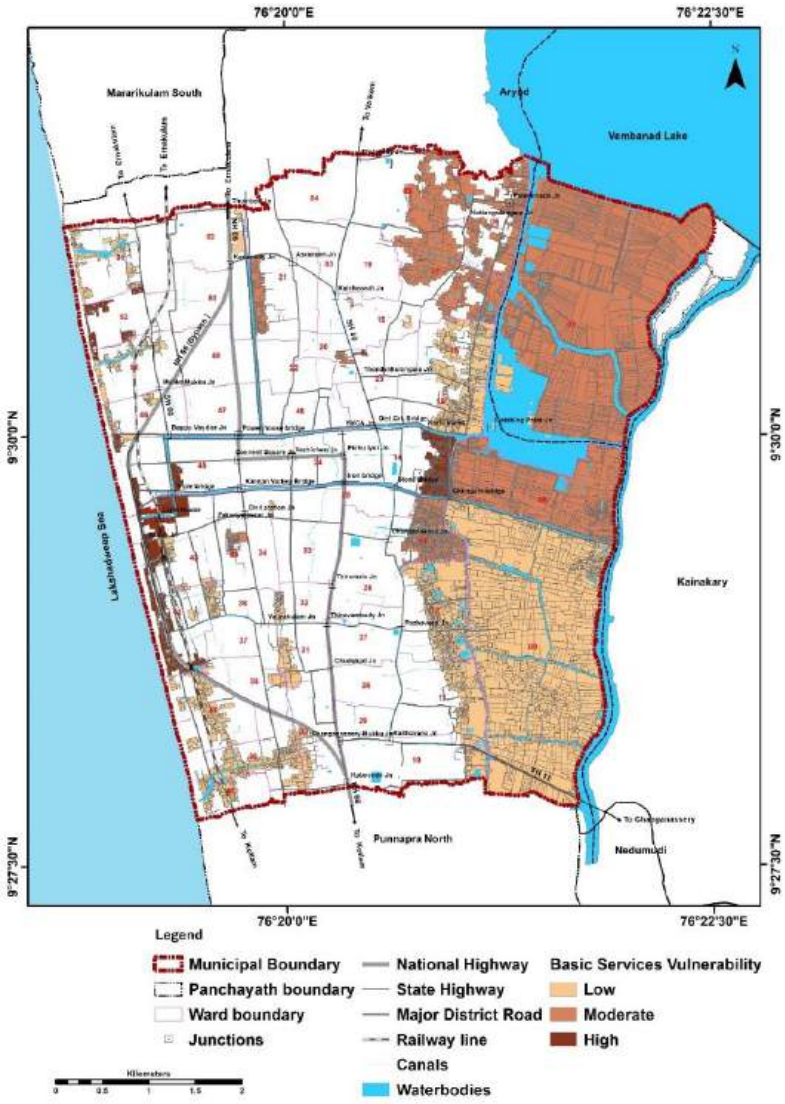


Figure 13-26: Basic Service Vulnerability Map

13.4.4.4 Economic Vulnerability

Earlier chapters have highlighted how Alappuzha remains crucially (and extensively) dependent on primary and tertiary sectors; the secondary sector is weakly developed and largely falls in the category of household industries.

Economic diversification is a crucial factor that affects disaster resilience. Economy contributes to 15% of the total vulnerability rating, and it is assessed under two sub-parameters: percentage of local level employment within the ward, and area of the economic zone likely to be inundated.

Local level employment, as per the analysis, is considered to be population employed in informal sector, daily wages, local level economic sector, or agriculture. The economic zone is defined as land use containing tourism, commercial, industrial, agriculture, fisheries, animal husbandry, or other primary/tertiary activities. In Alappuzha, the beach land use is considered as a tourism area. Data for the sub-components were collected at the ward-level through socio-economic surveys and geospatial analysis.

Local-level employment is extremely affected in Nehru Trophy (7) and Pallathuruthy (9) wards (at greater than 75% of total local employment). Thirumala (8), Kuthirappanthi (38), Gurumandiram (39), and Mangalam (52) also indicate highly affected local-level employment. It is fair to surmise that this vulnerability is affected by the presence of agricultural labourers, paddy cultivators, and coastal fishermen. It is imperative that primary activities within Alappuzha undergo diversification via value-addition, logistic and cold-chain support, and alternative employment generation activities in lean periods. This can limit the economic exposure of affected wards, and ensure cash flow even in trying times.

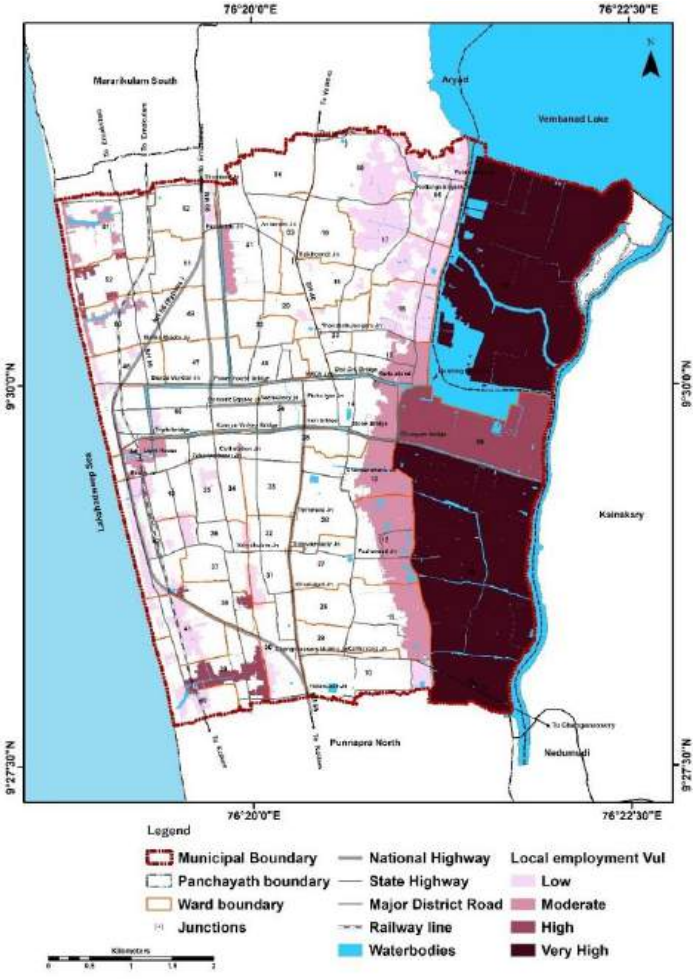


Figure 13-27: Local Level Employment Vulnerability Map

Economic zones within Kottamkulangara (5), Nehru Trophy (7), Thirumala (8), Pallathuruthy (9), Thathampally (16), Karalakam (17), Vadackal (40), Beach (41), Railway Station (42), and Kanjiramchira (50) are highly affected during a flood inundation event. Facility-scale interventions can be made mandatory in such areas; these include bioswales, construction of Miyawaki/pacchathuruthu groves on large plots, rainwater harvesting tanks, terrace agriculture, raingardens, etc.

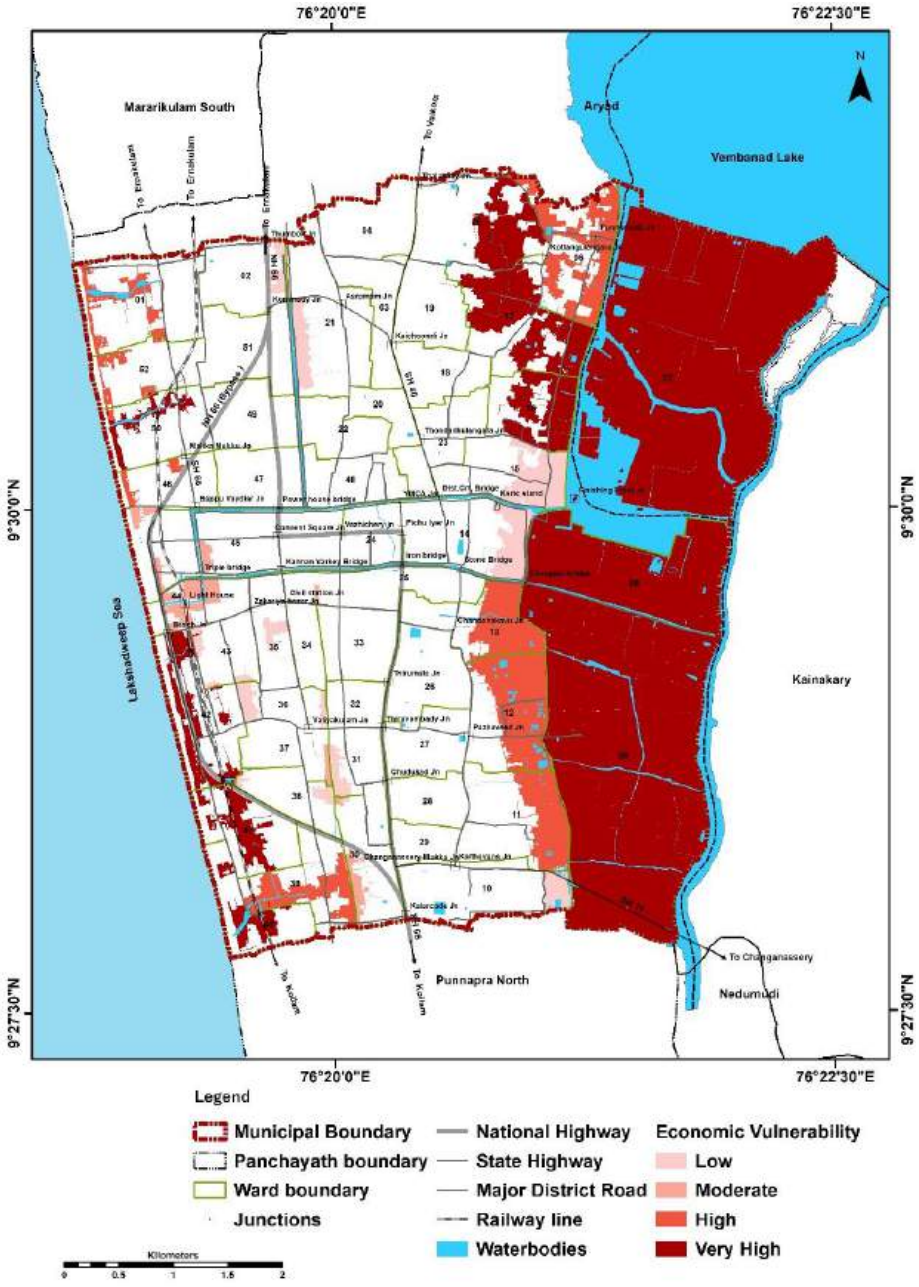


Figure 13-28: Economic zone Vulnerability Map

The geographical distribution of economic vulnerability is as indicated in Figure; highest economic vulnerabilities remain concentrated along Western coastal boundary and Eastern riverine boundary.

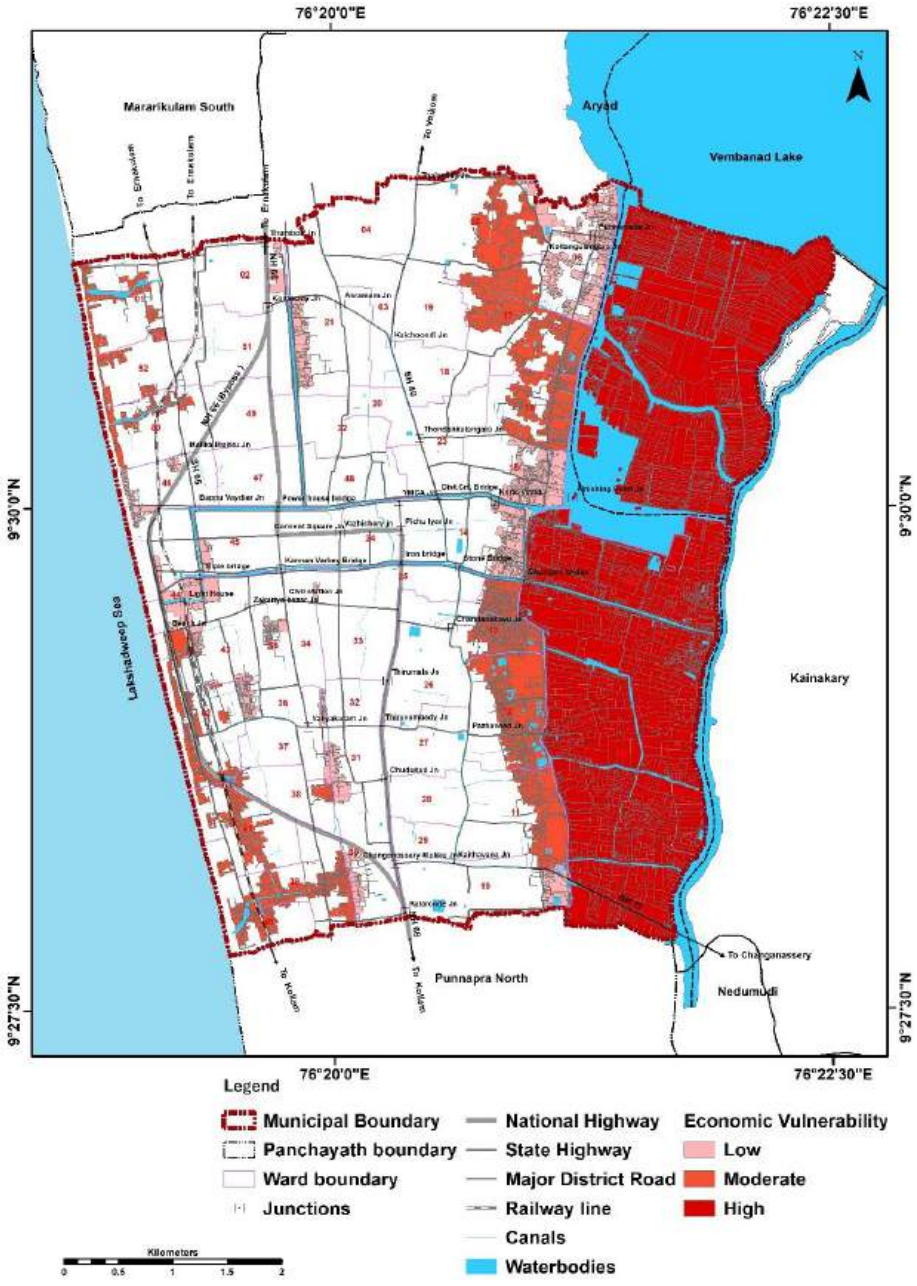


Figure 13-29: Economic Vulnerability Map

13.4.4.5 Environment and Heritage Vulnerability

Alappuzha Municipality is rich in environmental and heritage resources; the district has positioned itself as a key tourist location in Kerala. It offers tourism services related to the backwaters and creeks, Ayurveda, and agriculture. There is an untapped potential for heritage tourism, considering the available industrial heritage structures on either side of the

Commercial and Vadai Canals. These canals run through the East-West spine of Alappuzha, and form the basis for tourism proposals that link beach tourism in the West (Lakshadweep Sea), with agro-ecological and Kayal tourism in the East (Kuttanad).

Heritage areas were calculated at built form level, by tabulating the number of heritage structures per survey number. Environmentally-sensitive areas were calculated based on land cover, and included paddy and wetlands. It is important to note that water bodies offer a sizeable contribution to environmentally sensitive areas within the Municipality; however, noting the absence of fixed assets or people within water bodies, this land use was excluded during the vulnerability analysis.

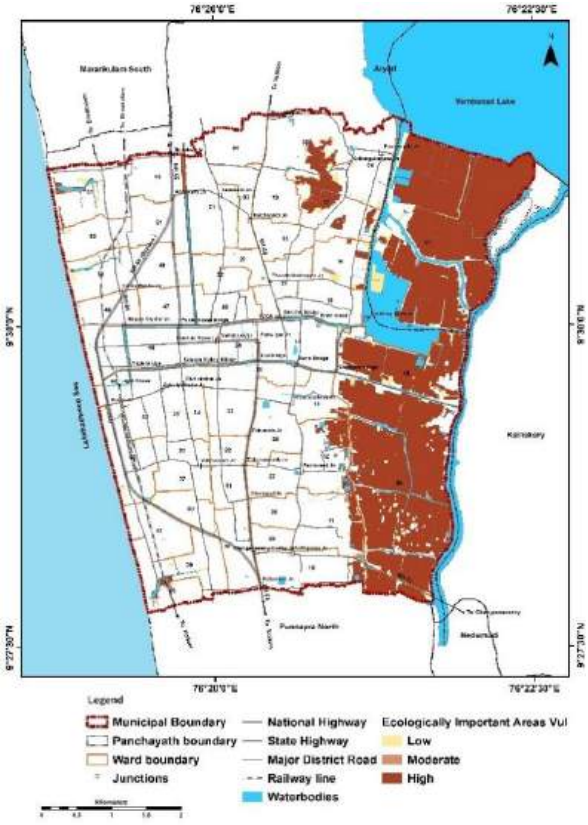


Figure 13-30: Environment Vulnerability Map

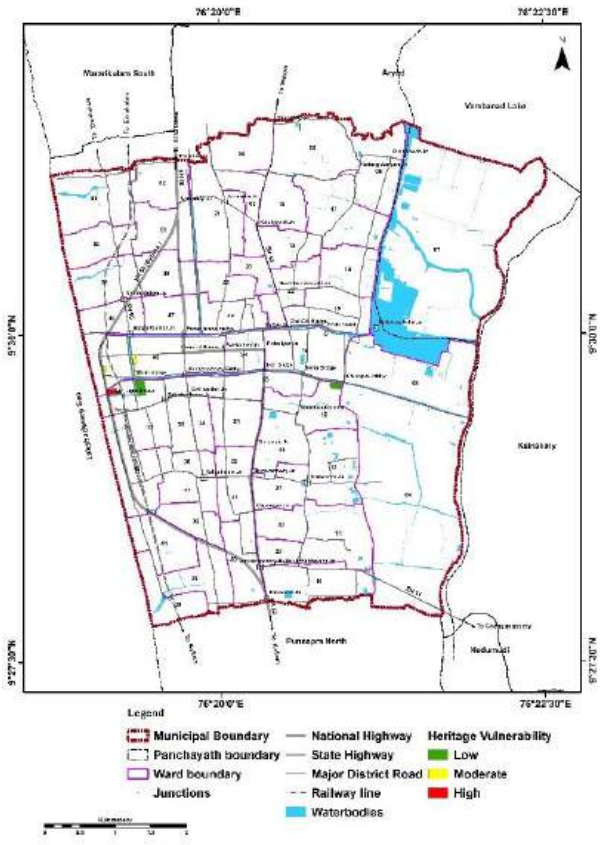


Figure 13-31: Heritage Vulnerability Map

Data for environmental and heritage resources was estimated at cadastral level. The spatial distribution of environmentally-sensitive and heritage properties is indicated in the following maps.

Ecologically important areas (Sensitive areas) predominate in wards Nehru Trophy (7), Thirumala (8), Pallathuruthy (9), Pazhaveedu (12), and Karalakam (17); sensitive areas include paddy, agricultural land, and wetland. Thumpoly (1), Gurumandiram (39), and Vadackal (40) are coastal sensitive area; sensitivity is driven by the presence of mangroves and tidal wetlands

Heritage vulnerability is low within the flood hazard zone in Alappuzha Municipality. The Western side of the Municipality contains certain heritage structures; it is important to note that they are also critical infrastructures.

The consolidated map indicating environmental and heritage vulnerability is indicated in Figure 13-32.

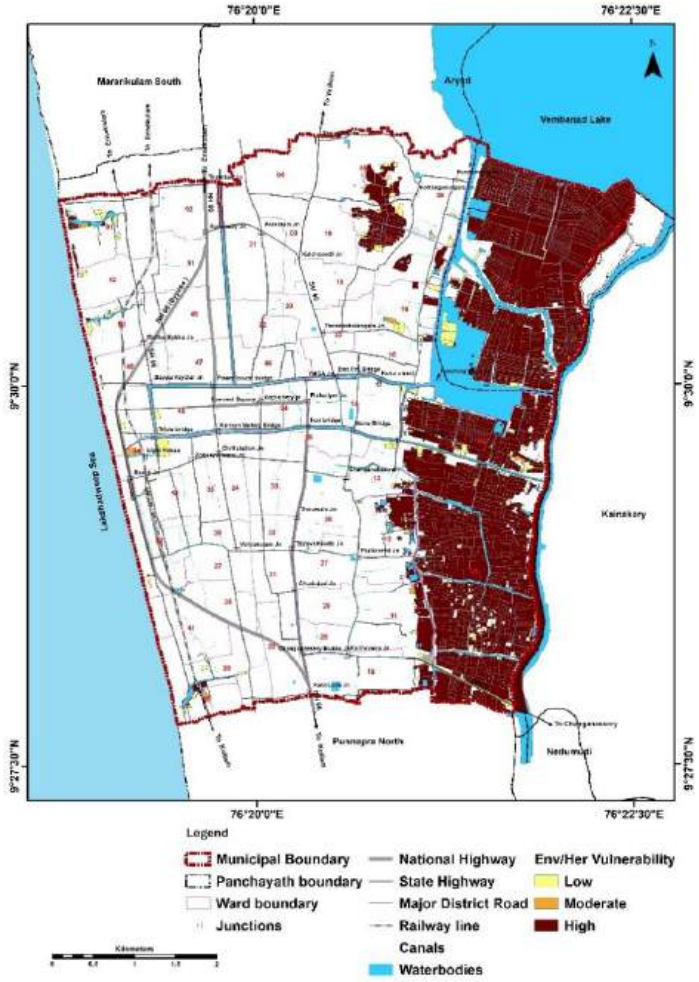


Figure 13-32: Environment & Heritage Vulnerability Map

13.4.4.6 Coping Capacity

The coping capacity factor focuses on the ability of organizations and systems, using available skills and resources, to manage adverse conditions, risk or disasters. The primary requirement for such an ability is the presence of an updated Local Disaster Management Plan (LDMP) at the Municipality level, a robust evacuation plan, committees to guide the implementation of the LDMP, and the status of various Disaster Risk Reduction (DRR) activities. Unlike earlier factors, vulnerability is inversely proportional to coping capacity. Therefore, the availability of any sub-parameter was assigned a null value.

Values for the above parameters were derived through primary methods; ward councilors were consulted, and a definitive status update was received via telephonic interview with the current LSG Disaster Management Coordinator.

While the Municipality is ahead in many aspects of Disaster Response System, the unavailability of an evacuation plan can hinder risk reduction and mitigation efforts during a disaster. Identification of relief infrastructure, routes and area available for alternative housing, rehabilitation, and relocation of affected populations is a priority action in this area. Service Level Benchmarking of relief and road facilities can give the Municipality an idea of where to target further DRR efforts in this parameter.

13.4.4.7 Total Vulnerability

An assessment of combined vulnerabilities reveals that certain wards require prioritized efforts to minimize exposure of flood inundated areas.

1. Nehru Trophy (7) indicates the highest exposure, with vulnerabilities driven by demographic factors (concentration of population, senior citizens, socially backward segments), physical factors (transportation and land cover), poor sanitation, economic factors, and the presence of ecologically sensitive areas.
2. Thirumala (8), Pallathuruthy (9), and Mangalam (52) follow, with high social vulnerability (population size, senior citizens, children below 6 years of age, people with health conditions or impairments, socially backward segments), poor sanitation, economic factors, presence of ecologically sensitive areas; Thirumala (8) is additionally affected by physical vulnerabilities (built form, road infrastructure).

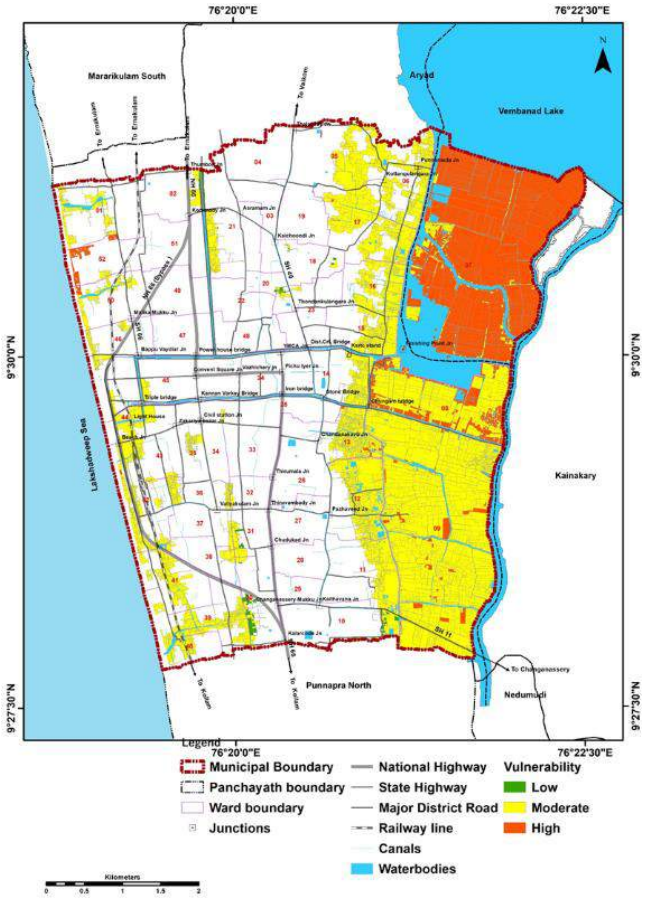


Figure 13-33: Total Vulnerability Map

3. It is imperative to upscale resilience measures that address specific vulnerabilities on priority in such wards; suggestive measures have been included in the later sections of this chapter.

13.4.5 Flood Risk

Risk is defined as "a measure of the probability [likelihood] and severity of an adverse effect to health, property, the environment, or other things of value" (EMBC, 2004). The risk analysis is, thus, not a definitive measure of damage; instead it primarily meant to convey the exposure of various cadastral plots to a future flood inundation event. It is a tool for citizen awareness, and meant to serve as a guide for individual plot-level actions to manage flood inundation in Alappuzha.

Final risk is calculated as per the risk matrix provided in the guideline for the preparation of Risk Informed Master Plan. The Risk Matrix used is shownTable 13-5 .

Table 13-5: Risk Matrix

			Hazard Impact			
			Low	Moderate	High	Very High
			0 - 2.5	*2.5-5*	*5-7.5*	*7.5-10*
Vulnerability	Low	*0- 25*	L1	L2	M3	M4
	Moderate	*26 - 50*	L2	M3	M4	H5
	High	*51 - 75*	M3	M4	H5	H6
	Very High	*76 - 100*	M4	H5	H6	VH7

Drawing conclusions at the Municipality level, the following observations have been made:

- High Risk is concentrated in the Eastern wards: Nehru Trophy (7), Thirumala (8), and Pallathuruthy (9)
- The central wards Pazahaveedu (12), Mullathuvalappu (31), Valiyamaram (32), Lajaneth (35), and Zacharia Bazaar (43) also shows high risk due to urban flooding
- Moderate risk is dispersed across the entire Municipality, predominantly fringing tidal water bodies, wetlands, converted low lands, etc.

However, the real power of such a map lies in its ability to spread risk information, and make citizens aware of their possible exposure to flooding events. Such a tool holds great significance; used wisely, it can spur individual plot-level mitigation measures, inform future investment, aid economic diversification, and allow contextual solutions to emerge.

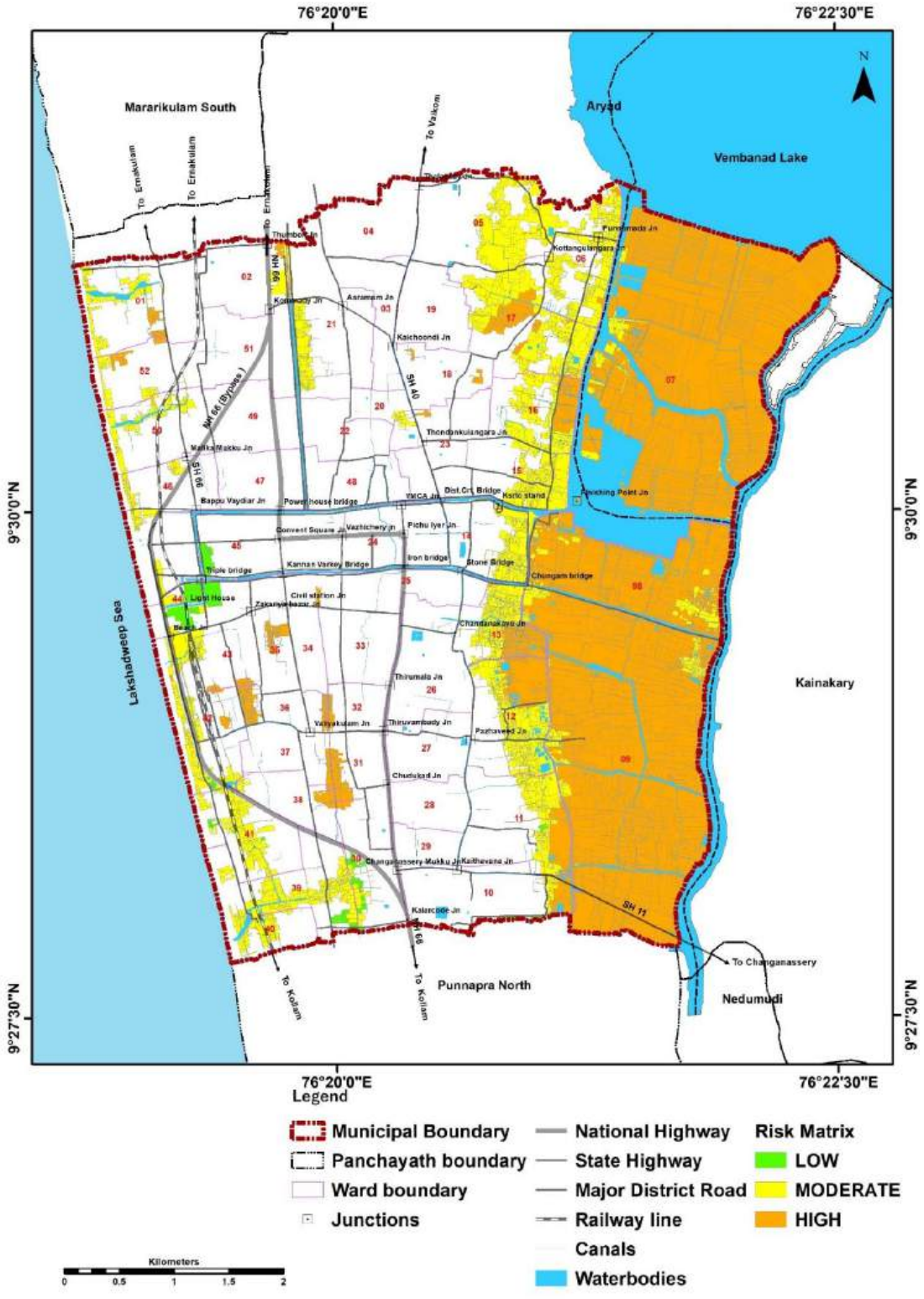


Figure 13-34: Flood Risk Map of Alappuzha town

13.5 Inference

Alappuzha town is exposed to effects of different types of hazards such as flooding, lightning, drought (drinking water scarcity), coastal erosion, but the major hazard that can affect the town is flooding which was evident by the recent mega floods. The sea level rise due to climate change is another factor that need to be addressed though its effect is flooding. Strategies and measures to reduce the consequences of hazards are to be formulated, which need to be addressed by land use regulations and other mitigation measures. Different factors assessed indicates the need for interventions to reduce socio-economic vulnerability ensuring alternate livelihoods and risk transfer mechanisms. The risk information available in this Plan can be used for formulating priorities and response measures in the projects and programmes taken up for disaster risk reduction by various agencies.

14 HERITAGE

The United Nations Educational, Scientific and Cultural Organization (UNESCO) defines 'Heritage' as "our legacy from the past, what we live with today, and what we pass on to the future generations" whereas, 'Cultural Heritage' has been described as, "the irreplaceable sources of life and inspiration that include monuments such as architectural works of monumental sculpture and painting, elements of structures of an archaeological nature, inscriptions, cave dwelling and combinations of features; groups of buildings, groups of separate or connected buildings; and sites including archaeological sites having outstanding historical, aesthetic, ethnological or anthropological value".

Heritage is the manifestation of our rich culture of the past. It reflects the life style of people, architecture, evolution of construction techniques and art forms along with the physical, social, and economic changes in the society. This chapter explains about the heritage structures in the planning area, their present conditions, potentials and issues of the sector.

14.1 Heritage in Alappuzha Town

The built heritage of Alappuzha is extensive and spreads across the town. The notable buildings and monuments which have existed for centuries are scattered across the town and are pivotal parts of its heritage. The surviving elements of Alappuzha comprise not only buildings but also the markets, streets and footways, bridges, sea piers and cemeteries (Kuriakose, 2018). Heritage resources are mostly built around canals. Churches are mostly found near the beaches, backwaters and canals. In contrast the temples are located to the middle of the town and in areas around Brahmin or upper caste areas of the time. There is a predominance of mosques towards the North Western part with a few significant ones near the canal.

A study conducted by the Department of Architecture of Rajiv Gandhi Institute of Technology Kottayam in collaboration with LSGD Planning in 2019 to identify the built heritage on either side of the Vadai Canal (from Vazhicherry Junction towards West up to link canal), Commercial Canal (from Kothuval Chavady bridge towards West up to link canal) and Western link canal (connecting Vadai Canal and Commercial Canal). Also the survey conducted by the LSGD Planning also identified heritage structures at various locations within the town. All these structures have not only historic significance but also have social, cultural, religious, architectural and ecological significance. Table 14-1 shows the list of heritage structures and location is shown in Figure 14-1.

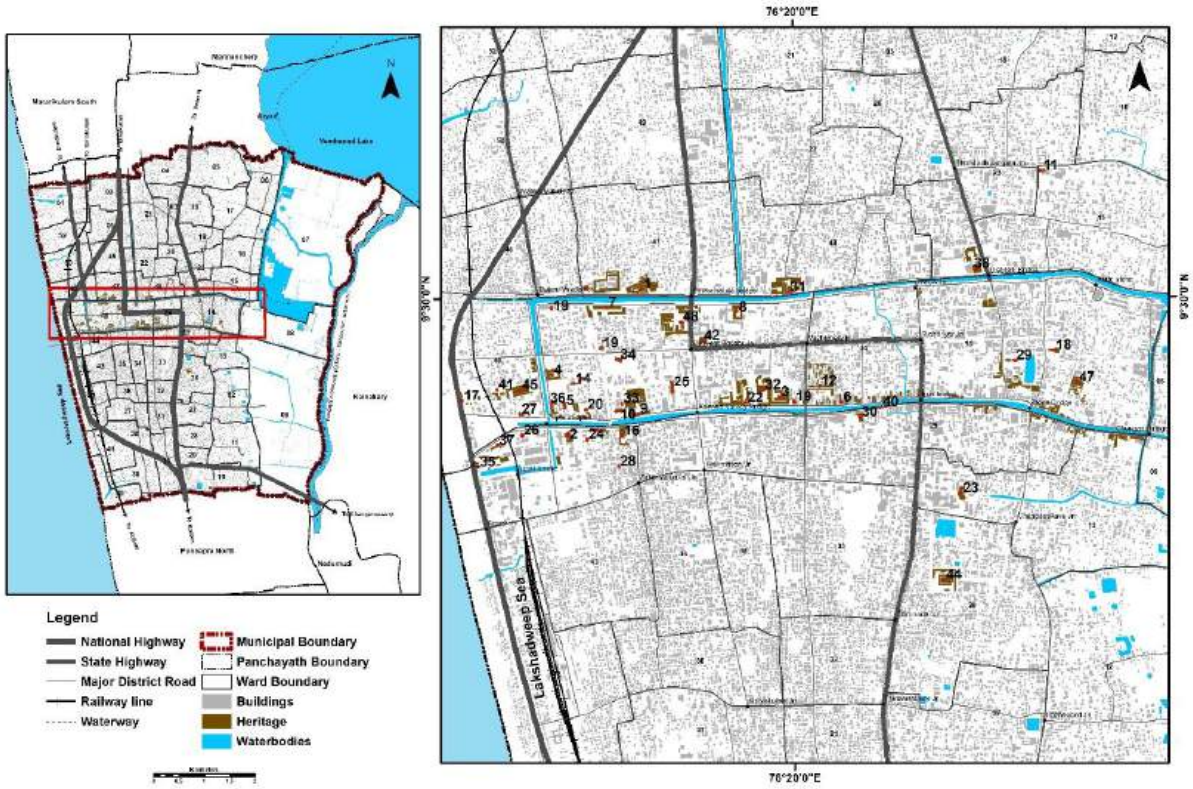


Figure 14-1 Heritage Structures

Table 14-1: List of Heritage Structures

No.	Name	No.	Name
1	Alleppey Company	25	Light House
2	Aspinwall Company	26	Malathibai Working Women's Hostel
3	AV Thomas & Co.	27	Mullakal Temple
4	BalaKrishna Haveli	28	Municipal Office
5	C.C Varghese & Sons	29	N C John & Sons (P) Ltd
6	Central Coir Marketing Society	30	New Model Coir Mat and Matting Co-Operative Society
7	Cochin Majlis Restaurant	31	Norton Bunglow
8	Coir Federation	32	Padinjare Shafi Juma Masjid
9	Cresent Orphanage	33	Port Museum
10	CSI Church	34	Post Office
11	CYMA HALL	35	Rest House
12	District Police Office	36	SDV School
13	Gujarati House	37	Sea Pier
14	Gujarati School	38	Shivaparvathy Temple
15	Gujarati Settlement	39	Shoukker Masjid
16	Gujarati Temple Complex	40	Sri Rama Temple
17	Hashimiyya/Maqam Masjid	41	St. Joseph Convent Church
18	Holy Cross Syro Malabar Forane Church	42	St. Thomas Orthadox Church
19	Jain Temple	43	Thirumala Temple
20	Kalarkode Mahadeva Temple	44	Vallabhdas Kanji Ltd
21	Kerala State Coir Corporation Ltd	45	Vellappally Church
22	Kottaram Hospital Building	46	Venkitachalapathy Temple
23	Kutchi Memon Masjid	47	William Goodacre Coir Factory
24	Leo XIII School		

14.1.1 Temples

The temples of Alappuzha are built mostly on Dravidian style of architecture with 45 degree pitched roof, namaskara mandapas and sanctum sanctorum.

- **Mullakkal Temple**

Mullakkal Sri.Raja Rajeshwary Temple is the most important and ancient temple in Alappuzha town. The temple complex was palace of Chempakassery Raja. The Raja Rajeshwary idol was installed by a refugee Namboothiri from Malabar in the time of Tippu in 1788. Then Raja Kesavadas took initiative to convert the Palace into Temple.



Figure 14-2 Mullackal Temple

It is a multi-faith place of worship. The temple is approachable for devotes from all castes and religions. Situated on one of the main streets of Alleppey, "Mullakkal theruvu", Mullakkal Rajarajeswari Temple is built in old Kerala architectural style. Being contained by well-maintained wall and a beautiful pond inside, the site has plenty of trees and jasmine plants (after which the place may have been named, since 'mullai' in Tamil and 'mulla' in Malayalam mean jasmine). Kodiyettu is a festival celebrated at the temple during the Navarathri, while the 'Chirappu' is the major and the most important festival held here.

- **Kalarkode Mahadeva Temple**



Figure 14-3 Mahadeva Temple

Sri.Mahadeva Temple Kalarkode is the most important Siva temple in Alappuzha. It is believed that 'Kallikroda Maharshi' installed the idol in the temple, and the place where 'Kallikroda puram' became Kalarkode. The temple was under the control of Chempakassery Raja.

- **Thirumala temple**

New Thirumala temple is located near the Alappuzha General Hospital about 500 m from the National Highway. It was established in 1852. The main deity is Sree Narasimha Moorthy in the Ugra form. The simhasana (seat) in the sanctum sanctorum has



Figure 14-4 Thirumala Temple

Venkatachalapathy with Lakshmi Devi and Bhoomi Devi at the top level. On the next step is Sree Narasimha Murthi with Mahalakshmi on the left lap. The Utsav deities are on the next step. Unlike in other temples the idols of Hanuman, Garuda and Ganapati are installed together on a platform within the Sreekovil.

- **Venkatachalapathy Temple**



Figure 14-5 Venkatachalapathy Temple

The Sree Venkittachalapathy Temple affectionately termed as the Old Thirumala Temple is a cultural landmark in the ancient history of the town of Alappuzha. Situated at Thirumala and settling between Commercial Canal and Vadai Canal, about one km North of the KSRTC bus stand in Thirumala Ward, it is an architectural prodigy and one of the most ancient and well-known temples of the highly resourceful and lively Gowda Saraswath Brahmin Community in the State. Legend has it that this sacred structure was built in 1625 A.D. and ranks as the third oldest temple among the cluster of temples managed by the GSB community.

It is about 400 years old. The Prathista is Venkatachalapathy with Lakshmi Devi and Bhoomi Devi on either side. The idols of Mahalakshmi, Hanuman, Garuda and Ganapati are installed within the inner temple. There is a sub temple inside the main temple (outside the Nalambalam) dedicated to Vanadurga and also a Naga pedestal. The Brindavans of Swami Sureendra Tirtha (the 12th pontiff) and Swami Sumateendra Tirtha (the 15th pontiff) are located in this temple.



Figure 14-6 Jain Temple

- **Jain Temple**

Jain temple was built by Jains 400 years ago. It is the only Jain temple in Travancore. The main idols are the marble statues of Swamy Dharmanath and Swamy Vasu Poojya. In early 90s the temple was renovated and covered with marbles.

Sree Jain Shwethambar Temple gives an impression making it a must visit place during your tour. The holy temple is ornamented using white marbles bought from Rajasthan. It gives a very fresh and elegant appeal to the temple without losing its religious significance. This temple is possibly the only temple that is constructed without using a dome or an iron for support. Sree Jain Shwethambar Temple exhibits many carvings and figures engraved from single marble pieces. In spite of the fact that, all Jain temples have their own architectural style, this temple has highly adopted or taken inspirations from other architectural styles of temples.

14.1.2 Churches

- **CSI Church**

CSI Church is the first Anglo Indian Church in Kerala, started in 1820, by Fr. Thomas Norton, a British native. He died in 1840 and was buried here. It was the first Anglican Church to be established in Travancore. There is a bell in the church, brought from England. Many foreigners are buried here.



Figure 14-7 CSI Church

- **Marsleeva Forane Church**



Figure 14-8 Marsleeva Forane Church

Mar Sleeva Syrian Church has an ironic heritage of 600 years. This is the first Christian Church in Alappuzha. It is the offspring of Champakkulam Martha Mariam (St. Mary's) Church. The Christian Community here got strengthened with the passage of time. The Church buildings and its architecture replicate the divinity. Present structure is 200 years old.

- **St. Thomas Orthodox Church**

Positioned at the heart of the Alappuzha city, the parish portrays a spiritual excellence and an architectural marvel. It carries with it an astonishing history of the struggle, sacrifice and commitment of a spiritually and socially elated group of people. The existence of a small local Syrian Christian community in the heart of this industrial city of Alappuzha fascinated many migrants and temporary civilians who came here for a variety of purposes such as



Figure 14-9 St.Thomas Orthodox Church

trade, industry, commerce, medical treatment, higher education, and so on. It was then that the thought for building a new, spacious and attractive parish premise shoot out as immutable inevitability, which was achieved on 14th April, 1944 (1119 Medam 4th), when the foundation stone was laid.

14.1.3 Mosques

- **Padinjare Shafi Juma Masjid**



Figure 14-10 Padinjare Shafi Juma Masjid

Padinjare Shafi Juma Masjid is 156 years old, built on 6 pillars with an area of 3000 sq. ft., in a plot of area 3.86 acres. The mosque is in traditional vernacular style. It is one of the two old mosques in Alappuzha. The old pond and tower for adhan (call for pray) are specialties of this mosque.

The mosque was managed by muthavallies, the Muslim representative of Travancore royal dynasty. Muthavallies followed the Marumakkathayam (matrilinear system) of inheritance, but in 1993 this tradition ended and the control was with the court for about 7years. Now an eighty-member committee manages the mosque. The madrasa was built in 1927.

- **Shoukker Masjid**

Shoukker Masjid is constructed in 1109 M.E. started by Muslim business man for worship. The Saukar Masjid is located at the brink of the canal along Commercial Canal North Bank Road. The mosque belongs to the Halais Memons community. The mosque faces the canals, as in olden days the main means of transport were waterways.

The structure is in distinct vernacular style. The masjid is the only structure without minarets and outstands every other mosque in Alappuzha. The Indo Sarcenic architecture style and the gabled ended tile roof, sunshade joins together to make this structure unique. The original building only consisted of towers and a prayer hall. The barge boards and the eave boards consist of a simple floral pattern. The reflection of this mosque in the canal water is eye catching.



Figure 14-11 Shoukker Masjid

- **Kutchi Memon Noorani Masjid**

A limited Kutchi Memon family from Cutch and Bombay (now Mumbai) came to Alleppey in the early part of the 19th century. The eminent and famous Dewan of Travancore State, Raja Kesava Dasa, invited them to create trade and business in Alleppey, then a developing port. Kutchi Memons identified Alleppey to have all amenities for conducting proper business, and migrated in large numbers. Flourishing in business and making good prosperities, Kutchi Memons helped the public and made good revenue for the state.



Figure 14-12 Kutchi Memon Noorani Masjid

The Kutchi Memons in Alleppey used their excess wealth in erecting masjids and establishing charitable trusts. The Kutchi Memon Noorani Masjid in Alleppey, the loveliest structure in this part of Kerala built by the famous Noorani family of Bombay, is a brilliant example of Kutchi Memon's deep sense of kindness and religiosity.

The building can be identified as a monument that showcases the mixed Architectural style which can be seen as a symbol of the integration of many Cultures and result in a spectacular entity in itself. The Masjid is a two-storied building with an area of around 2000 square feet. The Beautiful wooden engraved carvings can be seen in the Mosque, which was brought from Bombay in Pathemaris or boats at the time of construction.

- **Maqam Masjid**

The Maqam masjid is situated at Maqam Road, near Civil station ward in Alappuzha. The maqam masjid is the oldest mosque of Alappuzha. The mosque's architectural details are very different from the mosques in other parts of India. The style is drawn from the typical Kerala style of architecture. The Masjid is an L-shaped building where one portion of the building which is 2 storied. The Mosque has been constructed using laterite blocks and lime mortar and plastered with lime. The doors and windows and the roof are of timber with Mangalore tiles (Kuriakose, 2018).



Figure 14-13 Maqam Masjid

14.1.4 Canals

The canals which have historic and heritage importance and still continue to be the life lines of Alappuzha are:

- Commercial Canal
- Vadai Canal
- Alappuzha - Cherthala Canal



Figure 14-14 Buildings along Commercial Canal

The Alappuzha Town was well known as a centre of Trade and commerce, by virtue of it being the major port Town of Travancore. The Town was built around the Two canals, Viz. Vadai canal and commercial canal. The banks of the Canals being lined with old merchant houses, godowns, open court yards and residences and places of worship in traditional style and Architecture.

All these stands as an embodiment of the cultural heritage of the Town. Most of these old buildings are of great and varied character with strong unity and cohesion. The varied individual charm and distinctive unity of these buildings make it a special and unique canal side Architecture. Most of these buildings are located on either side of commercial canal from Chungom to Beach. A layer of buildings on either side of Commercial canal is considered as Heritage Zone to protect and conserve these Architectural features for the future.



Figure 14-15 Buildings along Vadai Canal

14.1.5 Coir Factories

- **Aspinwall & Co**



Figure 14-16 Aspinwall & Co

Aspinwall & Co was built by peoples from Gujarat. Handed over to foreigner named Aspinwall in 1867. He started the Aspinwall coir company. Aspinwall became a public limited company in 1956, with financial participation from Travancore royal family. The building abuts the canal bank road, with tiled roof giving the feeling of a massive structure. The buildings

and streets, once busy with hectic activities are devoid of the zeal and fervor once attached with them (VastuvidyaGurukulam, 2009).

- **The New Model Coir Mats & Mattings**

The New Model Coir Mats & Mattings has an age of nearly 100 years. East India Company started the firm. The pitched roof renders a grand appearance to the building. This type of buildings links the past of Alappuzha with the present. The old solid columns and hand rails follows the colonial architectural style. The rest house with the arches and wooden floors also follows the same style.



Figure 14-17 New Model Coir Mats & Mattings

They produced a variety of products for packaging, insulation and furnishing. The new model factory also consists of a series of buildings within the complex. They are made of locally available materials and use the regions architectural style of which is most climatically suitable for the functioning of the manufacturing units (Kuriakose, 2018).

- **Coir Federation Building**

Mr. Darragh, an American of Irish origin, saw the potential in coir and set up the first manufacturing unit in Alleppey in 1859. The company was enlisted as "Darragh Smail and Company" and is currently called the Coir Federation. The company brought coir to the forefront of international trade. At the turn of the century the company employed almost 1100 people and is said to have paid the highest wages to its employees at the time (Kuriakose, 2018).



Figure 14-18 Coir Federation Building

- **Kerala State Coir Corporation Ltd Building Complex**

The Coir Corporation factory set up by the Swiss Volkhart brothers and is one of the oldest coir factories in the coastal town of Alleppey. It is an institution that provided a means of income to hundreds of families and showcased the products on an international forum (Kuriakose, 2018).

The factory was built using the traditional architectural style of Kerala, using materials that were most economically available at that time. Transportation of goods produced by the factory was done by means of waterways, i.e. via the canals, thereby using the most sustainable means of transport. The volumes and spaces created in the factory buildings using traditional methods of building are one of a kind. There is a fine amalgamation between traditional building techniques of Kerala and materials that came about with the onset of the industrial revolution in Europe (Kuriakose, 2018).



Figure 14-19 Kerala State Coir Corporation Ltd Building Complex

There are various structures within the coir corporation that were built over various periods in time and therefore reflect the construction techniques of their respective periods (Kuriakose, 2018).

- **William Goodacre Coir Factory**

In 1863, William Goodacre and Sons, manufacturer of coconut matting was set up by William Goodacre in Abbey Lane, London. Following the example of "Darragh and Smail & Co." in Alappuzha William Goodacre and Sons factory was set up. They were involved in lots of other things- Engineers, Bankers, Builders, Metal Founders, Shippers, Omnibus and the maintenance of Railways, Water Works, Gas Work, Coal Merchants, Tile and Terracotta makers etc (Kuriakose, 2018).



Figure 14-20 William Goodacre Coir Factory

Goodacre factory houses one of the oldest bailing press which was used to compress the coir into bails for exporting the fiber. These fiber bails exported were used for making camouflage netting and for the wet and slippery decks on war ships and for beach landings ensuring silence for the war operation (Kuriakose, 2018).

14.1.6 Gujarathi Quarters

The flourishing coir industry of Alleppey, has invited many communities from Gujarat, to come settle in the beautiful town of Alleppey. These communities have helped in developing the rich heritage of Alleppey tremendously. These settlers helped in contributing to the „Golden Age" of Alleppey. Beautiful and intricate houses, mosques and temples, schools, hospitals etc. started developing with the help of Raja Kesavadas (Kuriakose, 2018).

- **Anil Seth's House**

In the Gujarati Quarters of the Alappuzha town, Anil Seth house is situated. The beauty of this house is its unique architectural features (Kuriakose, 2018).

The facade of the house is symmetrical with placement of window and door opening and all the doors and windows in the house are unique to each other. The roof is made up of traditional Mangalore tile roof. The house is built of laterite blocks with lime mortar and finished with lime plaster. Few windows and doors are decorated with stained glass as the influence of the Rajasthani Havelis. There are few motifs on the top of the building (Kuriakose, 2018).

The interior spaces of the building have also been decorated with intricate timber works. Few shelves are made of timber frame with intricate floral patterns with few animal and bird are used like Lions and Parrots. The interiors are decorated with Gargoyle like figures at the cornice of the building. The use of different colored stain glasses on window panes and ventilators can be seen. In few windows, instead of the metal grills, the decorated lace pattern timbers are used (Kuriakose, 2018).



Figure 14-21 Anil Seth's House

- **Gujarati Hitavardak School**

The Gujarati school was opened by Diwan of Travancore Kesavadas for the community of the Gujaratis" who migrated from Gujarat on invitation from the Raja himself. The school is 155-year-old and is located on the Gujarati street of Alappuzha. The building is built up of laterite blocks and lime mortar and finished with lime plaster. The roof of the building is made up of Mangalore roof tiles in a traditional way (Kuriakose, 2018).



Figure 14-22 Gujarati Hitavardak School

- **Gujarati Temple Complex**

The Gujarati Temple complex is situated near the Gujarati Quarters in Alappuzha. The complex consists of Shiva Parvathy Temple, Balakrishnan temple and Hanuman Temple. The temples are individually located within a small green area with numerous trees, a well and a small pond. The complex also has a house in which the Priest resides. By the style and age of the temples, it can be said that the Shiva and Parvathy Temple are the oldest and then the Balakrishna Temple was constructed. The recent one is the Hanuman Temple. The Balakrishna Temple is the structure which is in a very deteriorated condition (Kuriakose, 2018).



Figure 14-23 View of Priest House

- **Vallabhdas Kanchi Ltd**

Vallabhdas Kanchi is a commercial establishment of more than 100 years old for spices trading. Before the development of Cochin as a major port Alappuzha was the most important port in Travancore. The world famous spices from High range were exports through Alappuzha. On those days a number of trading companies were established in Alappuzha for spices trading by the ownership of Gujarathis. Now Vallabhadas kanchi is the only one company continuing that business in Alappuzha linking the glorious past of Alappuzha Town. They are exporters of spices like cumin seeds, fennel seeds, black pepper, spice flavours, chillies, ginger, turmeric, cardamom etc.



Figure 14-24 Vallabhdas Kanji Ltd

14.1.7 Other historic structures

- **Leo XIII Higher Secondary School**

Leo school was founded in the year 1888 AD by the diocese of Cochin, in memory of Pope Leo XIII the Pope of Rerum Novarum. The school was handed over to the Society of Jesus for running the school. Now it has been taken back from the Jesuits by the diocese of Alleppey which was formed in 1952 by the bifurcation of the diocese of Cochin (Kuriakose, 2018).



Figure 14-25 Leo XIII Higher Secondary School

The long building with its columns, arches and high-pitched roof gives a typical public building appearance. The School has traditional windows with detailing set along with traditional Mangalore roof tiles. The building is made up of laterite blocks and lime mortar finished with lime plaster.

- **SDV School**

The Sanatana Darma Vidyasala established in 1905 by Rao Bahadur K. A. Krishna Iyengar and Dr S. Venkitarama Naidu under the auspices of the Alappuzha chapter of the Theosophical Society. The building was built as a school which still functions as the same. The school opened with a vision to make education accessible to all continuities of the society where most of the educational institutes only belonged to the upper caste. The building is symmetrical with a central courtyard (Kuriakose, 2018).



Figure 14-26 SDV School

The building follows a traditional style of Kerala architecture. The building is made up of laterite blocks with lime mortar and lime plaster on top of the masonry. The roof is made up of wooden structure upon which the Mangalore tiles are laid. Few of the columns inside the building are of timber (Kuriakose, 2018).

- **SP Office**

SP Office is an old two storied building with a unique architectural style. Now the Office of District Superintendent of police functioning here. The architectural style of this building is attractive. It was built in 18th century as the military camp.



Figure 14-27 S P Office

- **Norton Bungalow**

The 200-year old Norton Bungalow is located at Commercial Canal North Bank Road within the complex of CSI Church. Rev. Thomas Norton was the first missionary who came to Travancore in connection with the C.M.S. Mission of Help to the Jacobite Syrians of Kerala in 1816 at the suggestion of Col. Munro, the regent of Travancore Residency. A bungalow was presented to Norton on his arrival at Alleppey by the Travancore Government as a gift from Rani Parvathi Bai. He is known to be a great missionary.



Figure 14-28 Norton Bungalow

In the 1830s he started a school in the Mission compound with 44 pupils in addition to an orphanage with 22 inmates supported by local contribution. A few years later he built another school in the Great Bazaar and the strength of the school rose to 301 boys and 37 girls. Therefore, the Norton Bungalow is one of the bungalows that has its own unique story to tell about the great missionary resident of the bungalow and also represents the special and unique typology of a by-gone era. The bungalow also symbolizes the individualization of private property, a concept new to the collective lifestyle of traditional societies in India (Kuriakose, 2018).

- **Kottaram Hospital**



Figure 14-29 Kottaram Hospital

'Kottaram' the word originates from Malayalam, meaning Palace. This palace was built by Raja Kesavadas. The Palace was later used as a General Hospital and now it is used as a District Medical Office (DMO). The building has been built with laterite blocks and lime plaster. The building has been extended to what was initially the Kottaram Hospital (Kuriakose, 2018).

- **CYMA Hall**



Figure 14-30 CYMA Hall

CYMA hall is an old traditional building, which is Kerala's first public auditorium built exclusively for organizing cultural activities, especially for staging dramas. The plot on which CYMA Hall is located is owned by St. Michael's Church, Thathampally. It all began in 1920 when some men came together to form an association called Catholic Young Men's Association. It included writers, scenic designers, costume designers, stage technique experts, makeup and lighting artists, amateur actors and theatre directors (VastuvidyaGurukulam, 2009).

The construction was started in 1926 and the hall was completed in 1936. The building is a blend of Venetian architecture and Kerala's Vastu Sastra. The building has a magnificent arcade. There are twin columns and horizontal mouldings. This arcade is quite effective in conjunction with two semi hexagonal room façade placed on both sides of the arcade. An

arcade with columns is the main characteristics of Venetian style. The ventilators are 14 ft. above the floor level, like the clear story windows associated with Buddhist architecture. A striking departure from the Venetian style is the imposing and pleasing roof covered with Mangalore tiles. The timber roof design is most accurate and scientific.

The building consists of hall with a stage and stair type gallery, a makeup room, reading room, office room and a store room. The hall of 95 ft. X 30 ft. size has no acoustical drawbacks such as reverberation or echo. The height of the hall is 18 ft. (VastuvidyaGurukulam, 2009).

- **Alleppey Port Complex**

Alappuzha was the principal seaport town of the Travancore Kingdom of Kerala. The Port was constructed by the then Diwan of Travancore, Raja Kesavadas in 1755, thus marking Alappuzha on the world map. The history of Alappuzha port is as old as the town itself (Kuriakose, 2018).

The Complex was the administrative base for the port activities housing the administrative office, port office and warehouses and sheds for storage of goods. There are seven buildings present in the port office complex. Each building has been constructed for a different purpose, which can be seen through their architectural character. All the structures have been abandoned now (Kuriakose, 2018).



Figure 14-31 View of Block F



Figure 14-32 Archival image of Port Building

The Port Building has been modified at various periods and currently used as a Central Government Port Office. The Port Building was an old signal station for the Alappuzha port. The building is made up of laterite and lime plaster as a binding material with lime plaster (Kuriakose, 2018).

- **Lighthouse**

The light house at Alappuzha is one of the oldest of its kind; built in 1862 by Hugh Crawford, a European Engineer, along the cost of Kerala. Alappuzha was the main port of Travancore up to 1960's. No cement is used for this construction. It is one of main land mark of Alappuzha.



Figure 14-33 Light House

The decline of the Port of Purakkad necessitated the rehabilitation of the traders for which Alappuzha was selected as a port and infrastructure was developed. The port was opened to foreign traders in 1792. There was no regular lighthouse provided in the 18th century, only a light on the pier head served the mariners. As port activities increased, the authorities had to provide for a lighthouse. The construction of the present lighthouse began in the reign of His Highness Marthanda Varma-II Maharaja (ruler of Travancore) and was completed during the reign of His Highness Rama Varma Maharaja of Travancore. The first stone was laid by Mrs. Mough Crawford on 26 April 1860.

- **Sea Pier**

Alappuzha was the main port of Travancore. The world-famous spices from high range and coir products from the coastal area had exported through this port. The goods were transported through Alappuzha pier to the ship and from ship to the port. A wooden bridge of length 1270 feet was constructed for loading and unloading cargos. By 1975 the bridge collapsed. Later it was repaired and but the same did not last long. In the place of old wooden bridge an Iron Screw Bridge was constructed in 1880-81. In 1892 when the sea receded the bridge was extended to enable docking of boats. It was repaired and renovated in 1907. Now only portions of this structure exist. Now it is in a damaged stage and most parts spoiled by the violent sea during the monsoon. The preservation of this pier is same as that of preservation of the glorious part of the Alappuzha.



Figure 14-34 Sea Pier

14.2 Major Issues

- **Structural Deterioration**

Many buildings suffer from defects such as leakage, dampness, cracks, termite attack, etc. irrespective of their age. The major defect seen in the new buildings are leakage and dampness due to poor construction techniques. Cracks and flaking of plaster have resulted in exposure of the reinforcement of the slab. Roof tiles missing or broken has led to leakage. Roof beams are found to be sagging. Timber ceilings face the problem of termites and fungal attack.

- **Aesthetic Alternation**

As time passes buildings demand changes and repairs which need to be in accordance to the original character of the building. But in Alleppey various buildings have been incongruously altered destroying their architectural character. A prominent example of this is the change of tiled roof to metal or asbestos sheet for roofing.

- **New Buildings and Damaged Skyline**

New constructions contrast the architectural style of the street in terms of character and scale. The new buildings have flat R.C.C roofs, flat sunshades and rolling shutters at the shop front.

- **Poor Maintenance**

The poor maintenance of buildings has structurally and aesthetically weakened the buildings. This has led to their further deterioration. For example, avoiding the building has led to vegetative growth and debris collection in the building.

- **Street Lighting and Electrical poles**

Absence of street lighting making visibility limited and the area unsafe during the dark. The cluttered wires and faulty electric poles hampering the views of the street.

14.3 Inference

Buildings /precincts of heritage importance are in abundance in the town. The port, the pier, the light house and the structures of archaeological importance spread along the banks of the main canals of the town are to be preserved and protected as tourist attractions. Tourism is a major tool to revitalize the once popular town of Alappuzha. Many of the heritage buildings are unaltered. There is a scope for adaptive reuse of these heritage structures.

15 DEVELOPMENT ADMINISTRATION AND FINANCE

15.1 Development Administration

15.1.1 The Elected Council

The elected council consists of 52 members one from each ward in the Town through election by the people of respective wards, among the 52 elected members 29 are women members. The Chairperson who is the head of the council has been elected from the elected members of the council. The Vice-chairperson, to assist the chairperson and also to discharge the duties of chairperson in his absence, is also elected by the members of the municipal council. There are six standing committees, i.e., for finance, development, welfare, health, education-art & sports and public works to assist the municipal council in respective fields. There are nine standing committee members in finance, development and welfare and eight members in health, public work and education-art & sports. The vice-chairperson is the chairman of the finance standing committee and the members of the council will elect the chairpersons of other standing committees.

15.1.2 Administrative Structure of the Municipality

The Municipal Secretary is the executive head of the Municipality and he is supported by the following six sections of staff.

i. General Administration section

ii. Revenue section

iii. Engineering section

iv. Public health section and

v. Peoples planning section

vi. Accounts and Auditing.

15.1.3 General Administration Section

The General Administration section is headed by the Junior Superintendent and consists of three sub-divisions i.e., Establishment, Accounts and other General matters.

15.1.4 Revenue Section

Revenue section is headed by the Revenue Officer. The section deals with the revenue of the Municipality.

15.1.5 Engineering section

The Engineering section is headed by Municipal Engineer in the cadre of Assistant Executive Engineer and is assisted by Assistant Engineer and public works overseers. This section is responsible for the project planning, execution and maintenance of basic services and other infrastructure within the town. This section looks after the implementation of the development plans and other town planning schemes, approval of building plan and lay out plans, detection of unauthorized construction, eviction of encroachments etc.

15.1.6 Public Health Section

This section is headed by the public health officer Grade I. This section attends works like collection and disposal of solid wastes, cleaning of drains and work related to public health, mother and child care, C.D.S works etc.

15.1.7 People's Planning Section

This section co-ordinate the plan formation under decentralized planning process. Annual plans and five-year plans for the Municipality are being prepared under decentralized planning process.

15.1.8 Functions of the Municipal Council

Alappuzha Municipality is the major agency implementing development works in Alappuzha. For the beautification and other necessary administrative services, the city has its own Municipality Board. The civic amenities such as electricity, urban development, drinking water facility and sanitation, road-construction are some of the important functions which performs under the Municipality of Alappuzha. The development works to be monitored by Municipal Council includes, the construction of Municipal roads and their maintenance, public health - primary health centre, community health centre, solid waste disposal, construction of public market and their maintenance, public cremation ground and its construction procedures, open spaces, parks and their construction works, providing infrastructure in slums, protection of water bodies. The maintenance of the institutions transferred to the Municipal Council such as schools, hospitals and other institutions in asset register

15.2 Municipal Finance

In order to review the status of municipal finances, the actual income and expenditure data has been collected and further regrouped and recast for the period Financial Year (FY) 2017-18 to 2021-22. Accordingly, the analysis has been carried to understand the revenue and

capital account status and overall closing balance for the review period. Following are the key highlights of the financial assessment.

Table 15-1: Income and Expenditure Statement of Alappuzha (2017 - 2022)

Particulars	2017 - 18	2018 - 19	2019 - 20	2020 - 21	2021 - 22
Total Revenue	61.621 cr	68.412 cr	64.193 cr	117.973 cr	117.460 cr
Total Expenditure	52.489 cr	108.096 cr	12.956 cr	144.754 cr	134.908 cr
Surplus / Deficit	9.164 cr	10.369 cr	80.982 cr	27.057 cr	25.769 cr

(Annual Financial Statement)

15.2.1 Current Status of Municipal Finance

Revenue Account- Revenue Income

Revenue Income consists of own sources of revenue and revenue grants and contributions. Further, own sources of revenue comprise of tax revenues and non-tax revenues. Following figures presents the trends in revenue income at Alappuzha Municipality. Contribution of each of the sources i.e. Tax Revenue, Non-Tax Revenue and Revenue Grant has been depicted the Figure 15-1. This figure indicates the over dependency on revenue grants and it would be a threat for Alappuzha in near future as it is mainly dependent on grants. Tax and non-tax revenues are contributing below 40% except the year 2019 - 20 of total revenue income.

Table 15-2: Revenue Income of Alappuzha (2017 - 2022)

Particulars	2017 - 18	2018 - 19	2019 - 20	2020 - 21	2021 - 22
Tax	11.919 cr	18.288 cr	10.392 cr	9.687 cr	10.537 cr
Non Tax	5.454 cr	6.556 cr	30.205 cr	9.680 cr	11.823 cr
Grants	44.247 cr	43.567 cr	23.595 cr	98.604 cr	95.585 cr
Total Revenue	61.621 cr	68.412 cr	64.193 cr	117.972 cr	117.946 cr

(Annual Financial Statement)

Revenue Expenditure

Like the receipts, the expenditure of the Municipality is also classified into three accounts revenue account, capital account and debts account. The expenditure under revenue account includes the expenditure for administration and tax collection, public works, town planning, education, water supply and drainage, public health, street light, maintenance of municipal properties, grant for maintenance of transferred assets etc. The expenditure under capital account includes expenditure for management, public works, education, water supply

and drainage, public health, street lighting, endowments, deposits, poverty eradication programmes, expenditure for the programmes implemented through the departments transferred to the Municipality, programmes under decentralized planning etc. With respect to own source revenues, the property and professions taxes are the major sources of own revenue for GPs. Following figures presents the trends in expenditure at Alappuzha Municipality.

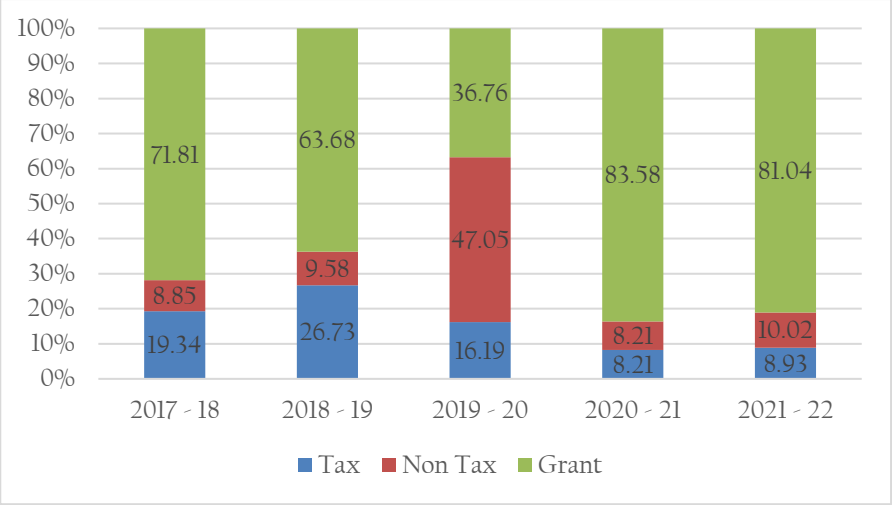


Figure 15-1: Revenue Income Composition

Revenue expenditure towards each heads i.e. Establishment & Administration, Operation & Maintenance, Capital Account and Interest has been depicted the Figure 15-2. Comparing the own source of revenue income to revenue expenditure, expenditure is exceeding and this shows the need to tap more sources or improve the existing system of collection.

Table 15-3: Revenue Expenditure of Alappuzha (2017 - 2022)

Particulars	2017 - 18	2018 - 19	2019 - 20	2020 - 21	2021 - 22
Establishment & Administration	18.059 cr	28.734 cr	23.654 cr	19.768 cr	25.338 cr
Operation & Maintenance	3.047 cr	10.655 cr	22.105 cr	28.732 cr	18.006 cr
Capital Account	31.382 cr	68.705 cr	83.807 cr	96.263 cr	91.563 cr
Total Expenditure	52.489 cr	108.096cr	129.567 cr	144.754 cr	134.908 cr

(Annual Financial Statement)

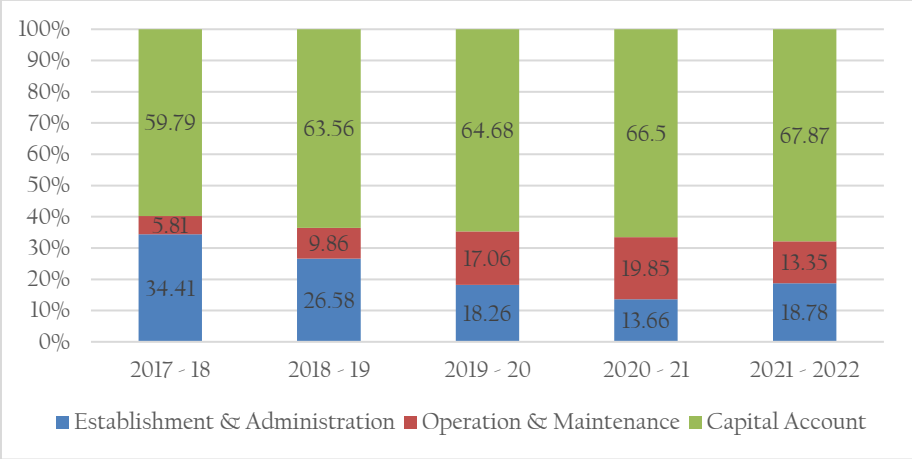


Figure 15-2: Revenue Expenditure Composition

15.3 Governance



Currently the municipal office is functioning in the old building which is having limitations in functioning and is proposed to shift to new building which is to be constructed near present building.

15.3.1 Other Departments

Kerala Water Authority is dealing the distribution of drinking water in Municipal area. Office of the Assistant Engineer is functioning at Alappuzha. The Electricity distribution system is maintained by the Kerala State Electricity Board. Correspondent department is Electrical Section Alappuzha is in charge of distribution of electricity. The Kerala State Public Works Department (Roads), NHAI, KRFB is in charge of construction and maintenance of roads, other than those roads owned by the Municipal Council. The Kerala State Public Works Department (Buildings) is constructing major buildings.

15.4 Inference

The Local Self Governments has major role in providing civic amenities, infrastructure facilities and civic amenities to the people. But the present institutional capacity is inadequate to provide better services to the people. Municipality has to identify new sources to improve tourism, industrial development, public transportation network etc. and to enhance resource mobilization. The rice bowl of Kerala is in depletion stage, encouraging and motivating the workers will be the one step solution to up keep the economic balance of the Municipality. Alappuzha should focus on balancing the finance and survive on own source of revenue which helps in reducing accumulation of debts.

16 LINKAGES & EXISTING SPATIAL STRUCTURE

Linkages between settlement characteristics and various sectors need to be addressed for carving out an integrated development vision. Also, the existing spatial structure of the planning area which is the physical demonstration of all such linkages is to be analyzed for visualizing the most desirable spatial structure of the area which will minimize the adverse effects on the environment. The details are elaborated in this chapter.

16.1 Inter - Sectoral Linkages

16.1.1 Effect of population growth on various development sectors

The growth in population has an all-evasive effect on all the development sectors since development is for the people and by the people. The effect of population growth is direct on sectors like water supply, electricity, housing, traffic & transportation, education, health care etc. where there is direct consumption. The rest of the sectors have secondary impact on them.

Population growth shall have impact on trade and commerce only beyond a threshold population. If we analyze the trade and commerce that take place in a town, distribution of basic necessities of life contributes only to a part of it. The rest of the trade depends on surplus income. So, even though there is an increase in trade due to population growth, the trade volume is more elastic towards the surplus income and thus the significant changes are often related to the change in surplus income rather than population growth. The increase in trade due to increase in demand for basic necessities shall not be apparent if the surplus income is reducing. When both the population and the surplus income grows, the trade & commerce take off at an accelerated pace.

In the case of tourism sector, the growth of population has no bearing on the performance of the sector within the town. Similarly, in the case of animal husbandry, agriculture and fisheries also, the town's population has not much influence in these sectors since the products from these sectors are not locally grown but imported to a large extent.

With growth in population, the human activities increase and it reflects on the transportation needs of the people. The transportation needs grow exponentially with the increase in population. The physical improvements of the transport network shall be attempted with this in view. The demand for water supply, sewerage system, solid waste management system, energy, education, health care, recreational and other civic amenities has direct relation to the increase in population. But physical infrastructure for these services cannot be built incrementally. Hence these facilities shall be developed in a phased manner

dove tailing with the respective threshold population. The housing sector also has direct relation to the growth in population. However, development in this sector can be taken up in an incremental manner to an extent.

16.1.2 Land use changes and environment

The changes in land use affect the environment to a great extent. The major land use changes thus affecting environment, identified in Alappuzha Municipality are the depletion of paddy land and encroachment of waterbodies. The agricultural production is not a very significant factor to be considered while formulating land use policy in an urban context. But situation is different in Alappuzha town. Here considerable area of Municipality is under paddy cultivation and is a livelihood of town. The paddy land essentially acts as green open space and also functions as a reservoir during rains preventing flood and fast run off.

The land use policy decides the compactness of built form in the town. A less compact built form (with more than necessary intrusion of residential, commercial and such other land uses requiring built space to agricultural / open land uses) shall mean wider building foot prints. This calls for putting more land under manmade structures which is detrimental to environmental quality. Reducing the building foot print is the answer to this problem. Reducing the building foot print also shall mean compact development for which it is easier and less costly to provide basic amenities like water, sewerage system, energy, roads etc. Providing waste treatment facilities are also a lot easier for a compact development. All these have positive impact on the quality of environment. The land use also has profound impact on the micro climate. Lesser foot prints shall reduce the possibility of creating heat islands within a town.

Another issue is that of other environmentally fragile areas such as the lake and canal sides. The changes in land use in these areas need serious consideration. Highly polluting activities in the lakeside shall threaten the cleanliness and quality of the lake.

The distribution of various land uses in the town decides the traffic pattern of the town and hence has environmental ramifications. So, the changes in land use shall be managed in such a way that traffic and transportation needs are optimized causing less pollution from vehicular traffic and less consumption of precious fossil fuels.

16.1.3 Industrial sector – effect on environment, land use and employment

Micro, Small and Medium Enterprises (MSME) sector is an important generator of employment. In Alappuzha Municipality the small enterprises are concentrated in some particular locations. The earlier efforts to earmark separate area for industrial land use (in the Master Plan in force) has not achieved the results. Considering the tremendous potential for employment creation, the MSMEs have to be promoted. The establishments of small scale units in the residential and commercial areas are to be viewed in this backdrop. However, allowing such industries in residential and commercial areas should not affect the environmental quality of the area. Hence the nature of industries that can come up in such areas should essentially be non-polluting and non-nuisance type.

There are no large-scale industries in the municipal area. Thus earmarking the parcels of land owned by private individuals who have no inclination to start an industrial unit can be avoided. Besides a policy of allowing non-polluting and non-nuisance industries of small scale in residential and commercial areas along with the development of necessary infrastructure required for industrial development such as good road connectivity, availability of water and electricity etc. may be attempted to promote industrial development in the Municipality.

In the case of large-scale industries of non-nuisance / non-polluting nature, the locations cannot be earmarked in advance due to the problems associated with the acquisition of land and uncertainty regarding the establishment of such units. In such instances considering the location decisions on a case-to-case basis only is feasible.

There is an issue as to where a polluting (with pollution abatement measures) / nuisance type industry has to be located in the Municipality if it is essential from other (economical / locational / strategic) considerations. The solution is to provide for allowing such industries in the less inhabited areas in the Municipality with strict guidelines for site selection prior to establishment of such industry and control of other land uses around such industries after their establishment.

16.1.4 Effect of various sectors on employment

The small industrial sector is considered to be the prime provider of employment in small and medium towns. But in the case of Alappuzha, the employment in industrial sector has depleted. The tertiary sector, mostly various services employ more people than industries. Trade and commerce is an important employment sector, both direct and indirect. However,

the employees in this sector are mostly unorganized and hence their share is not much reflected in the statistics. The fluctuation in employment level is also high in this sector.

Tourism, in the town as an employment sector, has much potential in creating more jobs. The investment required to create unit employment is low in tourism sector.

Even though studies based on physical features suggest agriculture, animal husbandry and SSI as thrust areas of employment in the town, the number of cultivators and agricultural laborers are on the decline in Alappuzha. This trend is not likely to be reversed. So, increase in productivity with increased technology inputs is imminent in this sector. Organized farming does exist in a few holdings in the Municipality. Their potential for creation of further employment is marginal. The case of animal husbandry and fisheries are also the same.

The employment in government and private office sector is almost at a saturation level and is not expected to grow at a fast pace. Education and healthcare are the major providers of organized employment in the state. In addition to the direct employment created by these sectors, development in these sectors create number of secondary employments besides making the population more employable. Likewise, improvements to the physical infrastructure of the town shall attract employment generating activities to the Municipality. So, providing better infrastructure also is a key to the creation of jobs in the municipal area. So tourism, industry, services, education, health care and physical infrastructure are the thrust areas for employment generation in the Municipality. In the development plan it is proposed to address this issue in two ways. First through the improvement of physical infrastructure and creating new infrastructure facilities in the thrust areas. The second approach is by putting in appropriate policy measures for the development of the identified thrust areas.

16.1.5 Changes in traffic & transportation needs due to growth in various sectors

The relation between demand for traffic & transportation infrastructure and different sectors of economy is a very dynamic one. The growth in any sector of economy calls for instantaneous changes in the demand pattern of transportation infrastructure. However, the transportation infrastructure cannot be provided in an incremental manner. Phase wise expansion is the only solution. Hence careful consideration is required in any development plan while dealing with development in major sectors of economy and social infrastructure.

The trade and commerce sector calls for increased freight traffic both in bound and out bound. Here, in bound traffic is likely to be more than the out bound traffic. Since the increase

in demand shall be for freight transport, development of a truck terminal is essential. So, a truck terminal, easily accessible from the network is a pre-requisite for development of industries and trade & commerce sectors. The increase in trade and commerce increases the intra city traffic also. So development of trade & commerce meant for local consumption should be decentralized to the maximum extent possible in order to reduce intra city traffic. These efforts shall focus on decongesting the town center.

Development of education and health care sectors also means establishment of institutions of higher order. This shall increase the passenger traffic. The locational decisions of such institutions shall be taken so that the existing network is suitably used by the additional demand and development of the network is possible in a phased manner. Otherwise the cost of development of new links in the network shall hamper the pace of development in these sectors.

The improvements of existing as well as development of new recreational facilities shall also result in changes in demand pattern. The trips generated by these developments shall be intra city in nature. Hence the location of new such facilities should be decided keeping the need to segregate through traffic and intra city traffic. On the other hand, development in tourism sector means an increase in inter city traffic which in turn call for improved arterial and sub arterial roads.

16.1.6 Changes in traffic & transportation needs due to changes in land use

The land use pattern and the traffic pattern are interwoven inexplicably. The traffic pattern is the dependent variable in the relation and various models were tried to define this relation. The changes in traffic pattern due to changes in land use can be studied using these models to a reasonable level of accuracy. The land use pattern can change mainly in two ways. One is due to the growth in population and subsequent increase in economic activities. The other is due to changes or increase in the pace of economic activities due to other impetus rather than population growth. The population growth is mainly reflected upon the residential land use, its geographic spread and densification. The number of trips generated increases in proportion to the growth in population and the origin of these trips are decided by the spatial distribution and density of residential land use. Typically, in the case of Alappuzha Municipality, there is an increase in volume and not in pattern since the various destinations are normally in place hence no major shifts in social infrastructure is anticipated.

The land use changes attributable to changes in the pattern of economic activity recast the existing traffic pattern and need special consideration. The distribution of commercial land use has a great impact on both the intra city and intercity traffic demand. This indicates need to locate commercial land use that are easily accessible from arterial and sub arterial roads. But the experience of the state in this regard is the occurrence of ribbon development which is detrimental to the proper development of roads and result in inefficient use of land. So care shall be taken to prevent ribbon development while considering development of commercial land use along the arterial and sub arterial roads. The attempt to re-route intra traffic away from NH also shall prompt dispersion of commercial use, discouraging ribbon development.

Another issue is the changes in land use due to large scale industries and higher level educational and healthcare institutions. These institutions are big enough to change the land use pattern in their vicinity. However, the location of such institutions cannot be predicted in advance in a development plan, in the present legal regime, unless land is available. The Municipality anticipates establishment of a number of such institutions in the coming years. The possible locations of these institutions (in terms of sheer availability of suitable land and not with the intention of acquisition by public agencies) will also be a determinant of the proposed road network.

16.1.7 Spatial distribution of trade & commerce: effect on real property values and equitable housing policies

The draft Housing Policy, 2011 of the Government of Kerala states that "the International Covenant of United Nations on economic, social and cultural rights, to which India is a signatory, upholds the right to adequate housing as a human right. Article 21 of the Constitution of India which defines the protection of life and personal property encompasses the right to shelter and right to livelihood also which are integral to the dignified living of the individual." The trend in urban development in the state had been such that more and more people are forced to out migrate from the towns. The draft Housing policy upholds the need for adequate and affordable housing for all. The spatial distribution of trade and commerce activities has a significant impact on the land value in any town. Development of a speculative market on land in the state cannot be ignored. The land banks amassed by private individuals in the state play a vital part in this speculative market. Investments are being made in this market on land for speculative purposes and only a small fraction of the buyers are real users. Due to such multiple transactions, the end users of the land end up paying a highly jacked up price which seriously affect the economic viability of the venture. The increase in land value in

commercial areas has a ripple effect on the price of residential plots also. This issue can be addressed in a development plan by ensuring adequate spread of commercial land use and making adequate area available for commercial development so that pressure on commercially developable area is released. This will have an impact on land values in residential areas as well, because there will be no unstated demand for commercial use and the resulting attempts by trade and commerce activities to intrude into residential areas. The extent zoned for residential use also should be adequate so that the demand for more houses could be met. Another provision that shall reduce the pressure on land for housing is allowing low density EWS and LIG houses in a restricted manner in areas zoned for dry cultivation etc. These policy interventions through zoning (in extent and zoning regulations) are expected to increase the availability of land suitable for residential purpose and hence reduce demand driven increase in land value.

16.1.8 Tourism and environment

Tourism and environment have a dual relationship. Certain level of environmental quality is a must for healthy development of tourism sector. But, unbridled development in tourism sector can adversely affect the environment. Well-developed tourist destinations lose their charm due to deterioration in environmental quality. The Alappuzha town has a serene environment to start with which can be utilized for the promotion of tourism projects in the town. The places of tourist attractions are mostly in the environmentally fragile areas of the Municipality. As a result, when developing new tourism projects, maintaining environmental quality should be given top priority. Provision of basic amenities for the anticipated number of visitors is a must. New concepts like e-toilets etc. merit consideration in this regard. Waste management practices (for both solid and liquid waste generated by the tourism activities) should be state of art and should not interfere with the biotic systems in any case. Maintaining environmental quality around locations of tourist attraction like lakeside needs special consideration. Proper waste management systems are to be provided in these locations. Negligence in this regard shall gradually kill the industry and the Municipality shall be let alone with a degraded environment and hence should be taken care of in the planning stage itself.

16.1.9 Inclusive growth in various sectors

The eleventh five-year plan of the country focused on inclusiveness. This specific focus in the eleventh plan has helped creating awareness and institution building for inclusive growth. The draft approach paper to the twelfth five-year plan, released by the Planning

Commission of India, aims at faster, *sustainable* and more inclusive growth. Inclusiveness, being a multidimensional concept, is difficult to assess. The concept can be explained in terms of livability, poverty alleviation, access to health, education, basic amenities etc. in general. Housing is the most prominent component of inclusive growth in the context of a development plan. Adequate and affordable housing should be ensured to all by direct intervention and / or policy measures to promote affordable and decent housing for the poor. The road connectivity, availability of water supply, electricity, educational facilities, healthcare facilities, recreational options and other amenities are addressed by the development plan. An equitable distribution of such amenities is targeted by this development plan which shall improve the inclusiveness in urban development. In the trade and commerce sector, recognizing the street vendors as legitimate entrepreneurs addressing the shopping needs of the common man is a big step towards inclusive growth. By this initiative the street vendor is no more a person to be taken off the road for illicit occupation, but someone whose trade is to be facilitated by the public authority in the interests of the common man. The attempt is to share a part of the demand for trade and commerce and the profit there from with the poor who ekes out a livelihood by peddling goods for day-to-day use. Besides, the common man receives his supplies at reduced prices since the overhead expenses are minimal for the street vendor.

In the industrial sector, allowing micro enterprises in residential and commercial zones is a policy measure for ensuring inclusive growth in the sector. The zoning regulations in general have to be lenient towards the housing needs of the poor, being inclusive. The spatial distribution of educational and healthcare facilities is also important from the inclusiveness point of view. Access to school and primary healthcare facilities at walkable distance is essential for bringing in inclusiveness in the growth of these sectors. Ensuring proper sanitation (by giving sanitary toilets, efficient collection of wastes, abatement of waste water logging etc.) should be given top priority in alleviating slum like conditions within the Municipality.

In the traffic & transportation sector, interior collector roads shall be widened so that public transport systems like buses can reach the remote habitations, measures for the safe passage of pedestrian traffic etc. can be considered as attempts at inclusive growth.

In the energy sector no additional effort is required since the town is almost fully electrified.

Various policy and other measures for creating employment in the town shall also contribute towards inclusive growth.

16.1.10 Energy efficiency and land use

Energy efficiency is a very important consideration in the design of any system that uses energy. The urban system as a whole is a guzzler of energy. The energy requirement of an urban area is much more compared to a rural area of the same size. Conservation of energy is a need of the day due to various reasons such as depletion of fossil fuels, carbon emission and related climate change, depletion of ozone layer etc. The energy saved is considered to be energy produced. The benefits of energy saved by land use planning measures are of long term and hence need careful consideration. The compact nature of development reduces intra city traffic and thus saves fossil fuel. Efficient layout of various land uses based on their compatibility and trip generation characteristics shall result in reduction in use of energy for transportation needs. The compactness and proper layout shall prompt pedestrian traffic also contributing to energy conservation. This also helps conserve energy in sectors like water supply, electricity etc. The formation of urban heat islands within the Municipality can be avoided by appropriate land use measures. This shall cause savings in energy by reduced demand for air conditioning and artificial ventilation.

16.2 Spatial Structure

Alappuzha town is located in the Ambalappuzha taluk of Alappuzha district and occupies a prominent position as the important town between Kollam and Ernakulam on the National Highway 66. The activity pattern of the wards in the Municipality, their connectivity and the hierarchy of nodes/centers within the town are studied in detail to derive the spatial structure of the town.

16.2.1 Functional Character

The functional character is determined based on the land use, population distribution and average plot size within the settlement. It is classified as rural, semi-rural, semi urban and urban. At the regional level the functional character of Alappuzha Municipality is determined as urban. The wards in the Municipality are studied in detail with respect to aspects like total area under each land use category, Concentration pattern of population percentage of workers engaged in non-agricultural pursuit. Average plot size in the residential/agricultural mix use category. Figure 16-1 shows the functional character of wards within the Municipality.

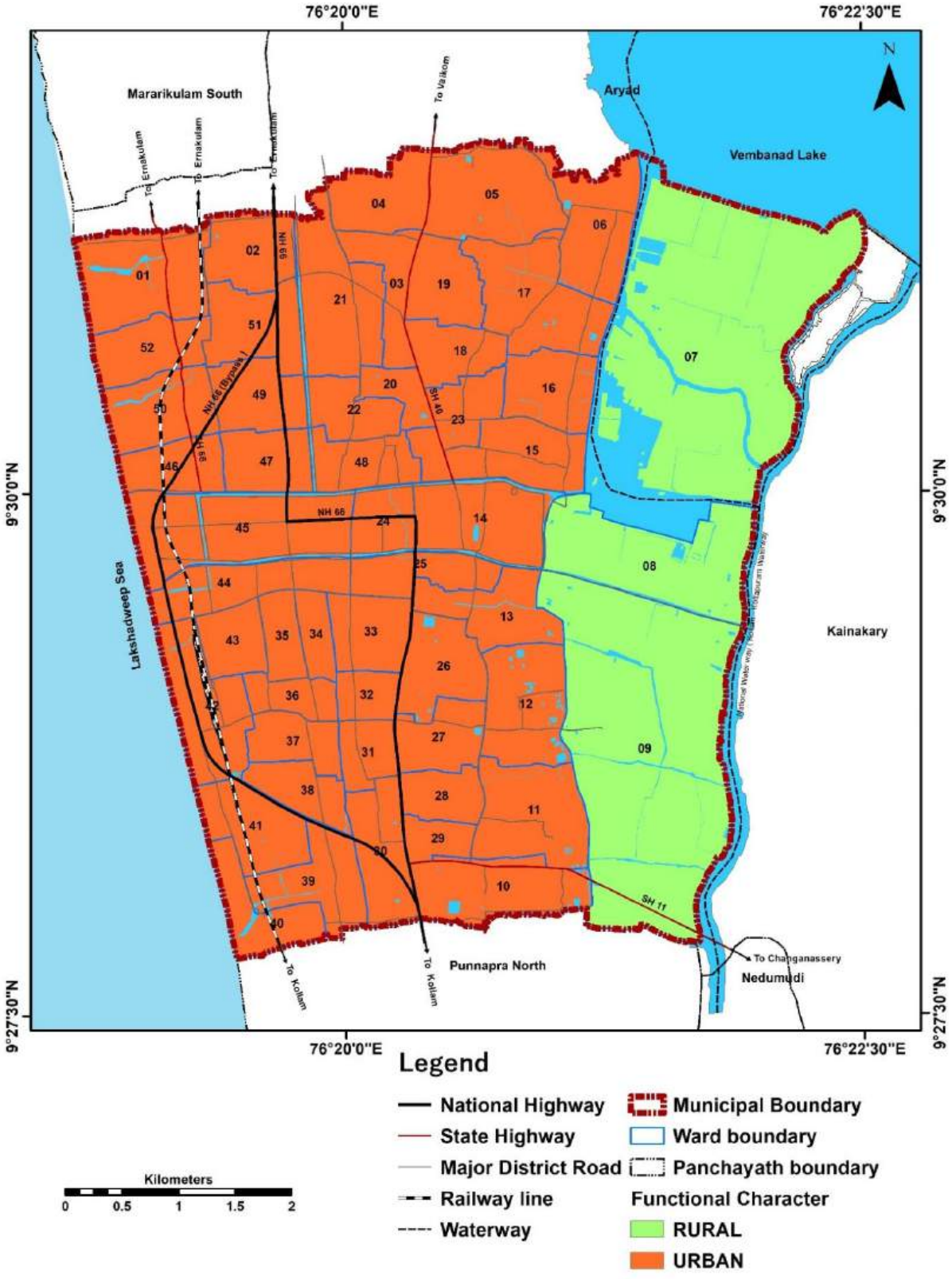


Figure 16-1: Functional Character of wards in Alappuzha Municipality

16.2.2 Activity pattern

The term activity pattern is used to indicate the major economic activity of a place or that can be brought there in future. It may be agriculture/plantation (primary activity), industries (secondary activity), service activities (tertiary activity) or a combination of theses like agriculture and animal husbandry and small-scale industries. The activity pattern can be derived through the integration of the land use concentration pattern, functional character and the urban profile. From the regional setting study, the activity pattern of Alappuzha Municipality is obtained as tertiary activity. etc. Figure 16-2 shows the activity pattern.

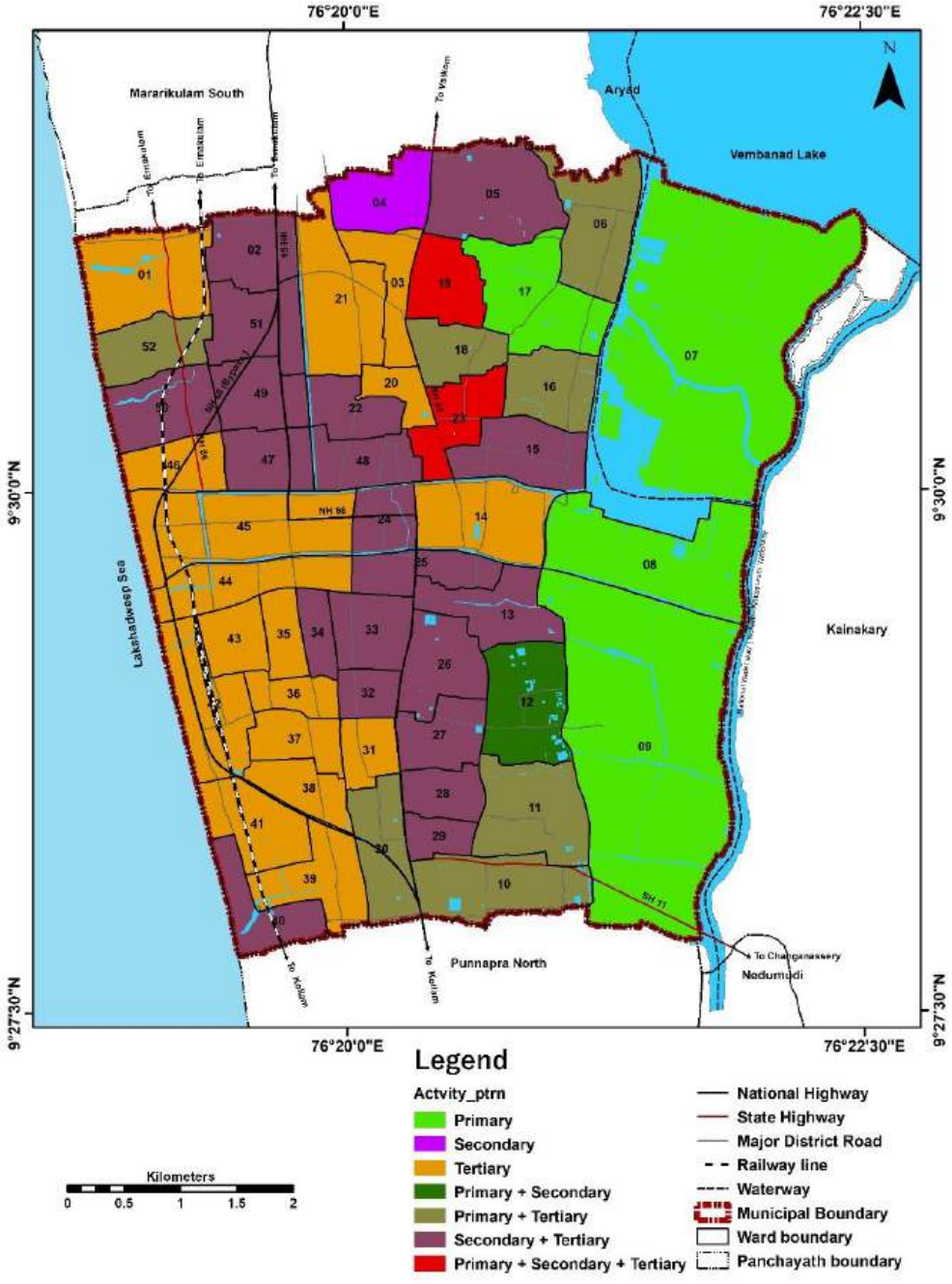


Figure 16-2: Activity Pattern

16.2.3 Connectivity pattern

Alappuzha town has good road connectivity. The NH 66 covering a distance of 7.48 kms passes almost through the middle of the town starting from North at Thumboly to South at Kalarkode. The total traffic through the newly constructed bypass and arterial roads. The State Highways 11, 40 and 66 originate from this town. Apart from these roads, numerous Municipality roads constitute the road network of this town. The road network is of grid pattern and the roads are placed parallel to each other. Majority of the facilities are located along the important roads. Figure 16-3 shows the connectivity pattern.



Figure 16-3: Connectivity Pattern

16.2.4 Hierarchy of Space/Nodes/Centres

Commercial nodes are identified on all important intersections of roads where commercial activities are concentrated and in the case of linear development, commercial activity or physical development for a distance of 250 m. The most important commercial nodes thus identified are Zilla Court Bridge Junction, Mullakkal Street –AVJ Junction, Zero Junction, Pichu Iyer Junction, Stone Bridge Junction, General Hospital Junction and Iron Bridge Junction. Many of the educational, health, civic and other facilities are also located at these places. Figure 16-4shows the hierarchy of commercial nodes.

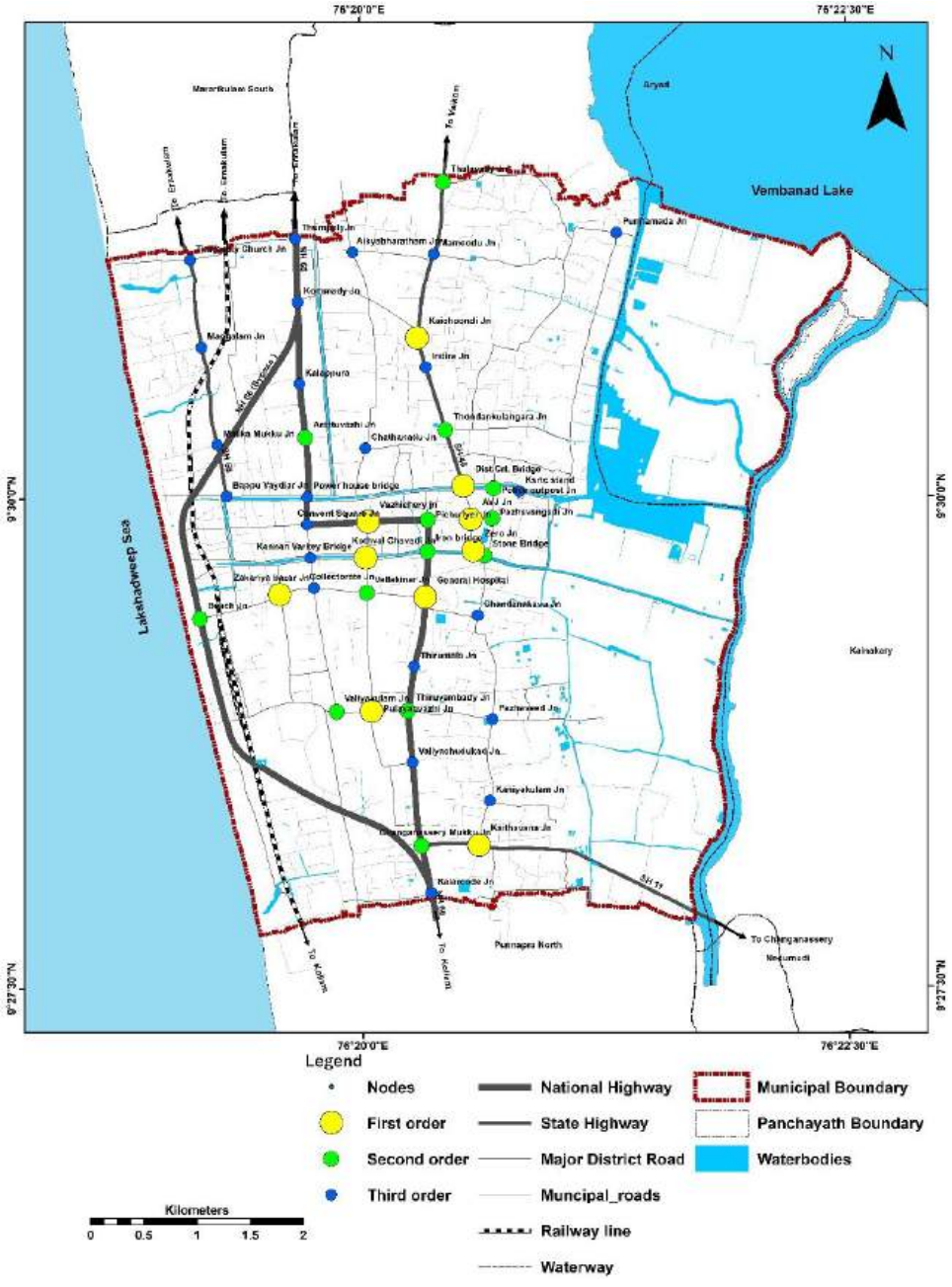


Figure 16-4: Heirarchy of Commercial Nodes

16.2.5 Existing Spatial Structure

Functional character, activity pattern, connectivity pattern and hierarchy of commercial nodes are considered together to formulate the spatial structure of the Municipality. The spatial structure obtained by overlaying the maps are shown in Figure 16-5.

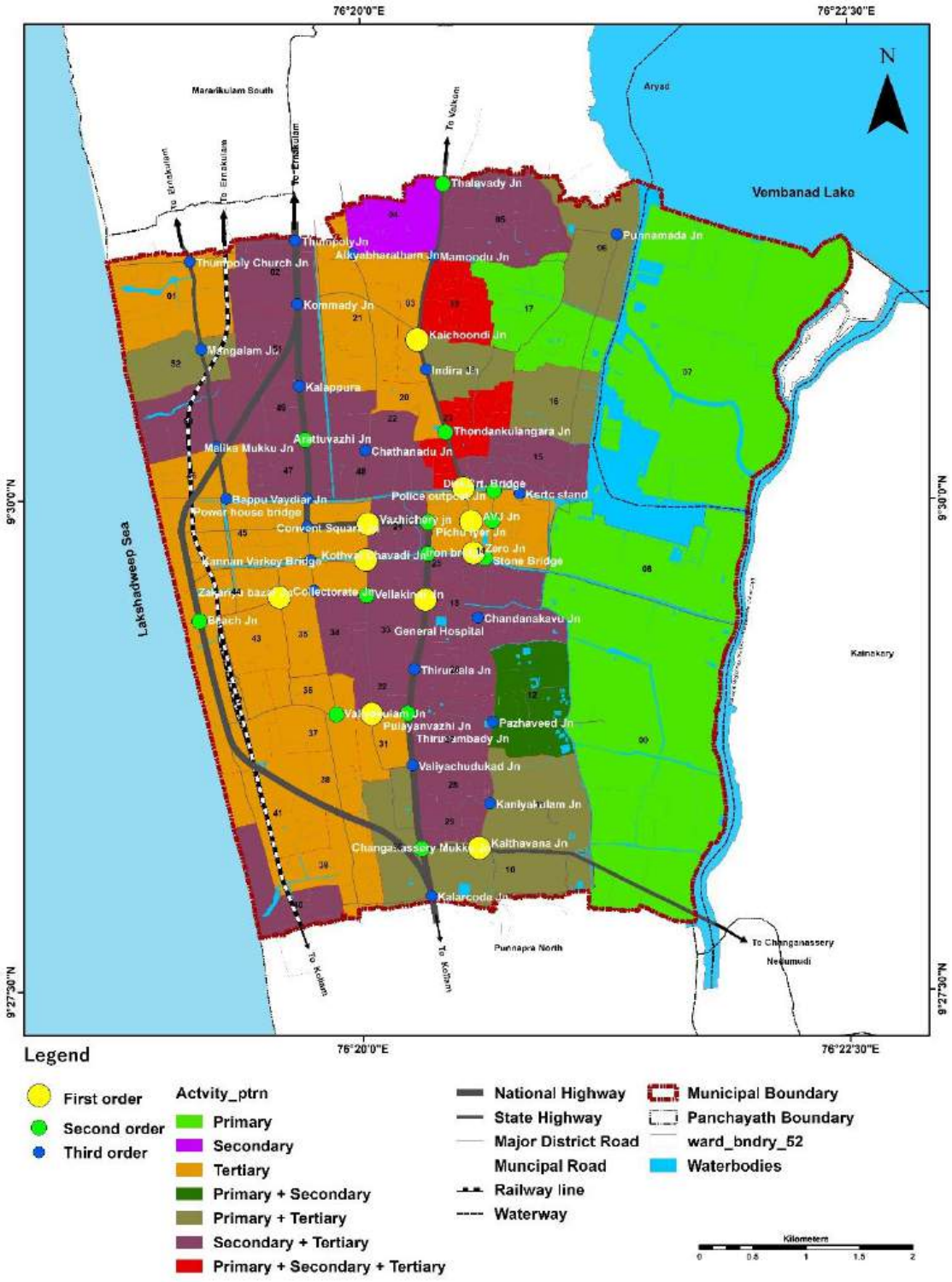


Figure 16-5: Spatial Structure

It shows that the whole area is urban except for only three wards in the Eastern periphery which is rural. The core area is actively public and semi-public and commercially developed. Tertiary activity is the main function throughout the major corridor and in the core city. 17 wards out of 52 show tertiary activity. Primary activity is very less in the Municipality.

The development of the town is concentrated around the first order nodes of the town such as Zilla Court Bridge, Mullackal Street, Pitchu Iyer Junction, Stone Bridge, General Hospital Junction and Iron Bridge. Even if canals are in a deteriorated stage, still there is scope for further development along canal side. Tourism, Industry, and commercial activities may have further scope for development along canal area. The lower order nodes are scattered throughout the town and the connectivity of the nodes are there, but needs improvement.

PART II

INTEGRATED DEVELOPMENT VISION

17 SUMMARY OF FINDINGS & SWOT ANALYSIS

Summary of the major findings from the detailed sectoral analysis are listed out to assess the strength, weaknesses, opportunities and threats faced by the town to evolve an integrated development vision for future development of the town and is explained in this section.

17.1 Summary of Findings

17.1.1 Regional Setting

- Alappuzha town is the only first order settlement in the district. State Urbanization Report of Kerala 2012 envisages that Alappuzha Urban Agglomeration will form a part of the Alappuzha urban cluster in 2021 and which in turn in 2031 forms part of the Alappuzha – Ernakulam-Thrissur- Palakkad Urban Corridor.
- The connectivity patterns show that Alappuzha town, being the administrative headquarters and commercial center serving the entire district acts as the first order node. The higher order nodes and settlements are well connected by existing National Highway, State Highway and other district roads.
- Tertiary activity is predominant in Alappuzha Municipality.
- Functional character of Alappuzha Municipality shows that it exhibits an urban character.
- Alappuzha is the commercial hub of adjacent local bodies.
- The town is well connected to the other parts of the district and State.
- The water bodies have leashed a new breath of life to the economy of the town by way of developments in waterfront tourism and related activities.

17.1.2 Demography

- The total population of Alappuzha Municipality is 1,74,176 which is about 8.19% of the total district population of Alappuzha.
- Population growth rate of the town as well as the district is gradually declining.
- Comparing with State, State Urban, District & District Urban, Alappuzha Municipality has the highest population density.
- According to 2011 census, sex ratio of Alappuzha Municipality is 1077.
- The literacy rate is higher than the state average and district average.

- The household size is lower than the state average, but higher than the district average.

17.1.3 Employment

- The total number of workers in Alappuzha Municipality shows an increasing trend over the last decades.
- The work force participation rate is also increasing gradually.
- The production sector including agriculture and industrial sectors shows declining trends of growth.
- The number of workers in tertiary sectors is increasing throughout the decades.
- Majority of the urban population depends on the service sector for their livelihood. The shift in occupational structure is conspicuous.

17.1.4 Land Use

- 50.15% of the municipal area is used for residential activities.
- Commercial land use is concentrated at the core of the town and along the major transportation corridors.
- The large scale industries are primarily coir based and most of them are more than 100 years old and they are seen mostly along the canal side.
- The industrial land use constitutes only 1.11% of the municipal area.
- The developable area for recreation is very less compared to the standard (0.76 %: [12-14% URDPFI Std.])

17.1.5 Economic Aspects

i. Tourism

- The Municipality has immense potential for development of tourism sector with a clean and beautiful environment.
- The town lacks in tourist infrastructure, accommodation facilities etc.
- There is a need to enforce measures to prevent various levels of pollution within the town.
- Areas having tourist potential are not developed so as to attract tourists.
- National water way-3 passes through Alappuzha.

- Threat in affordability, the rate and expenses in tourism sector is relatively high with respect to the standardized rate of other countries.
- Architectural and heritage attractions are rarely mentioned in tourism brochures.
- Lack of accredited guides having adequate training.

ii. Trade & Commerce

- Alappuzha Town is the main commercial center in the district. Commercial facilities are concentrated at the Market Road, VCSB Road, CCNB Road, CCSB Road, Cullen Road and VCNB Road. Problems faced by the town are insufficient space for parking and for loading & unloading.
- Commercial nodes within the town are mostly characterized by congestion due to vehicular and pedestrian traffic beyond the capacity of the existing facilities.
- The town needs a faster commercial development to catalyze the economic development and to serve the nearby local bodies.
- Market area is very congested and it doesn't have proper waste disposal and drainage facilities.

iii. Agriculture

- Agriculture has not become organized and is not being done on a professional basis. The infrastructure facilities are also not commensurate with the area under cultivation.
- Reduction of rice cultivation due to lack of agriculture labor and lack of efficient utilization of mechanization.
- Flood threats in puncha fields in Kuttandu due to weaker outer bunds.
- Reduction in the area of cultivation as agricultural lands are converted into other uses.
- Majority of the workers are entering into tertiary sectors.
- No organized market for selling agriculture produces within the town.

iv. Fisheries

- Alappuzha is the only Municipality which has fishermen villages as part of it. The flow of income into the families are not regular. They are not well equipped to find alternatives during off season.

- Women have lost a major income source with the introduction of nylon nets in place of handmade nets.
- There have been change overs to new sectors. This shift to non-fishing sector has resulted in unemployment or even under employment due to lack of opportunities for occupational diversification and employment potential.
- The coastal area of the town does not have a fishing harbor.

v. Animal Husbandry

- The increasing cost of cattle feeds, land scarcity for fodder cultivation, low yielding varieties of cattle and poultry have made this sector non profitable.
- Fodder cultivation has to be promoted and quality control of cattle feed has to be ensured.
- Larger commercial diary units may be promoted to get hold of a leap in the field of milk production.
- Better credit facilities at low interest rate have to be made available to the farmers.
- There is no modern slaughter house present in the town area.

vi. Industry

- The town has not attracted any large scale or medium scale industrial investment for a long time in spite of accessibility and availability of land. Labor problem can be attributed to be one of the main causes for industrial decline in this town.
- The traditional industrial sector of coir and coconut oil have potentials for flourishing as the relevance of coir related products are gaining importance as an alternative to plastic products.
- Other small-scale industries significant to Alappuzha are umbrella parts manufacturers, processing of spices and other agro based industries.
- Lack of skill development and training center in the town area.

17.1.6 Traffic & Transportation

- The existing road network within Alappuzha Municipality is in the form of grid pattern.

- The roads are in a planned manner connecting most of the central parts of the town. The main arterial road of this town is the section of National Highway 66, which has already exceeded its capacity.
- The reasons for traffic problems in Alappuzha Municipality are: Narrow roads within the central area, Poor geometrics of road at junctions, Unorganized parking, Heavy pedestrian crisscross movement, Loading/unloading activities on the roads and encroachments on road side by vendors, Movement of inter-city bus traffic on congested urban roads due to the location of intercity-bus stand within the central area of the town etc.
- Public transport had a significant role in meeting the inter – city passenger demand.
- Lack of private parking spaces encourages kerb parking, which reduces the carrying capacity of the roads.
- Waterways being more environment friendly and economical, recently its importance is recognized, specific to this town, especially in the context of waterfront tourism developments gaining more attention by virtue of the potentials in this sector.
- The improvement of existing canal system can promote goods movement and passenger movement within the town through water transport.

17.1.7 Physical Infrastructure

i. Water Supply

- Tube well is the main source of water supply by Kerala Water Authority. Diminishing yield for the tube wells is an issue.
- Wells cannot be considered as the prime source of water supply, as the area is waterlogged and the ground water table is high. Open wells in this area are highly polluted by salinity and are contaminated.
- Shortages in water supply do exists in some wards of the Municipality.
- Worsening quality of the water supplied – increased presence of fluoride i.e., beyond 1 ppm.
- Lack of ground water recharging and rain water harvesting practices.

ii. Drainage

- Canal network is the backbone drainage system of Alappuzha and if this does not ensure smooth flow, the surface drainage system in the town is bound to fail.
- Stagnation is the primary drawback of the canal network caused by accumulation of all solid waste. The situation is aggravated by the growth of weeds due to lack of salinity. Removal of silt and solid waste ensures proper flow and controlled salinity could solve most of the problems.
- The major challenge facing the city in regard to achieving service level benchmarks are lack of cross drainage facilities, closure of the culverts due to the encroachments and also the drains without standard dimensions.
- The city has high water table with clayey soil in many parts and also the terrain is more or less flat which also aggravates the issue.
- Most of the canals are blocked at the mouth by sand bars. The drains in the city are built arbitrarily without taking in to account the runoff. The drainage networks are not sufficient to carry the peak flow.

iii. Sewerage

- The Municipality doesn't have any facility for the treatment of waste water at present which poses a serious threat to the public health and environmental quality.

iv. Solid Waste Management

- The total solid waste generated is not treated properly, especially plastic wastes.
- The waste collection system is not efficient and segregation at source is not being attempted.
- The new model of waste treatment through aerobic composting implemented in the town is making Alappuzha a clean town

v. Energy

- There is potential for alternative source of energy which is not yet exploited.

17.1.8 Social Infrastructure

i. Education

- The conventional educational facilities in the town, especially at the school level are commensurate with the population of the town.
- There is no professional college or polytechnic in the town.
- Most of the colleges are offering only the conventional course which is one of the reasons for the increasing demand for colleges outside the district.
- Basic educational facilities available in the Municipality are sufficient in quantitative terms. But in qualitative terms the facilities are below standard.

ii. Health

- Major problem in the health sector is the insufficiency of facilities in the hospital.
- There are no super specialty hospitals in Municipality.
- Though the number of general hospitals and intermediate hospitals is adequate to meet the needs of the present population, the lacunae lie in the absence of nursing homes and small clinics and dispensaries.

iii. Recreational Facilities

- The recreational facilities in the town are not adequate to cater the present population leave alone the target population.

iv. Other civic Amenities

- The civic amenities in the town are not met with the present population.
- Lack of lodging and basic infrastructure facilities especially for employees and travelers

v. Housing

- In Alappuzha municipal area the housing sector as such do not show any serious problems.
- Shortages can be covered by the housing projects by government for the economically weaker sections.
- In slums and other backward settlements, infrastructural facilities are very acute. Lack of drinking water facilities, lack of sanitation facilities and absence of internal roads are major problems in slums.

17.1.9 Special Concern Areas

- For the welfare of weaker section of the town more facilities are to be provided.
- In the changed social structure more attention is needed for the welfare of old age people.
- Projects have to be evolved for the economic development of women, Scheduled Caste and Scheduled Tribe people.

17.1.10 Environment

- All the canal stretches were found to have the presence of fecal coliforms indicating sewage contamination.
- Rejuvenation of the canals would require control of sewage inflow, reduction of sewage concentration through pre-treatment and aeration of canals to increase dissolved oxygen to the safe levels for aquatic animals.
- Even though the Municipality has a serene environmental quality, some problems do exist and hence the authorities need to be vigilant to mitigate the present problems as well as to conserve the environmental quality.

17.1.11 Disaster Management & Risk Assessment

- Presence of Vembanad lake and low lying paddy fields towards the Eastern side contributes to the flood hazard vulnerability of the town whereas Lakshadweep sea contributes to the coastal hazard vulnerability of the coastal region of the town.
- Alappuzha is natural flood prone region with long durable flooding. It is observed that the flooding of urban core can be prevented by providing proper drainage network being maintained timely.
- Rescue measures are difficult during flooding – lack of easy accessibility and difficulty in locating people.
- When considering the whole district, town has its important role to act as a relief center for the flood victims of Kuttanad region. There is a scope for setting up permanent shelters within the town and outside the vulnerable areas.

17.1.12 Heritage

- Buildings /precincts of heritage importance are in abundance in the town.

- The port, the pier, the light house and the structures of archaeological importance spread along the banks of the main canals of the town are to be preserved and protected as tourist attractions.
- Tourism is a major tool to revitalize the once popular town of Alappuzha.
- Many of the heritage buildings are unaltered.
- There is a scope for adaptive reuse of these heritage structures.

17.2 SWOT Analysis

SWOT analysis is a strategic tool used to identify Strengths, Weaknesses, Opportunities and Threats faced by a city. It is a way of reviewing and analyzing data and information on the current situation from Internal (strengths and weaknesses) and External (opportunities and threats) perspectives. The internal perspective relates to those areas where the Municipality has some degree of control to influence and effect change in the city. The external perspective relates to those areas where the Municipality has no major control over but which are important to be aware of, as they can be important factors in shaping the future of the city.

The town level SWOT analysis has been done based on the assessment of the status of various sectors of the city. Individual factors have been grouped in 8 major criteria to bring out the positive and negative factors affecting the development of the town, of both internal and external origin. They are:

- Regional & Demographic Aspects
- Economic Aspects
- Transport Infrastructure
- Physical Infrastructure
- Social Infrastructure
- Environment & Disaster Management
- Heritage

17.2.1 Regional & Demographic Aspects

Strength	Weaknesses
▪ Administrative headquarters and commercial center serving the entire district. ▪ High population density.	▪ Population growth rate is declining.

▪ Increased workforce and participation rate.	
Opportunities	**Threats**
▪ It is envisaged to be the part of the Alappuzha – Ernakulam – Thrissur - Palakkad Urban Corridor in 2031. ▪ To enable adequate employment possibilities for the young people.	▪ If the urban growth is not controlled and developed in a planned manner, it will affect the quality of life of the people and also increases the problem of congestion and pollution.

17.2.2 Economic Aspects

Strength	**Weaknesses**
▪ Immense potential for development of tourism sector with a clean and beautiful environment. ▪ Alappuzha town is the main commercial center in the district. ▪ Alappuzha is the only Municipality which has fishermen villages as part of it. ▪ Value addition of agriculture & marine products. ▪ Presence of paddy fields.	▪ The town lacks in tourist infrastructure, accommodation facilities etc. ▪ Commercial nodes within the town are mostly characterized by congestion due to vehicular and pedestrian traffic beyond the capacity of the existing facilities. ▪ Shift to non-fishing sector has resulted in unemployment or even under employment due to lack of opportunities for occupational diversification and employment potential. ▪ Animal husbandry sector is non profitable due to the increasing cost of cattle feeds, land scarcity for fodder cultivation, low yielding varieties of cattle and poultry.
Opportunities	**Threats**
▪ Tourism potential among all over India. ▪ Areas having tourist potential are not developed so as to attract tourists which will help to enhance the local economy. ▪ Potential for development of waterfront tourism. ▪ Creation of visual features to improve the aesthetics and friendliness of the town.	▪ The facilities for the tourist population is very poor. Hence need for design of appropriate infrastructure facilities. ▪ Market area is very congested and it doesn't have proper waste disposal and drainage facilities. ▪ High land value (Industries shifting to outskirts).

▪ Diversity of tourist packages based on combinations with other types of tourism and tourist attractions. ▪ Agriculture has not become organized and is not being done on a professional basis. ▪ The traditional industrial sector of coir and coconut oil have potentials for flourishing.	▪ Pollution of waterbodies affect tourism & environment.

17.2.3 Transport Infrastructure

Strength	Weaknesses
▪ The town is well connected to the other parts of the district and State.	▪ Poor geometry and congestion in roads. ▪ Poor condition of road infrastructure. ▪ Unorganized parking on road sections. ▪ Encroachment on road side by vendors ▪ Lack of terminal facilities for goods
Opportunities	**Threats**
▪ To improve public transport operations, parking facilities, NMT facilities etc. ▪ Presence of National Water Way 3 and new Bypass.	▪ Narrow roads ▪ Unavailability of land for future developments.

17.2.4 Physical Infrastructure

Strength	Weaknesses
▪ Electricity supply systems are in good condition. ▪ No open defecation. ▪ Presence of canal and drainage networks. ▪ Full coverage of water supply. ▪ Successful solid waste treatment system. ▪ Proper plastic collection & disposal methods.	▪ High dependency on tube water. ▪ Worsening quality of the water supplied ▪ Open wells in this area are highly polluted by salinity and are contaminated. ▪ The coverage of drainage and sewerage network is very poor. ▪ No facility for the treatment of plastic wastes. ▪ No facility for periodical cleaning of sanitary wastes.
Opportunities	**Threats**

▪ Appropriate measures such as conservation and rain water harvesting can recharge the ground water as well. ▪ Introduction of renewable energy resources and power saving technologies ▪ The energy potential of household waste can be used.	▪ If appropriate measures are not taken to improve the water quality, availability of water will become a problem. ▪ High level of water table leads to sanitation problems. ▪ Flat topography & presence of clayey soil.

17.2.5 Social Infrastructure

Strength	Weaknesses
▪ Good educational and health infrastructure to meet the needs of the population inside and outside the town. ▪ No housing shortage. ▪ High literacy rate within the Municipality.	▪ Recreational facilities in the town are inadequate. ▪ The service level in slums is poor i.e. lack of drinking water facilities, lack of sanitation facilities and absence of internal roads. ▪ No super speciality hospitals.
Opportunities	**Threats**
▪ To use the possibilities to improve the healthcare facilities. ▪ Maintenance and reconstruction of trees and shrubs on public landscaped areas. ▪ Scope for providing higher order facilities since Kuttanad is depending on Alappuzha.	▪ Green spaces are necessary to restore the balance in natural environment.

17.2.6 Environment & Disaster Management

Strength	Weaknesses
▪ Presence of lake, beach, canal etc. ▪ Presence of paddy fields and wetlands. ▪ Floods not affected the municipal area much. ▪ Availability of infrastructure to cater the needs during any disaster	▪ All the canal stretches are contaminated. ▪ Lack of drainages leads to flood proneness of the area.
Opportunities	**Threats**

▪ Improving and upgrading the tourism infrastructure and environmental quality can substantially improve the urban environment and quality of life. ▪ Town can act as relief centre for flood victims from the surrounding areas.	▪ In the event of any natural disaster, the low lying areas are under threat. ▪ Pollution of rivers on the upstream sides also affect the waterbodies within the Municipal area. ▪ If immediate action is not taken to improve the condition of the contaminated waterbodies, its quality will further deteriorate and affect the natural habitat. ▪ Defecation from houseboats to waterbodies makes it polluted.

17.2.7 Heritage

Strength	Weaknesses
▪ Historic significance of town ▪ Presence of heritage structures. ▪ Abundance of buildings/precincts of heritage importance. ▪ Most of the heritage structures are unaltered.	▪ Degradation and abandonment of heritage structures. ▪ Lack of incentives for conservation. ▪ Lack of enforcement of development controls
Opportunities	**Threats**
▪ Scope for adaptive reuse of heritage structures. ▪ Rich culture of Alappuzha.	▪ Pressure of urbanization and development on heritage structures.

18 VISION, GOALS & OBJECTIVES

A vision statement is realistic and reliable which reflects the preferences & values of the city and envisages the future of the town. Goals are usually long-term and represent global visions. Objectives define strategies or implementation steps to attain the identified goals.

18.1 Development Vision

Alappuzha in her glorious past had been an important trade centre, port, cultural center, and administrative headquarters of the district. With the gradual shift in the transport modes and marketing options, the economic base of the town grew weaker. This has resulted in physical decay as well, as evidenced by various derelict edifices in the old town core. In the recent past, the town has lost many of its industrial production units. However, the town has been trying to catch up with the new economic system with modest attempts in tourism sector and other new generation service industries.

The environmental decay and apathy crept in during the downslide needs to be checked. The town needs to reverse the adverse impacts in this transition and build upon the various inherent strength and potentials in order to regain the lost glory. So, this Master Plan is more about a turn around and further going forward. Considering this reality, the development vision of the town is defined as:

"Develop Alappuzha as culturally and socially vibrant town through tourism development with efficient infrastructure system, conservation of the culture and heritage and to prepare to cope with the effect of climate change by sustaining green and pollution free environment, so as to enhance the economic base of the town."

The Figure 18-1 Shows a pictorial illustration of the development vision for Alappuzha town.

18.2 Development Goals & Objectives

The objective of the Master Plan is to create enabling spatial and land use planning framework to achieve the desired vision for the town. The development goals are formulated based on the observations, conclusions and inferences derived from the study of existing scenario through various sectoral analysis, local level analysis and spatial analysis.



Figure 18-1: Development Vision for Alappuzha Town

Earlier Alappuzha town had a mono centric urban pattern with Commercial Canal & Vadai Canal as central point, which is surrounded by various industrial and trade establishments. But as the trade and industrial activity diminished, the town now shows a polycentric urban growth pattern with the canal and surroundings as the CBD with commercial establishments and administrative buildings. The other growth inducing nodes in this polycentric pattern are the tourism area near punnamada kayal & beach, industrial node near Kommady on the North and institutional node in the South which includes SD College in the planning area and Sagara Hospital and College of Engineering & Management in the nearby Grama Panchayat. Thus, the planning approach is to divide the planning area in to

various zones for locating different activities such as industrial, commercial, residential mixed use etc. Along with the zonal demarcation, an integrated development of Alappuzha town is envisaged by linking each zone with appropriate infrastructure facilities is also considered.

The following development goals & objectives are formulated for developing Alappuzha into a vital town in the social, economic and administrative scenario of the district, anchoring on its strengths and utilizing the opportunities to the maximum, while strengthening the weak sides and preventing the threats, for the comprehensive development of the planning area.

1. **To make Alappuzha a service centre for the whole district.**

In the district level studies (District Urbanization Report, Alappuzha) Alappuzha is a first order settlement of the district. Hence to develop Alappuzha as the major service town of the region is the first goal. Alappuzha shall be developed with higher order facilities in order to serve the entire district.

- Enhance educational, health and trade and commerce sector.
- Efficient circulation network for intra zonal and inter zonal movements.
- Improve the traffic and transportation facilities of central area of the town aiming at the decongestion of central area and to ensure the free flow of traffic.

2. **To develop the tourism potential of the town.**
   - Identify and develop different types of tourism promotion zones.
   - Promote tourism through development of supporting infrastructure and create a tourism circuit covering important destination within the town and to enhance the potential of the town.
   - Provision of an efficient traffic and transportation network with regional connectivity.
   - Create adequate parking spaces as an integral part of commercial, industrial and institutional planning and development.
   - Ensure round the clock cleanliness in tourism spots and better waste management facilities.
3. **To conserve the built & cultural heritage of Alappuzha.**
   - Retain the character of town and preserve the heritage sites while providing it all basic infrastructure facilities.
   - Initiate coordinated approach to heritage area conservation and planning.

- Encourage the preservation, restoration, continued use, and reuse of historic buildings and areas.
- Integrate tourism & heritage management to obtain mutual benefits.

4. **To enhance economic base of town.**

The economic base of the Alappuzha Municipality shall be enhanced by promoting tourism sector, trade, commercial, industrial and agricultural activities.

- Create a well-defined hierarchy of settlements in order to achieve rational and planned growth.
- Strengthening of the existing retail and whole sale trade and commercial activities.
- Promoting industrial and agriculture activities by using the available resources and by providing sufficient infrastructures and development of marketing facilities.
- Develop the traditional industries of Alappuzha, especially coir industry.
- Enhance agricultural sector, especially paddy cultivation
- Promotion of homestead (coconut based products) agricultural activities and bio organic farming, etc.
- To promote value addition products under agriculture and animal husbandry sector.
- Evolve better strategies for development of hotels and auditoriums by ensuring efficient services.

5. **To conserve the ecologically sensitive areas and protect the town from disasters.**
   - All environmental sensitive areas are home land of wide variety of flora and fauna; hence their conservation should be considered with utmost importance.
   - Create a green buffer strip around environmentally sensitive areas like water bodies and solid waste dumping land to ensure proper encroachment and pollution protection.
   - Increase public awareness in regards to the protection of the environment.
   - Develop land use zoning & regulations for flood prone zones and promote resilient constructions
6. **To promote sustainable green urban development along with conserving the resources for future generations.**
   - Conserve existing greens and promote new greens

- Create recreational spaces that can enhance bonding between inhabitants and nature.
- Prepare and implement a comprehensive solid waste, sewerage and drainage Plan
- Regulate noise levels by silence zones
- Improve urban aesthetics
- Implement Urban forestry /Social Forestry and promote bio-diversity conservation
- Create a traffic culture that will depend more on public transportation means other than private vehicles so that traffic volume intensity can be minimized which will in turn reduce pollution of atmosphere.
- Create green walkways, pedestrian friendly streets, cycle tracks

7. **To ensure basic amenities to all the inhabitants of the town.**
   - Ensure availability of basic infrastructure to the inhabitants, especially to the socially backward sections.
   - Rationalise the distribution of physical and social infrastructure in order to ensure appropriate quality of life.
   - Ensure availability of basic housing infrastructure to all the inhabitants.
   - Improvisation of water quality to provide pure drinking water for all and to promote rain water harvesting and recycling of water.
   - Improve drainage network to prevent water logging and safeguard quality of roads. Constructing new drains integrated with the new roads development. Perforated tiles footpaths to allow penetration of rain water into ground.
   - To develop a proper transportation plan by integrating local road network to the regional network and ensuring connectivity between different zones and make public transportation accessible to all.
   - To create adequate parking spaces as an integral part of commercial, industrial and institutional planning and development.

19 DEVELOPMENT CONCEPT

A development concept throws light into the form into which the area may develop. It also suggests an ideal future pattern of development. The development concept of a particular area is formulated based on the development goals and objectives envisaged with a spatial reference. The problems and potentials existing in the area, the conclusions & recommendations of sectoral studies and proposed spatial structure are also considered for the formulation of development concept. The development concept will clearly indicate how the plan area will develop in future and also will give an overall idea of the location of determinant development proposals.

19.1 Overview to the Concept

A people – oriented approach is the right key to the development of the town. The development concept of the town is formulated based on the findings of the spatial and sectoral analysis while remaining in the purview of the goals fixed and also in line with the broad development vision arrived at the state and district level. As per the State Urbanization Report (SUR) of Kerala published in 2012, Alappuzha urban agglomeration which includes Alappuzha Municipality, Kalarkode Out Growth, Punnapra Out Growth and Komalapuram Census Town, is envisaged as a 3rd order hierarchy urban center, where corridor type peri - urban development can be expected. According to the future urbanization trend delineated in SUR, in 2021 Alappuzha UA forms part of the Alappuzha urban cluster which in turn in 2031 forms part of the Alappuzha – Ernakulam-Thrissur- Palakkad Urban Corridor. As per District Urbanization Report (DUR), Alappuzha is the only first order settlement in the district and the service area is the whole district for first order settlement. Hence Alappuzha shall be developed with higher order facilities through proper infrastructure improvement.

Alappuzha is an important tourist destination which attracts lakhs of travelers from all over the world. Alappuzha town is well connected with the major urban centres of the state through road, rail and waterways. The existing major road network comprises mainly of the national Highway-NH66 and State Highway viz. Alappuzha Changanasserry road SH 11, Alappuzha Madurai road SH40 and Alappuzha Chellanam road SH66. With the commissioning of the coastal railway line in 1992 Alappuzha merged with the main stream of industrial development and rail transport with the rest of the state. The interconnected perennial water bodies provide an ideal platform for inland water transport. The national water way III passes through the town and a terminal is located within the municipal limits. It is likely to boost up the transportation of goods by waterways.

Influx of tourist population in addition to the residents has increased the stress on the existing facilities within the town. Development may be oriented to tap the issues faced by the tourists and also it should not affect the residents as well. The economy of the town is mainly depended on the activities related to tourism. So better strategies are to be formulated to enhance the economic base of the town by strengthening the potentials of tourism, industrial, commercial, agriculture and related sectors. In addition to this due consideration should be given to heritage sites and environmentally sensitive areas for proper ecological balance. Proper connectivity is also well-thought-out to ensure integration between different activity zones. All these factors are considered while formulating development concept for Alappuzha Municipality.

19.2 Spatial Structure of the Town

Existing spatial structure is arrived by considering the functional character, activity pattern, existing road network, hierarchy of nodes, hierarchy of settlements and concentration of other sectoral land uses. Existing spatial structure of Alappuzha Municipality is shown in Figure 19-1. It depicts the present activity distribution in the Municipality.

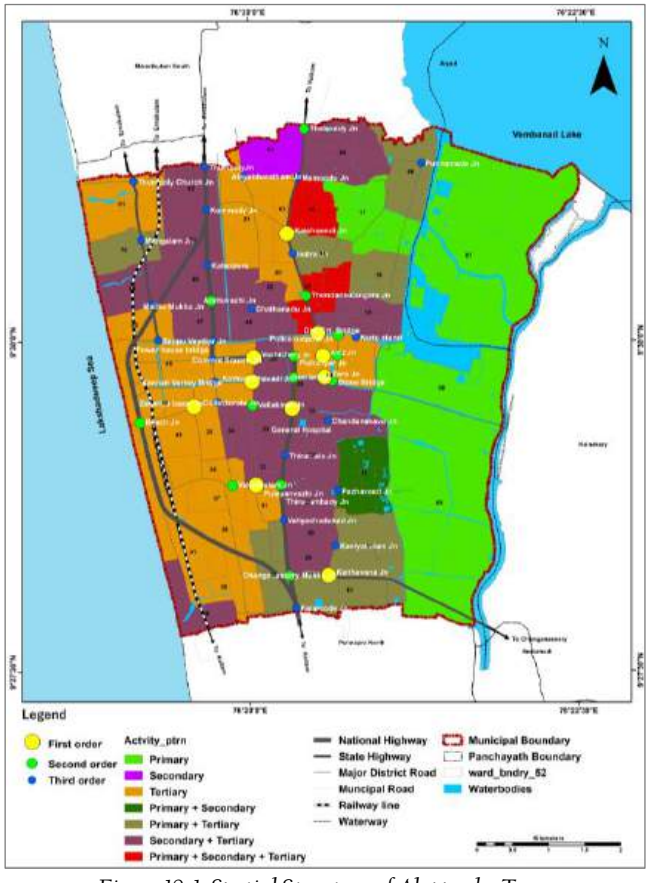


Figure 19-1: Spatial Structure of Alappuzha Town

It shows that the whole area is urban except for only two wards in the Eastern periphery which is rural. The core area is actively public and semi-public and commercially developed. Tertiary activity is the main function throughout the major corridor and in the core city. 17 wards out of 52 show teritiary activity. Primary activity is very less in the Municipality.

The development of the town is concentrated around the first order nodes of the town such as Zilla Court Bridge, Mullakkal Street, Pichu Iyer Junction, Stone Bridge, General

Hospital Junction and Iron Bridge. Even if canals are in a deteriorated stage, still there is scope for further development along canal side. Tourism, Industry, and commercial activities may have further scope for development along canal area. The lower order nodes are scattered throughout the town and the connectivity of the nodes are there, but needs improvement.

19.3 Concepts Based on Major Development Sectors

The findings from the spatial and sectoral analysis of the town reveals the development direction of the town. As Alappuzha is a prominent tourist destination, the major activities occurring in the central business district (CBD) is more or less related to the activities of the tourism. The study reveals that the existing CBD area is very congested with inadequate road width, lack of parking facilities etc. are the major problems. It has also been kept in mind that this town has to preserve the heritage & natural environment and it should continue as a scenic spot for ever. It is better not to worsen the crowded situation in the town centre, the planning intervention is to propose a compact development in that area.

19.3.1 Commercial Development

Future concept on commercial development is formulated mainly based on spatial distribution of commercial activities. Potential area for commercial activity is identified in central area. The commercial sector of the city is now troubled by infrastructure deficiencies. The old commercial core is choked with unavailability of organized parking places and streets of inadequate width and has started decaying with collapsing old buildings. The commercial areas have spread along all roads, resembling ribbon development. The commercial culture has started changing from the chain of retail shops to hi-tech malls and super-hyper markets.

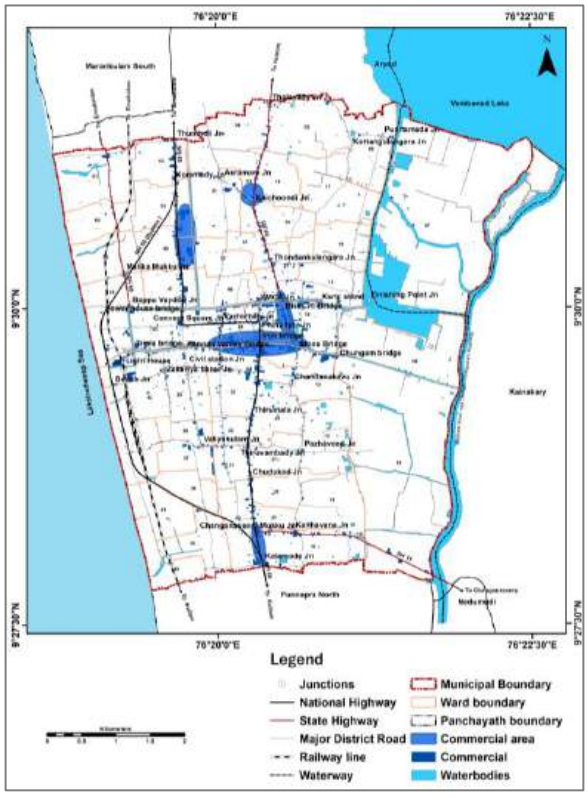


Figure 19-2 Commercial Activity Area

The new age developments brought about in the town like tourism industries are expected to boost the demand for high quality commercial and recreation centres

as well as office spaces, restaurants, lodging facilities etc. Improving the commercial base is also imperative to make the town attractive as a job provider and to retain the required population in the urban area, in the context of the negative population growth in the Municipality in the last decade.

The existing commercial areas within the CBD has to be remained as such, which is vital for the existence of the town and necessary for satisfying the needs of thousands of tourists arriving daily and for the future need. The major commercially active areas are shown in Figure 19-2.

19.3.2 Tourism Development

The planning area has a long and beautiful coastline, abundance of inland water bodies, multitude of built heritage of religious, cultural and administrative nature, and its own footprint in the international trade and cultural exchange. However, the tourism potential of the planning area is not yet explored the way it deserves. Development of tourism sector is identified as yet another objective. This can be mainly achieved through the utilization of potential of water bodies available in Alappuzha. A well-developed transportation network with adequate road capacity and proper connectivity to different activity centers is an added advantage for tourism promotion. The tourism potential areas are shown in Figure 19-3.

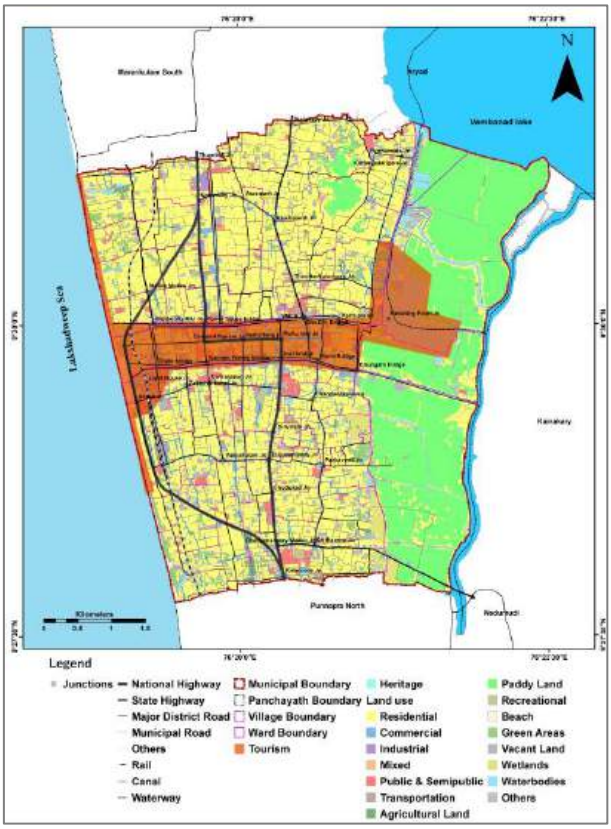


Figure 19-3 Tourism Potential Areas

In relation to the heritage conservation, tourism potential of the town and its surrounding areas are to be explored so as to enhance the economic base of the town. There is a scope for developing heritage tourism circuits connecting the major heritage structures within the Municipality itself. Also, leisure tourism can be promoted at locations such as Beach, Canal banks, Punnamada Kayal surroundings etc. This can also be connected with the nearest tourism spots outside the Municipality also. This tourism

activity will create a potential for supporting activities like accommodation and will help in enhancing the economic base of the town.

19.3.3 Industrial Development

Alappuzha was once famous for its industries in coir, coconut oil, rice, spices etc. But all these industries have either died out or declined and now the district has no commendable presence in the industrial scenario of the state. The negative population growth in the Municipality also urges the policy makers to strengthen the industrial base of Alappuzha and make it attractive as a job provider.

The environmental and social sensitiveness, as well as the unavailability of suitable large extents of land, diminish the prospect for large scale and polluting industries in the planning area. However, the road, rail and waterways-based connectivity of the planning area will surely make it a centre of transaction of industrial goods, both raw materials and products, between the hinterland and the outside world.

The major objective of developing Alappuzha as an economically vibrant town shall be achieved through coir based industrial development. Proper connectivity and availability of raw materials will catalyze the industrial development in Alappuzha. Hence, the development concept for industrial sector in planning area is expansion of existing projects, along with policy and project measures for development of common infrastructure for production and marketing, establishment of ancillary and value-addition industries in coir and agriculture sector, revitalization of the traditional industries, and thus creation of a strong industrial base for the town.

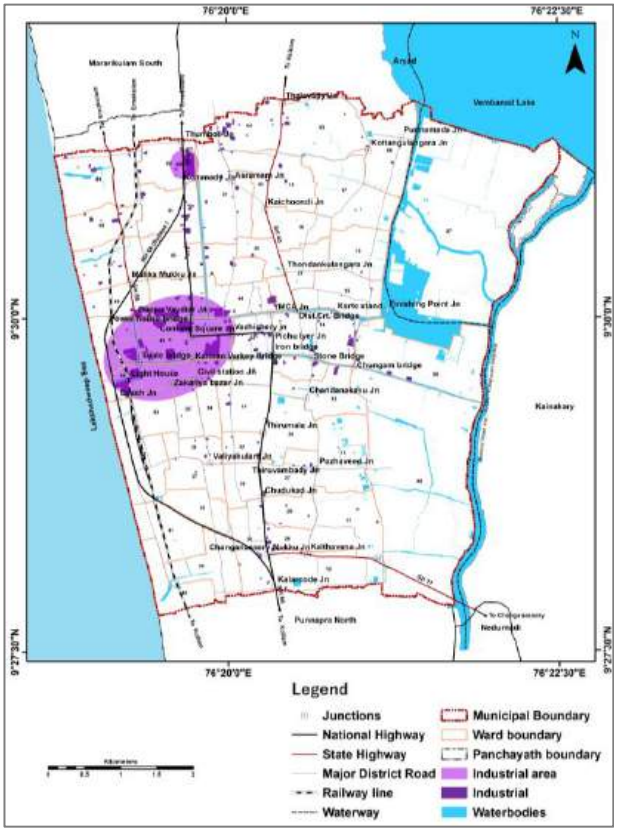


Figure 19-4 Industrial Activity Areas

19.3.4 Primary Sector Development

In Alappuzha Municipality, the agriculture activities and urban activities are spatially separated. The agriculture dominant areas (paddy fields) are located in the peripheral areas of the town towards the Eastern portion. The agriculture activity area can be retained and promoted for satisfying the demand of the local economy. Agriculture sector is proposed to be revived utilizing the recent developments in urban agriculture, by promoting homestead cultivation, terrace farming, organic agriculture, horticulture and floriculture projects. Effective strengthening of the existing industrial activities and provision of new agro allied and household industrial activities can also give a thought. These wet agriculture land is to be ensured which act as a natural retention basin during flood situations.

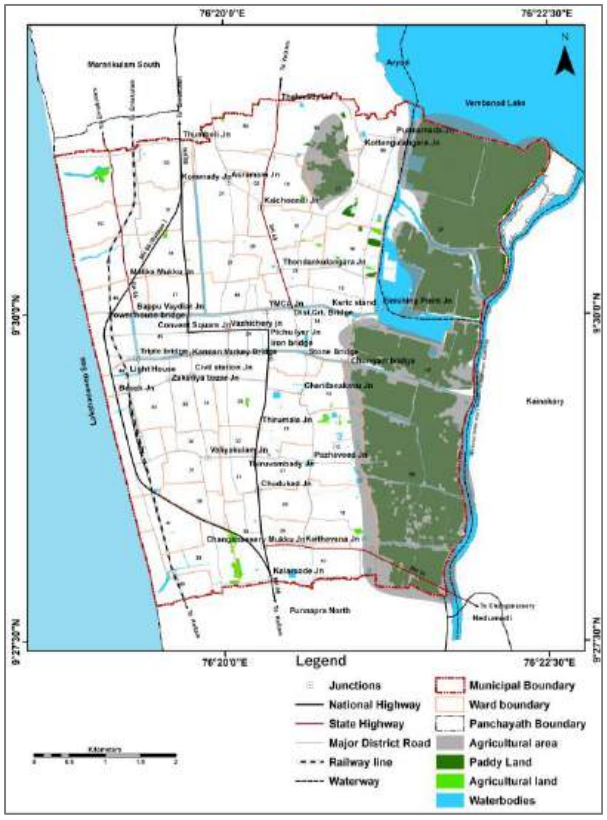


Figure 19-5 Primary Activity Areas

19.3.5 Heritage Conservation



Figure 19-6 Areas of Heritage importance

The built heritage of Alleppey is extensive and spreads across the planning area. The notable buildings and monuments which have existed for centuries are scattered across the town and are pivotal parts of its heritage. The surviving elements of Alleppey comprise not only of buildings but also the markets, streets and footways, bridges, sea pier and cemeteries. Heritage conservation is the preservation of culture of an area. It protects the identity of the people residing there and provides various benefits.

Preservation of heritage sites allows for creation of jobs for the local communities, thereby involving them in the whole process. Heritage tourism is a major boost to the economy. Heritage tourism is based on existing infrastructure, making the harnessing of the process much easier. The Master Plan identifies the important built heritage and envisages improving the cultural identity by conservation of existing heritage structures, promotion of adaptive reuse and integration of heritage management with tourism thus obtaining mutual benefits by introducing the heritage structures in the tourism circuit of town.

19.3.6 Environmental Conservation

The ecologically important areas in the town include paddy areas, punnamada kayal, beach and canal areas as shown in Figure 19-7. It is shown in ecologically important areas play a vital role in maintaining the ecological balance such as water infiltration, protection of biosphere, provide livable space for various flora and fauna, strengthen food cycle etc. Therefore, these areas have to be retained and preserved along with urban development.

The concept on conservation of the environmentally sensitive area is to allocate the future activities in the sensitive areas judiciously so that permissible activities do not impact adversely on the overall environmental balance. Kayal & Canal tourism promotion is envisaged in the plan. Hence conservation of sensitive areas is ensured through judicious planning for tourism sector. The plan also envisages improving the environmental quality by conservation of existing greens and promotion of new greens, a comprehensive solid waste, sewerage and drainage plan, implementation of urban forestry /social forestry and promotion of green manures and organic farming, and improvement of urban aesthetics.

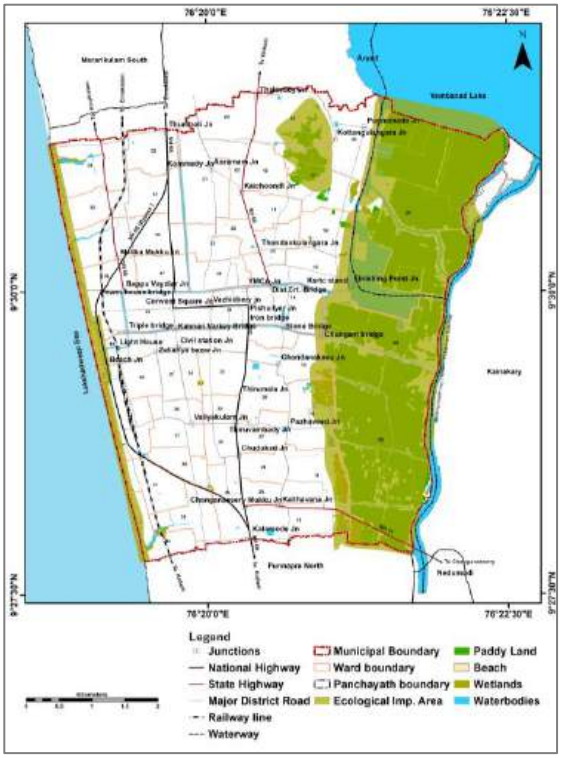


Figure 19-7 Areas of Ecological Importance

19.3.7 Public and Semi-Public Development

In general, within residential areas, social facilities have to be provided to meet the needs for public services. The provision for social facilities at regional level has to be reasonably planned and sited for the needs of the town and its growing residential population in the new housing areas and its surrounding hinterland. All existing public and semi - public institutions are proposed to be retained in their existing locations. The public and semi-public activity is mainly concentrated around central area and towards South as visualized from the spatial analysis. The areas where existing public and semi-public activities are concentrated at present and the areas with potential for public and semi-public development in future are included in this area.

19.3.8 Settlement Pattern

Low rise, high coverage residential developments, characteristic of the city, is already swallowing a large chunk of the productive urban as well as agricultural land of the planning area, leaving practically no space for development projects and green pockets. The proposed residential area for medium towns as per URDPFI Guidelines is 40-45% of the developed area. The existing residential area is 69.84% of the developable area, which verifies that there is no demand for more residential area. Suggested developed area density as per URDPFI Guidelines is 100- 150 persons per hectare, whereas the existing developed area density is 49 persons / hectare and existing residential area density is 64 persons / hectare. This suggests the ample scope for densification of the developable areas, especially residential areas, of the planning area.

19.3.9 Connectivity Network

The planning area is blessed with a good transportation network in grid iron pattern. The existing major road network comprises mainly of the National Highway-NH66 and State Highway viz. Alappuzha Changanasserry road SH 11, Alappuzha Madurai road SH40 and Alappuzha Chellanam road SH66. Besides, the town has an existing broad gauge rail network along the coast and a feasible water way network cris - crossing the town. The national water way III passes through the town and a terminal is located within the municipal limits.

The traffic congestion existing in the city is due to insufficient road widths, poor road geometrics, poor segregation of through and intra-city traffic, mixed vehicular traffic and encroachment on road sides for parking and other activities. Besides, the dependence on personal transport is increasing due to the inefficient and poor-quality public transport as well

as life style changes. Hence the development concept in traffic and transportation sector is 'a strengthened public transportation network achieved by improving the existing road network with design and management interventions and organized parking facilities; supported by a strong waterway network and integration of different modes of transportation.

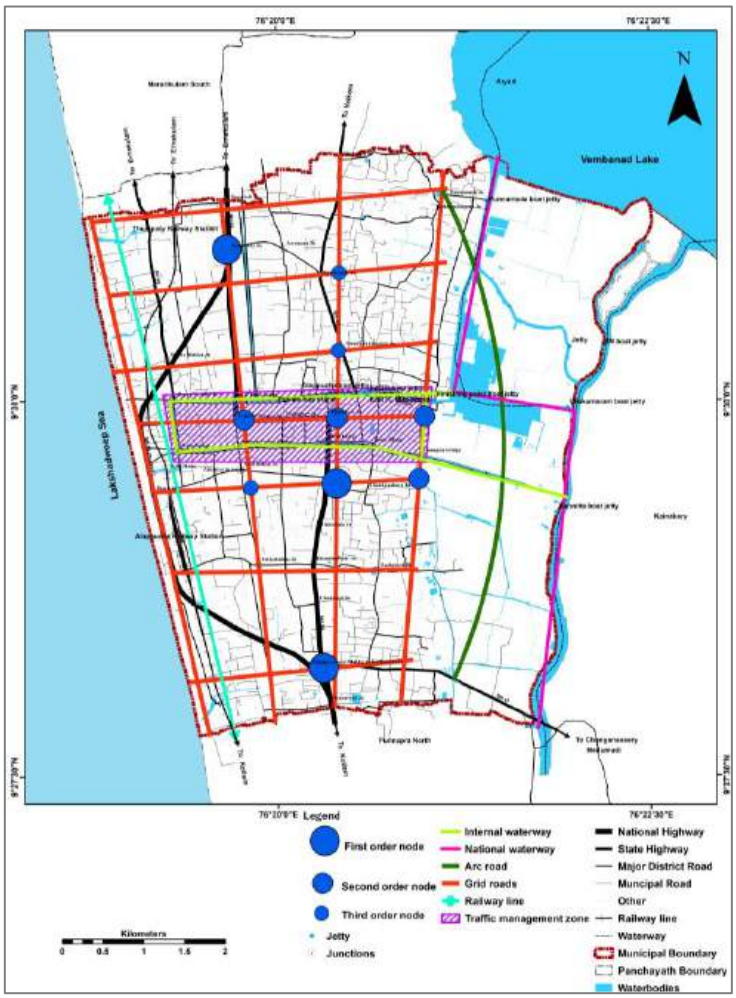


Figure 19-8 Proposed Transportation Network

The road network for the planning area is visualized as grid pattern at central area with semi rings at outer portion. The NH- 66 bypass and its proposed parallel road are considered as part of semi ring road. Another part of ring is the Alappuzha-Changanassery by pass. The ring road segregates the through traffic from town centre thereby reduces the traffic congestion at town centre. Connecting links between the major roads are visualized in the concept of transportation network. The concept of transportation network is transferred on land and the proposed transportation network is shown in Figure 19-8. Widening of state highways and radial roads are also proposed along with this conceptual road network. There should be a

proper traffic management proposal to ease the traffic and reduce congestion on the town roads. Adequate junction improvement needs to be done at main junctions of all major roads.

The water way network through Commercial canal and Vadai canal is proposed with water taxi circuit, which will also act as a transit way to the city core. A mobility hub is envisaged at existing KSRTC Bus station, which will act as an interchange hub water way and road transport and terminal for inter district buses.

19.3.10 Green and Sustainable Development

Driving the planning area towards sustainability is a major concern addressed by this Master Plan. The plan focuses on measures to reduce pollution, cut down fuel and energy consumption, check conversion of productive land, promotion of non-conventional energy sources, increase green cover etc. The mixed-use developments proposed will house public transportation, commercial, schools, offices, and entertainment in walkable distance, reducing the trip distances to work, education, shopping etc. and thus the fuel consumption.

Promotion of high-density developments with low coverage will reduce the productive land covered under concrete, diminishing the average shelter footprint multi-fold, when compared to low rise independent or group housing units accommodating similar numbers of population. Besides, such development reduces per capita land and infrastructure development cost reducing the per capita energy use exponentially with population density.

Installation of solar panel at important buildings, use of LED lights at roads and public spaces, introducing incentives for green building are also proposed for building energy positive town. For making town technology efficient, creating Wi-Fi hotspots as much as possible and coverage of important office and other public spaces with strong Wi-Fi network, setting up of e-Sewa Kendras, skill upgradation plan of technical wing of city administration, provision for underground utility tunnel (both for wet and dry purpose), using GPS based compactors and monitoring etc. can be attempted. Installation of CCTV at important locations, setting up of web based system for centrally monitoring security aspect of the town are promoted for making town safe & secure.

The waste management concept centered on reduce-reuse-recycle principle, decentralized waste management, and the proposals for producing electricity and manure from the waste will reduce the waste footprint of the planning area.

The promotion of public transport and state of the art mass transit systems will cut down the carbon emissions from personal transport modes. Water way transport, when compared to other modes of transport is less polluting and energy consuming, which is promoted in the Master Plan. The development of walkable streets and promotion of pedestrianisation, designated cycle tracks and public transit corridors, use of battery-operated vehicles etc. also contribute significantly to lower the foot print of urban transport. The proposed multilevel parking facilities will reduce the congestion on roads, again contributing towards reduction of air and noise pollution.

The plan also comes up with strict measures for environment conservation and increasing green cover. It also proposes conservation of wetlands, mangroves, pine forest, sacred grooves, ponds along with canal banks, beaches and other water fronts. Urban afforestation, parks (both creation and revival), nurseries, floriculture, pocket forests (miyawaki & pachathruth), plantation along the median of the roads etc. are proposed to attempt as part of greening plan. Conservation of water bodies, water based recreation, canal/water front development and hedges along water front are promoted to attain blueing Plan. The plan envisages promotion of urban agriculture, aquaculture etc. and specifically organic agriculture, another step towards a sustainable future.

19.3.11 Concept to cope with the effects of climate change and disasters

The Eastern region of the town which is bordered by the Vembanad Lake and Pallathuruthy river is more susceptible to flooding due to water level rise in the lake or due to heavy rain. Climate change effects such as sea level rise may also contribute to increased water level in the lake, which is a major concern of the near future. Risk assessment reveals that this region is highly vulnerable to flood hazard and the impacts seems to be very high as shown in Figure 19-9 . The Western region of the town which is bordered by Lakshadweep Sea is also under threat of sea level rise due to climate change happening at the global level. Presence of pozhi towards the coastal area is a major concern which results in the flooding of low-lying residential areas nearer to it. In addition, the town is also under the threat of urban flooding due to heavy rain which is falling on impervious surfaces and overwhelms local storm water drainage capacity. It is imperative that the Master Plan also includes strategies to cope with the effects of floods experiencing in the town and the effects of climate change that may happen in the future. The future development aims to prevent the sufferings of the local people due to floods, to eliminate the situation of waterlogging in the city during heavy rains due to the lack of channels to drain the water, and to take measures to deal with the disasters that may occur

to the coastal residents and towards the Eastern region due to the rise in sea level as a result of climate change.

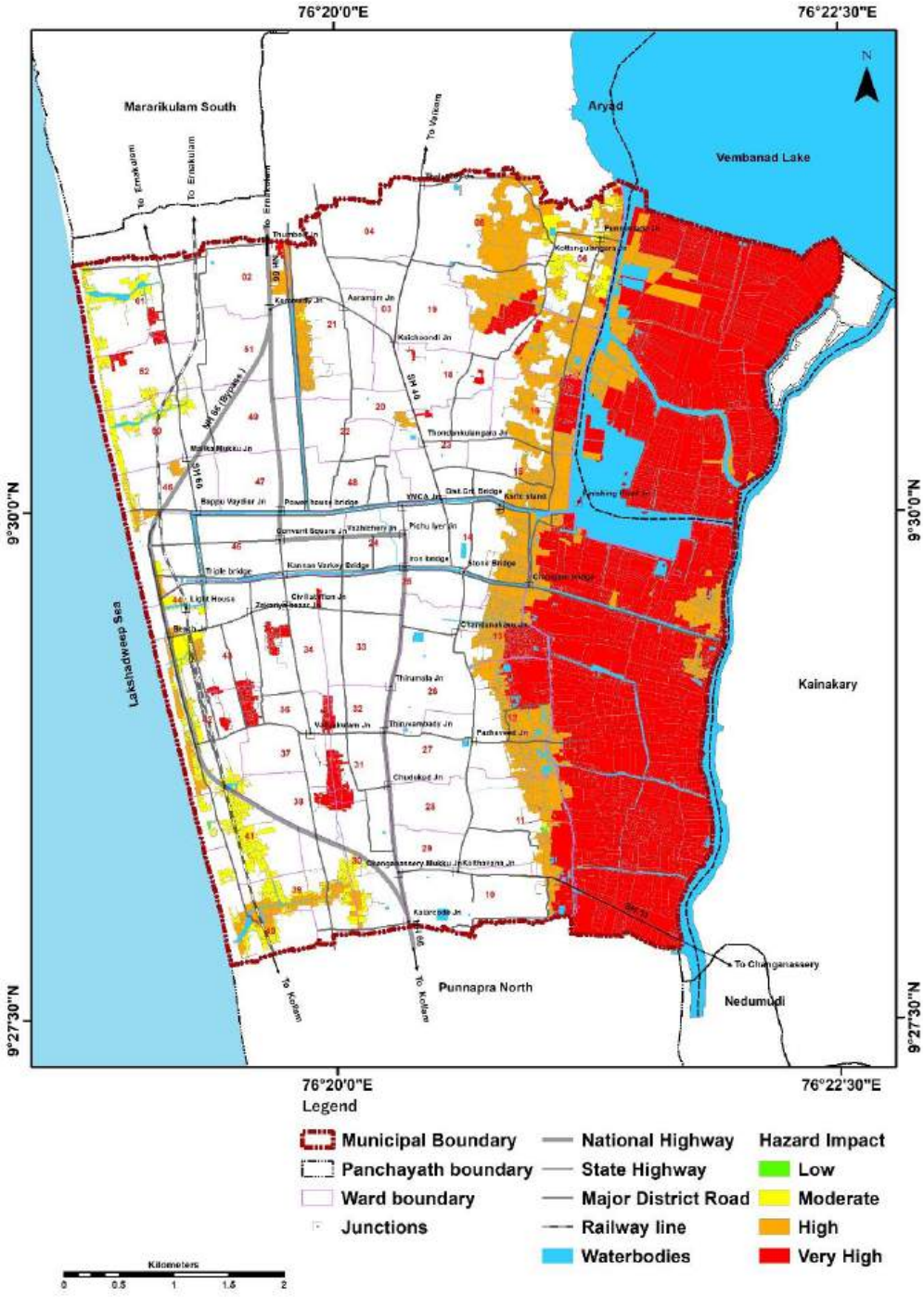


Figure 19-9: Intemsity of hazard impact within the municipal area

19.3.11.1 Adoption of sponge city concept in future development proposals

The goal of the Sponge City Concept is to create a city with a water system which operates like a Sponge to absorb, store, infiltrate and purify rainwater and release it for reuse when needed. The concept evolved in China and the primary goals for Sponge City Concept includes on-site retention of 70–90% of average annual rainwater by applying the GI concept

and using LID measures, preventing urban flooding, improving urban water quality, mitigating impacts on natural ecosystems, and alleviating the urban heat island impacts (UHI). (Objectives and indexes for the Implementation of Sponge Cities - A case study of Changzhou City, China, 2018).

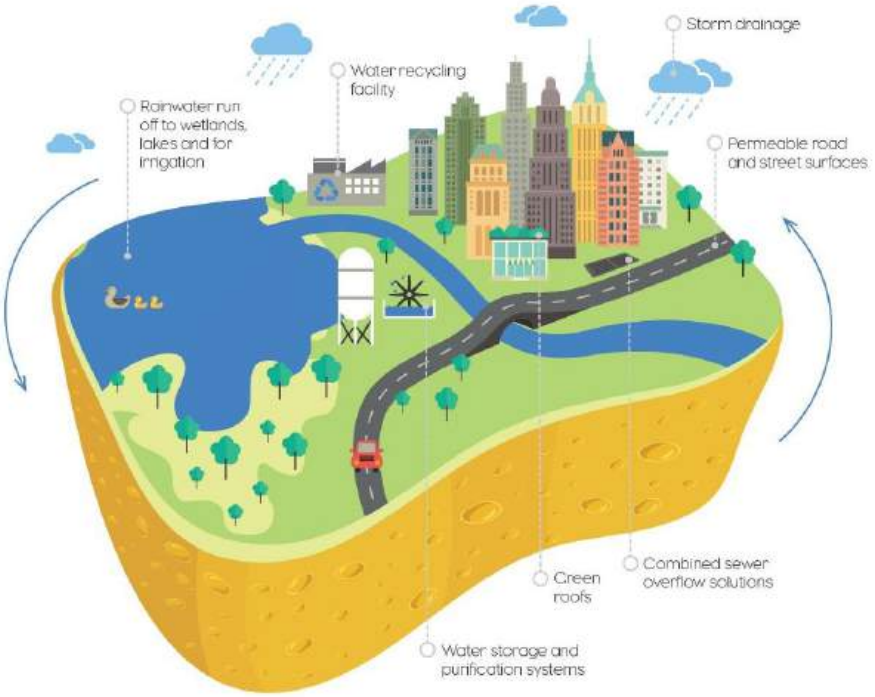


Figure 19-10: Sponge City Concept

The main objective of the sponge city concept to be adopted in this Master Plan is to protect the urban area's ecosystem, application of ecological restoration and mitigation measures to repair damages created by flood and other climatic changes, using low impact development (LID) practices in design and construction. Essentially, the concept resembles "Resilient Design" with a particular focus on storm water management and flooding. By evaluating these circumstances, sponge city planning aims to manage urban development to prevent flooding, to support the achievement of water resource protection objectives. (Integrating Sponge City Requirements into the Management of Urban Development Land: An Improved Methodology for Sponge City Implementation, 2022). Urban flooding is accompanied by other negative impacts such as water quality deterioration, losses to the economy, and even casualties. The establishment of the concept may include the protection of Paddy fields on Eastern side in low lying areas, water bodies' bed to be deepened or dredged, to give room for water to escape in flood. Drainage network of the urban areas to be planned properly with stake holders and make layout of sewerage, sullage waste and drinking water lines routes and it should be published. Vulnerable area identified should be made resilience to

adapt with the mitigation measures. The road network and bridges to be developed according to this concept as weathered roads for easy evacuation in disasters. The infiltration capacity of the soil strata will improve the absorption of more water to the core and reuse when needs. The collected water can be reused for industrial, agricultural as well as homely need after purification, in correlation with some water treatment plants. Strict measures have been considered, fine the public who were spoiling the precious water and exfoliate the wastes from housing as well as commercial and industrial building into the water source. Forestation help to store water in the root zone and urban heat island impacts can be reduced. Thus, the conceptual image of Sponge city can be achieved in future.

19.4 Future Development Concept

The development concept for the planning area is derived by combining the sectoral concepts presented above. The development concept for the planning area is formulated by physically overlaying all the above concepts as shown in Figure 19-11.

Thus, the planning area is envisioned as a service center of the district with a strong base of tourism sector and industrial base of coir and agro - industries as well as traditional and small-scale initiatives, a city which respects its culture, heritage and environment and offers ample spaces for leisure and entertainments, as well as agriculture, and offers high quality of living to its residents.

The development concept thus encompasses a strong transportation network of integrated rail-road-water modes favoring public transport, supported by parking plazas, truck and bus terminals and the mobility hub; heritage conservation, exclusive industrial zones for creating a strong industrial base for the city; a well laid out hierarchical commercial development; high development promotion areas of mixed use; low density developments in environmental and heritage hot spots interwoven with eco-tourism activities; earmarked residential and commercial rehabilitation areas; comprehensive and customized projects for primary sector development in urban contexts; and incentive based policies to pool land for public purposes; within the concept of risk informed planning.

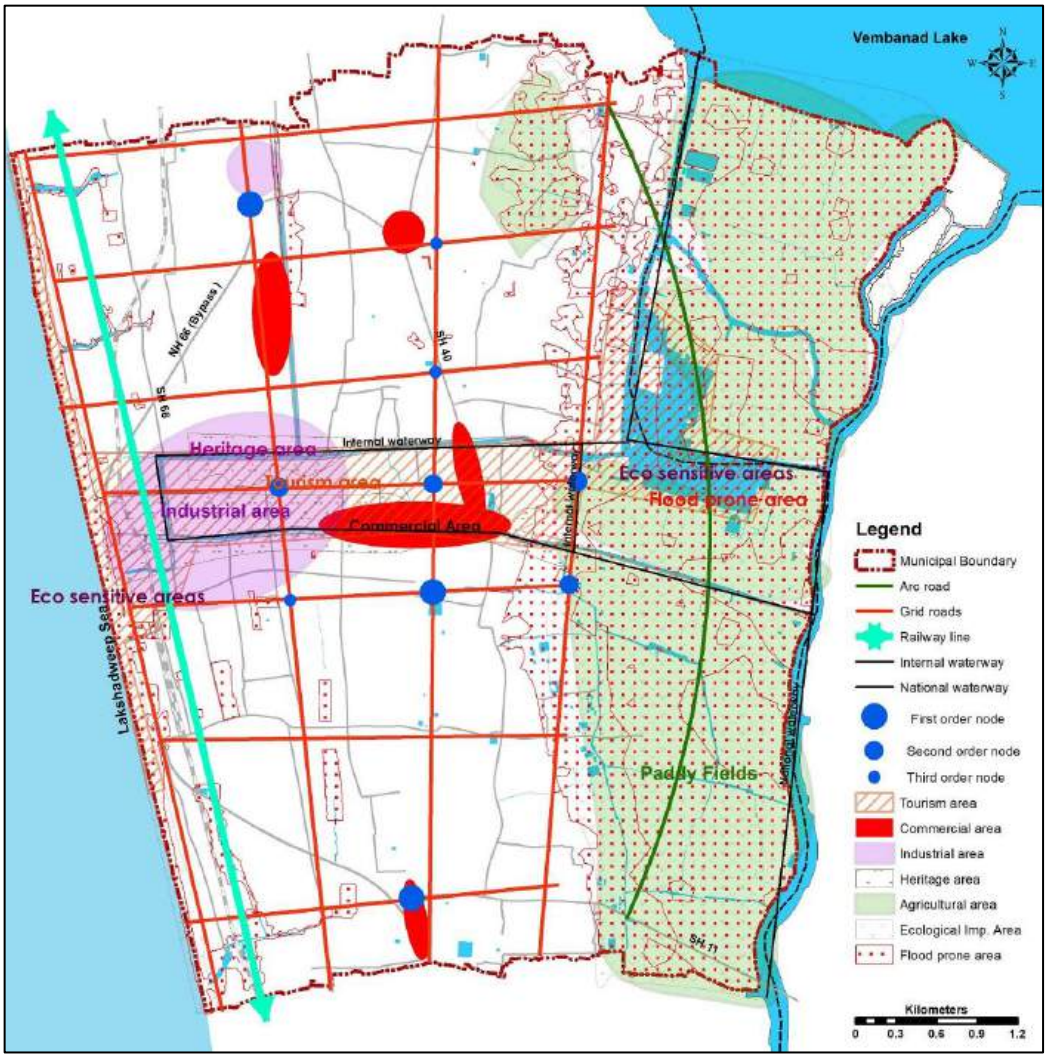


Figure 19-11 Development Concept

20 DEVELOPMENT POLICIES & STRATEGIES

The development policies and strategies are evolved for the implementation of the development concept formulated for a period of 20 years. They are framed as a measure to ensure that the development goals are achieved without conflicts of interests among various development proposals. The policies and strategies are intended to bring in synergy to the development process by considering various aspects of the development potential, development demands and the need to conserve certain values and features.

20.1 General Development Policy

The general development policy is to streamline all the developmental activities as envisaged in the goals to attain the envisaged vision for Alappuzha Town. The general development policy is to develop Alappuzha as a tourist destination. The spatial development envisaged for this optimizes the utilization of resources, reduces regional, spatial and economic imbalance, protects the environment and maintains an ecological balance. In order to capture the potential of water bodies, canal, backwater and beach based tourism promotion is envisaged in the plan. Heritage tourism is also incorporated in the plan to obtain mutual benefits for heritage and tourism sector.

In order to cater to the needs of whole district with special emphasis to nearby local bodies, upliftment of infrastructure facilities in the town shall be envisaged. Thrust should be given to the development of coir-based industries and effort should be made to achieve maximum self-sufficiency in agricultural sector, especially paddy cultivation and coconut cultivation.

The policy plan aims to achieve an urban structure in which development areas form a coordinating system and each area is allowed to expand in an orderly manner. Public-private partnership has to be encouraged in the development activities. The development activities are required to be in an environmentally, economically and socially sustainable manner.

20.2 Sectoral Policies & Strategies

The sector wise policies and strategies for the major sectors identified for Alappuzha Municipality are furnished below.

20.2.1 Tourism

Policy: *To promote Heritage Tourism, beach tourism, canal tourism and backwater tourism within the limit of carrying capacity ensuring environmental balance, enhancing economic base of the local community thereby improving the quality of life of the people through connected activities in tourism sector.*

Strategies:

- Form a tourist circuit at Alappuzha to connect the adjacent Tourist Places.
- Enhance the tourism potential by inter linking different types of tourism like heritage tourism, pilgrim tourism, farm tourism, beach tourism, canal tourism and backwater tourism
- Development of local tourist points in the city.
- Provide adequate facilities to tourists.
- Develop an efficient transportation network with regional connectivity.
- Create and develop adequate parking spaces for the floating population as an integral part of commercial, industrial and institutional planning and development.
- Ensure round the clock cleanliness in tourism spots.
- Facilitate the activities related to the arts and craft such that craft routes could be identified where tourist can see how the goods are made.
- Create awareness among tourists.
- Protect the environment and reduce pollution of water bodies.
- Encourage communities to manage their own resources through public participation
- Formulate regulations and guidelines for tourism activities.

20.2.2 Industry

Policy: *To develop Alappuzha as a destination for coir industries utilizing the potential of availability of raw materials, higher order marketing facilities, better connectivity, scope for exporting the products, etc.*

Strategies:

- Strengthen and modernise coir industries by diversification of products and implementing new technologies.
- Strengthening of marketing facilities.
- Develop mutually beneficial link between industrial sector and tourism sector
- Promote coconut cultivation in order to increase the availability of raw materials for coir industries and oil industries.
- Develop and promote agriculture related industries like Agro-industrial parks.
- Create skilled labour force through proper training programmes.
- Encourage woman entrepreneurs, Kudumbashree units and Self-Help Groups.

- Encourage private investments in industrial sector.

20.2.3 Trade and Commerce

Policy: *To develop Mullakkal and surrounding area as major commercial centre and to have a well-defined hierarchy of commercial activities in the planning area so that balanced development is achieved.*

Strategies:

- Improve the facilities of existing commercial centres in order to cater to the demand of whole district.
- Develop new higher order commercial centres at nodes having growth potential.
- Develop commercial centres and sub centre in order to decongest existing town centre area.
- Provide adequate infrastructure in the existing as well as new centres.
- Enhance access to commercial areas for pedestrians and public modes of transport.
- Rationalisation of land use to promote development of commercial activities.
- Provide sufficient parking facilities, waste management system etc.
- Existing market need to be modernized and renovated.
- Provision of facilities for informal sector and avoid their encroachment to public places.
- Provide market facilities for locally produced value-added products and agriculture products.

20.2.4 Traffic & Transportation

Policy: *To develop an efficient transportation network with regional connectivity considering the traffic need of the town, connecting the various activities and nodes of the town and to establish better traffic and transportation system by providing road widening, parking and pedestrian facilities, efficient public transport system and by integrating all modes of transport.*

Strategies:

- Design a hierarchical road network
- Transportation infrastructure facilities to be improved to ensure seamless connectivity by providing/developing ring roads, fly overs, elevated corridors,

scientifically designed junctions, widened roads, parking plazas, diverting through traffic from the core town through bypass roads etc.

- Development and enforcement of an integrated traffic and transportation plan.
- Facilities and safety requirements of pedestrians.
- Strengthening the role of water transport.
- Encourage public transport system.
- Promote Non-Motorised Transportation.

20.2.5 Agriculture and Allied Sectors

Policy: *To back up the economic base of the town through strengthening the agricultural sector and to achieve self-sufficiency in the production of milk, meat and egg to the extent possible by proper integration of agriculture and animal husbandry sector.*

Strategies:

- Promote homestead agricultural activities and bio-organic farming
- Conservation of existing paddy cultivation areas and promote group farming.
- Cultivation of coconut and horticultural products are to be given thrust in this regard.
- Utilize the potential of available markets and provision of dedicated spaces for farmers in order to sell their goods directly.
- Promotion of units for the value addition of agriculture products.
- The existing potential of canal, water courses and ponds may be utilized fully for formulating viable irrigation projects.
- Promote floriculture and related industries through special groups.
- Implement organic farming through various policy initiatives.
- Integration of homestead cultivation and animal husbandry sector.
- Establish more dairy, goat and poultry farms and increase productivity through scientific methods.
- Provision of basic infrastructure facilities and upgradation of offices like Veterinary clinics, etc.
- Promote cultivation of fodder grass.

20.2.6 Water Supply

Policy: *To develop additional source of water for fulfilling the present and future demands and to increase the coverage of protected water supply system.*

Strategies:

- Ensuring 100% coverage of the town and regulate water supply.
- Ensure drinking water of required standard throughout the day for all households of the town. Also provide sufficient water to the commercial and industrial establishments.
- Proper maintenance of RO plants.
- Restoration or conservation of existing water resources in the Municipality.
- Rainwater harvesting through well recharge and watershed management interventions.
- Water quality analysis and well mapping.
- Development of water policy.

20.2.7 Sanitation

Policy: *To develop sewerage or drainage network and waste management system.*

Strategies:

- Integrated scientific systems for drainage, sewage, sanitary and solid waste management including special focus on proper treatment of wastes generated from hotels, hospitals etc.
- Establishment of proper drainage network with treatment plant for recycling the waste water.
- Ensure safe, adequate, and cost-effective water supply and waste treatment to all residents.
- Promote safe and hygienic collection, transportation and disposal of solid waste.
- Stop disposal of untreated waste water into waterbodies.
- Provide storm water drainage system in order to prevent water logging.
- Adopt technologies to generate energy from waste.

20.2.8 Education

Policy: *To improve the general education status of the town and diversification of courses in higher education sector so as to improve Alappuzha as an education centre catering the need of surrounding areas.*

Strategies:

- Provide technical institutions as required per planning standards.
- Provision of adequate infrastructural facilities for general education institutions in government and aided sector.
- Modernization of educational institutions with facilities like smart classes, language labs etc.
- Supporting facilities like hostels, libraries, sports complexes and career development programmes.
- Improve basic infrastructure facilities in anganwadis.

20.2.9 Health

Policy: *To provide modern health facilities to cater the needs of people of Alappuzha Municipality as well as surrounding areas, to improve the general health condition of the people by preventive measures and to provide quality treatment through three systems of medicines.*

Strategies:

- Provide technical institutions as required per planning standards.
- Providing sufficient working space and infra structure facility to the primary health centres.
- Promote health tourism.
- Providing infrastructure facilities for Indian System of Medicine and Homeopathic Medicine System.
- Arrest the spreading of epidemics through proper environmental hygiene measures.
- Health awareness programmes.
- Centre for care of aged and differentially abled.

20.2.10 Energy

Policy: *To provide sufficient quantity of energy and quality power to the existing consumers and new establishments.*

Strategies:

- Promoting non-conventional source of energy like solar to the extent as possible.

- Provide uninterrupted power supply with sufficient voltage.
- Provide a good street light system for the town.
- Electrification of the houses of socially and economically weaker section.
- Promote energy conservation practices.

20.2.11 Housing

Policy: *To improve structural condition of houses of economically weaker sections and to improve housing quality of substandard housing area.*

Strategies:

- Specific action plan would be prepared by Municipality to meet the housing needs of the landless.
- Provide adequate residential areas in land use plan.
- Improvement of substandard housing area through different programmes.
- Provision of basic infrastructure like quality roads, street light, recreational facilities, drainage, drinking water etc. in residential areas.
- Facilitate affordable housing, having required quality, accessible especially to low/medium income group, including special provisions for proper accommodation for migrant laborers from other states.
- Housing programmes promoted should be cost effective and with environment friendly technologies and the concept of green building will be propagated.

20.2.12 Civic Amenities and Recreational Facilities

Policy: *To provide civic amenities and recreational facilities as per standard considering the resident as well as floating population.*

Strategies:

- Provide new parks and open spaces at town level and local level.
- Provide comfort stations associated with parks, parking spaces, and traffic terminals.
- Improvement of existing recreational facilities.
- Improvement to the existing libraries and provision of modern facilities.

20.2.13 Heritage

Policy: *To enhance the quality of conservation and management of heritage in order to increase the social, historical and economic values.*

Strategies:

- Conserve the heritage sites and buildings through proper control measures.
- Provide incentives for conservation.
- Introducing adaptive reuse of heritage structures.
- Create awareness among local people about the importance of heritage conservation through public participation

20.2.14 Environment

Policy: *To sustain environmentally sensitive areas through proper conservation mechanism and to ensure clean, green and hygienic living environment to make Alappuzha Municipality an eco-friendly and aesthetically pleasing town.*

Strategies:

- Strict enforcement of environmental protection acts and CRZ norms
- Provide effective waste management system
- Monitor the canal and backwater pollution and maintain the pollution level within the permissible limit
- Increase in town green cover through Miyawaki and Pachathuruth initiatives for carbon absorption thus reducing pollution.
- Developing parks and areas near to water bodies to promote tourism.
- Environmentally fragile areas including paddy fields, lake, beach, ponds, canals and natural drains etc. are to be preserved/protected/restored.
- Various measures for eco restoration of environmentally fragile areas are to be adopted.
- Improving aesthetics of the town through various efforts like planned street scape, organized open space etc.
- Create awareness among local people about the importance of environmental conservation

20.2.15 Disaster Management & Mitigation

Policy: *To build a safe and disaster resilient town by developing a holistic, proactive, disaster oriented and technology driven strategy through a culture of prevention, mitigation, preparedness and response.*

Strategies:

- Prevention of disaster through proper measures.
- Mitigation or reduction of risk and Preparedness to deal with disaster
- Capacity building including research and knowledge management.
- Encouraging mitigation measures based on technology, traditional wisdom and environmental sustainability.
- Mainstreaming disaster management into the developmental planning process.
- Establishing institutional and techno-legal frame works to create an enabling regulatory environment and a compliance regime.
- Ensuring efficient mechanism for identification, assessment and monitoring of disaster risks.
- Developing contemporary forecasting and early warning systems backed by responsive and failsafe communication with information technology support.
- Ensuring efficient response and relief with a caring approach towards the needs of the vulnerable sections of the society.
- Undertaking reconstruction as an opportunity to build disaster resilient structures and habitat for ensuring safer living.

21 PROJECTED REQUIREMENTS

21.1 Population Projection

The population projection for 2021, 2031 and 2041 of the Municipality are made by assuming that same trend in the population growth continues. The population is projected by two methods and the average of the two is taken to arrive at the population figures in 2021, 2031 and 2041.

The following methods were used.

a. Decreasing rate method

b. Apportionment method

Decreasing rate method

In this method it is assumed that rate of percentage increase decreases and the average decrease in the rate of growth is calculated. Then the percentage increase is modified by deducting the decrease in rate of growth. This method is applicable only in such cases where the rate of growth of population shows a downward trend. By this method, the population growth rate of 2021, 2031 and 2041 are calculated by assuming that the same percentage decrease in population growth prevails as that of 2011 for the succeeding decades. Table 21-1 shows the projected population of Municipal area using decreasing rate method.

Table 21-1 Projected Municipal population – Decreasing rate method

Year	Population	Growth rate (r)	% Decrease in growth rate
1981	169940		
1991	174666	2.780982	
2001	177029	1.352868	1.43
2011	174176	-1.6116	2.96
		Average (r')	**2.20**
2021	**167544**	$P_n = P_0 + [(r_0 + r') * P_0/100]$	
2031	**157484**		
2041	**144570**		

Apportionment method

In this method, the ratio of the Municipal population to the district population is found out and the same is projected to the next decades by interpolating the ratio for 2021,2031 and 2041. The projected population of the Municipality based on the apportionment method is shown in Table 21-2.

Table 21-2 Projected Municipal Population – Apportionment method

Year	District Population (x)	Municipal area Population (y)	Ratio (y/x)
1981	1865580	169940	0.091
1991	2001083	174666	0.087
2001	2109004	177029	0.084
2011	2127789	174176	0.081
2021	2215192	**173907**	0.078
2031	2302595	**173694**	0.075
2041	2389998	**172943**	0.072

The projected total population by the above mentioned methods differs slightly. The average of these two projected values is taken as the population figures of the Alappuzha Municipality. Table 21-3 shows the final projected population of the town.

Table 21-3 Final projected population of the Town

	Final Population		
Year	Total population as per decrease rate method	Total population as per Apportionment method	Average population figures
2021	167544	173907	170725
2031	157484	173694	165589
2041	144570	172943	158756

So, it can be concluded that the total population of Alappuzha Municipality will be 170725, 165589 and 158756 on 2021, 2031 and 2041 respectively based on the projection. However, the Municipality shall attract migration of certain population to it due to the development projects envisaged in some of the sectors and the recent development of tourism activities in the region. Hence, the population in the horizon year is considered to be 180,000 for calculation purposes.

21.2 Sectoral Projections

The projected population in 2041 is 158756. For the purpose of assessment of sectoral requirements this is taken as 180,000, considering the migration of population due to the proposed development activities.

21.2.1 Estimation of labour force for 2041

Alappuzha town is expected to accommodate 1,80,000 populations by the year 2041. In 2010, 56% of the total population of the district was in the age group of 20-59. Up-to-date data of the age structure of the town is readily not available, almost the same age structure is assumed to prevail in the town in the next decades. Thus 56% of the population is considered as in the working age group during 2041 which works out to be 100,800.

Sex ratio for age group 0-6 in 2011 is 949. So the working age group population can be divided into 46353 females and 48847 males. % of female workers to the female working age group population is 25.1% (12835/ 46353) x100.

Assuming that this participation rate will improve to 35% due to the increased literacy rate, female workers as on 2041 will be 46353x 35/100 = 16224

Total number of workers = 16224 + 48847 = **65071**

Proposed distribution of workers

Primary labourers:

In 2011 the number of primary labourers is 1709. It is 2.89% of the total labourers. Expecting the same trend for next decades we can assume that 2.5% of total labourers will come under primary labourers.

65071 x2.5/100 =**1627**

Secondary labourers:

In 2011 the number of secondary labourers is 1334. It is 2.25% of the total population. Expecting the same trend for next decades we can assume that 2.5% of total labourers will come under secondary labourers.

265071 x 2.5/100 =**1627**

Tertiary labourers:

In 2011 the number of tertiary labourers is 56189. It is 94.86% of the total population. Expecting the same trend for next decades we can assume that 95% of total labourers will come under tertiary labourers.

65071 x 95/100 =**61140**

Table 21-4 Sector wise distribution of workers 2011

Sl No:	Sector wise distribution of workers (2011)		%
1	Cultivators	221	0.37
2	Agricultural labourers	2429	4.10
3	Livestock, Fishing etc.	4680	7.90
4	Mining & Quarrying	30	0.05

5	Household industries	2074	3.50
6	Non Household industries	12142	20.50
7	Trade & Commerce	13311	22.47
8	Transport, storage etc.	6279	10.60
9	Others	18066	30.50
	Total	59232	100.00

21.2.2 Trade and Commerce

A total labour strength of 61817 is required to be accommodated in the development plan area. It is assumed that a density of 150 workers/hectare of land is required.

Area required = **434.44 Ha**

*As per existing land use survey commercial area in the town comes to **99.3** hectares.*

Table 21-5 Commercial Centres and Population served

Sl No	Hierarchy of commercial center	Population served	Requirement (by 2041)
1	Cluster center	1000-4000	19 Nos with 36 shops each
2	Sector center	5000-20, 000	4Nos with 100 shops each
3	Community center	25000-1 lakh	No with 450 shops

21.2.3 Water supply

Domestic purpose: Requirement of water for domestic purpose for a population of 180,000 for the year 2041 = 180,000 x 150 = **27 MLD**

Medical: Requirement of water for 961 beds in the various hospitals at the rate of 455 per bed = 961 x 455 =**0.437 MLD**

Educational: Colleges: Requirement of water for 3500 students in colleges = 3500 x 45=0.1575 MLD

Schools: Requirement of water for 36145 students (40,000) at the rate of 45 lpcd = 40,000 x 45= 1.8 MLD

Industries: Water requirement for 67186 workers in various factories at the rate of 30 lpcd = 67186 x 30 = 2.015 MLD

Total = 27 + 0.437 + 0.1575 + 1.8 + 2.015 = **31.34 MLD**

Adding 25% (i.e. 7.83 ML) for commercial, public institutions, park and open spaces, street taps etc. the total requirement of water for 2041 =31.34 + 7.83 = **39.17** MLD

21.2.4 Solid waste management

Waste generated = 220gm/head/day

Waste generation in 2041 = Waste generation in 2041 = 180,000 x 250 = 45 ton/day

Waste collected/day = 45 tons (considered only HH waste)

Apart from HH waste generated, there would be wastes from commercial, industrial and especially tourism related floating population also.

21.2.5 Liquid Waste Management

For the purpose of assessment, population for the year 2041 is taken as 180,000.

Approximate water requirement = 135 Litres/Capita/Day

Approximate water required in 2041 = 180,000 x 135 = 24.3 Million litres/day

Approximate waste generation = 80% of water requirement

Hence approximate waste generated in 2041 = 80 % of 24.3 MLD = 19 MLD

For the construction of 19 MLD sewage treatment plant large area is required and it is also difficult to convey the sewage from different parts to the plant. Hence it is not feasible to construct a single sewage treatment plant. So by considering the population of different wards sewage treatment plants can be proposed at different locations.

21.2.6 Energy

The electric power requirement in the town is computed at the rate of 1 KWH per capita per day for residential use and 4 KWH per worker per day for industrial purposes.

Residential use = 170000 KWH

Industrial use:

Workers in industries other than household industry constitute about 20.50% of total workers = 65071 x 20.50/100 = 13340

Power required = 13340 x 4 = 53360 KWH

Total power requirement = 170000 + 53360 = **223360 KWH**

Table 21-6 Energy availability and projected demand

Category	Existing Nos	Standards recommended	Demand 2041
110KV substation	1	1 for 1,50,000 persons	1 Nos
Fire station	1	1 for 2 lakh person s	1 No
LPG Godowns	2	1 for 40-50,000persons	2 Nos
Petrol pumps	7	1/150Ha of gross residential and 1/40 Ha of industrial area	10 Nos

21.2.7 Traffic & transportation

Traffic projections help in evaluating the shortfall in the road network and accordingly plan the road network improvements, augment the facilities such as providing new roads, developing missing links, bypass road etc.

21.2.7.1 Methods of Traffic Projection

Various methods of traffic projection employed in the transport planning include;

i) Growth factor methods

ii) Regression method based on economic indicators like population, per capita income growth rate and growth rate in industrial sector and land use parameter

iii) Interpolation method based on past trend in traffic growth rates

The relationship established between the various economic indicators for passenger and goods traffic movement can be used to estimate the future demand in an area. Also the growth rate of vehicular population in the area over the years will give a good estimate of the future trips. The traffic volume on links from the past years can be used to establish a growth rate for predicting the future volume on links.

21.2.7.2 Techniques Adopted for Projection

In the case of Alappuzha town, traffic projections were carried out according to the growth rates worked out on the following basis:

- Growth rate based on realistic estimates using influencing parameters

- Studies conducted by NATPAC in different towns of similar size in Kerala in the past
- Growth rate of vehicular population in Alappuzha over the years
- Variation of AADT on major roads from biannual counts made by PWD periodically

The growth rates estimated as per the above basis are shown in Table 21-7;

Table 21-7: Growth rates considered for Projection

Methods	Annual growth rate (%)
Studies conducted by NATPAC in similar towns in Kerala in the past (Peak hour traffic growth)	3 to 6
Growth rate of Motor vehicles registration in Alappuzha district during 2007-2018	15.54
Biannual traffic count on major roads by PWD during 2007-08 (growth in AADT)	13.50

The impacts of annual traffic growth on peak hour traffic were estimated based on the peak hour factor. On the basis of a critical evaluation of the above growth rates and also factors such as moderation in traffic growth over the years due to development of Information Technology in transportation sector, the following growth rates (Table 21-8) were adopted for Alappuzha town for different categories of roads viz. arterial, sub-arterial and collector roads.

Table 21-8: Future Traffic Growth Rate

Hierarchy of Road	Traffic Growth Rate (%)	
	Up to 2030	Beyond 2030
Primary road	4.5	3.5
Secondary road	3.5	2.5
Tertiary road	2.5	1.5

21.2.7.3 Projected Link Volume on Existing Network

The estimated daily traffic for different horizon years on various road stretches and volume-capacity ratio for the horizon years in Alappuzha town are given in the Table 21-9. It can be seen that almost all the major road corridors in Alappuzha town would be severely congested in the horizon year with the anticipated traffic more than the capacity of the roads under "do-nothing option". The capacity utilization of the major corridors that is the part of NH 66 passing through the town from Kalarcode boundary to Pitchu Iyer junction, Convent Junction and up to Thumpoly had far exceeded their carrying capacity in the base year itself. The road sections, Vazhichery bridge to Outpost of WCSB road, Kaithavana to outpost of NS Bose Road, AC Road, SH 40 road were found to exceed the carrying capacity. The capacity of

road sections of Alisery Road, Power House –KSRTC Bus Stand (WCSB road), Thaneermukkam road will carry traffic much beyond the capacity in the horizon years.

The projected traffic on the existing road network within the CBD area implies that the existing road network would not be able to handle the traffic in the horizon years without upgradation of the transport infrastructure facilities. Augmentation of the capacity of the existing road network and bridges by strengthening/widening and the construction of missing links, flyovers, bypasses and link roads is a must considering the dramatic increase in the traffic volume.

Table 21-9 Volume-Capacity Ratio on Major Road links within Alappuzha Study Area

Road/ Link No.	Road Link	Capacity (PCU/ day)	2019		2025		2039	
			Volume (PCU/ day)	Volume-capacity ratio	Volume (PCU/ day)	Volume-capacity ratio	Volume (PCU/ day)	Volume-capacity ratio
1	Kalarcode(Municipality Border) to Changanassery Junction	15000	39,472	2.63	51,403	3.43	83,205	5.55
2	Changanassery Junction to Chudukadu	15000	45,039	3.00	58,652	3.91	94,940	6.33
3	Chudukadu to Thiruvambadi	15000	35,151	2.34	45,776	3.05	74,097	4.94
4	Thiruvambadi to GH South Junction	15000	40,900	2.73	53,262	3.55	86,216	5.75
5	GH South Junction to GH North Junction	15000	39,502	2.63	51,441	3.43	83,268	5.55
6	Iron bridge South to Iron bridge North	15000	29,743	1.98	38,732	2.58	62,696	4.18
7	Iron bridge North to PitchuIyer	15000	30,701	2.05	39,981	2.67	64,717	4.31
8	Power House Bridge South to Power House Bridge North	15000	31,296	2.09	40,755	2.72	65,970	4.40
9	Power House Bridge North to Kommady	15000	39,520	2.63	51,465	3.43	83,307	5.55
10	Kommady to Thumpoly	15000	41,467	2.76	54,001	3.60	87,411	5.83
11	Stone Bridge North to Stone Bridge South	15000	34,336	2.29	44,714	2.98	82,807	5.52
12	District Court Bridge North to Thondankulangara	15000	32,331	2.16	42,103	2.81	77,972	5.20
13	KannanVarkey South to Civil Station	15000	33,468	2.23	43,584	2.91	80,715	5.38

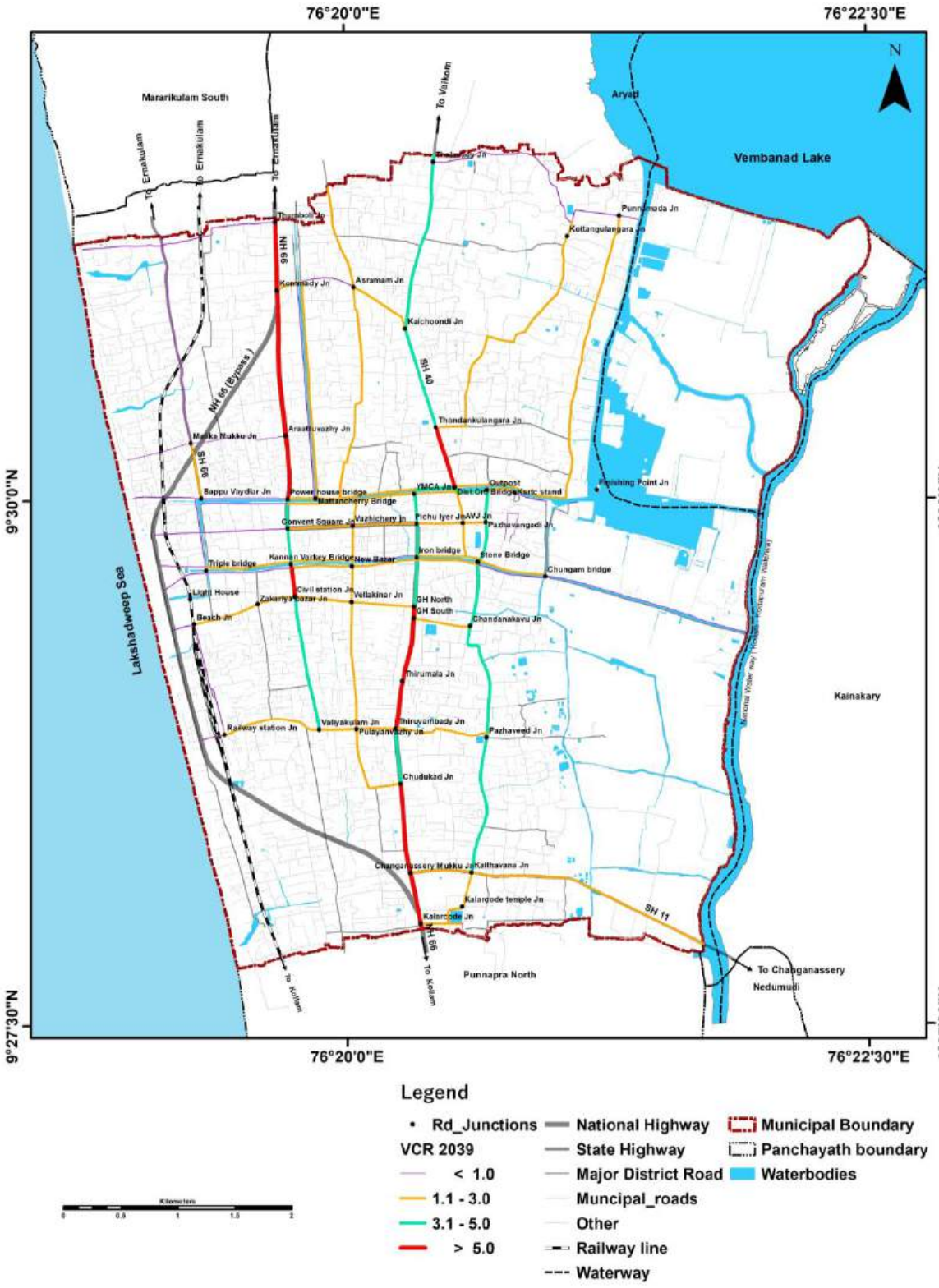


Figure 21-1 Projected V/C Ratio of Major Roads in Alappuzha in 2039

21.2.8 Education

- **High School (8th Std to 10th Std)**

As per the UDPFI guidelines manageable student strength of a high school is 700-750 students. The total number of populations with 700 students of age group 13-15, can be obtained from the age structure. The age structure of Alappuzha District is shown in the Table 21-10.

Table 21-10 Population Distribution in 0-19 category of Alappuzha District

% of People in various age groups Alappuzha District	
Age	%
0-4	7.87
9-May	7.01
14-Oct	8.15
15-19	8.07

Total % of students in the age group (13-15) = (8.15x3)/5 = 4.89 %

Total No. of people = 700x100/4.89 = 14315 (say 14000)

Threshold Population of a High School with student strength of 700-750 is 14000

In 2041 number of high school needed = 180000/ 14000 = 12.85 schools with 700 strengths. ie schools with a capacity of **9000** (12.85 x 700) students is needed. Existing facility constitutes schools with a capacity of **9777** students as per secondary data.

The existing high school facility is sufficient.

- **Higher Secondary School.**

It is derived that for a population of 14,000, a high school with strength 700 is sufficient. Assuming a 60% pass from the HS, the number of students opting for higher education from within a population of 14,000 =700x.6= 420

Assuming 80% of students from this 420 is opting for higher secondary education i.e. 420x0.8= 336

The number of divisions of an HSS, if the strength of the first division is 50 and that the subsequent divisions are at 45 each = 8

One Higher Secondary School with 8 divisions for 14,000 populations

In 2041 number of high school needed = 180000/ 14000 = 12.85 schools with 336 strengths. i.e. schools with a capacity of 4317 (12.85 x 336) students is needed. As per secondary data there are schools with a capacity of 5373 students in the town.

The existing HSS facility is sufficient.

- **Arts & Science Colleges**

It is derived that for a population of 14,000, a higher secondary school with strength 336 is needed. Assuming 80% pass from the HSS, and majority of this (Say 60%) opt for college education the number of students opting for college education (including Professional Colleges) from within a population of 14,000 =336x.60= 202

Assuming that 65% of the 202 students are opting for arts & science colleges, the number of students opting for higher education from Arts and science college = 202x.65=131

The total student's strength of an arts & science college = 500 (BSc-120, BA-120, BCom-120, Others-120) So the total number of population having 500 students for Arts & Science College = 14,000x500/81 =86420 (Approximately 86,000)

For 86,000 populations 1 college with 500 student's capacity is needed.

In 2041 number of colleges needed = 180000/86000 = 2.09 colleges with 500 strengths. i.e. colleges with a capacity of **1046** (2.09 x 500) students is needed. As per secondary data there are 2 colleges with a total capacity of 3011 students in the town.

The existing Arts & Science college facility is sufficient.

- **Professional College**

One professional college for 2,50,000 populations with student strength of 250 at the entry level. No professional college in the town as per secondary data. There are more than two professional colleges in the immediate vicinity of the town in the surrounding Panchayats which are easily accessible from the municipal area.

- **Other Professional Institutes (Polytechnic, ITI & ITC)**

20% of the total students appearing for the HSS is failing i.e. 336x0.2=68. Assume that, of the failing students, a 10 % of this and 5% of the students passing HS and a 20% of students passing higher secondary schools are opting for Polytechnic.

Total number of students opting for Polytechnic=7+21+54 (10% of 68+ 5% of 420+20% of 268) = 82

Total strength at the entry level of a polytechnic = 150

Threshold population of a Polytechnic = 14000 x150/54= 38,888 (say 38000)

Polytechnic needed = 180000/38000 = 4.7

*Polytechnic with student strength **710** (4.7x 150) is needed. There is no polytechnic in the town as per the secondary data.*

Assume that 20% of the students failing HSS and 10% of the students failing HS and 15% of students passing HS and 2% of the students passing Higher Secondary Schools are opting for ITI or ITC. No. of students opting for ITI or ITC = 14+ 28+63+6(20% of 68+10% of 280+ 15% of 420+ 2% of 268) = 111 Students strength at the entry level on an ITI or ITC = 300 Threshold population of an ITI or ITC

= 14000x300/109

= 38532

≈38000 (say)

Threshold population of an ITI or ITC = 38000

ITI/ITC needed = 180000/38000 = 4.7

*ITI/ITC with student strength **1410** (4.7 x 300) is needed.*

- TTC

Assume that 10% of the students passing out of the HSS are opting for TTC No. of students opting for TTC = 27 (10% of 268)

Total Strength at the entry level of a TTC

Threshold population of TTC = 14000x120/13 = 129230 (Say 120000 population)

For 1,20,000 population TTC with a strength of 120 is needed.

TTC needed = 180000/120000 = 1.5

*TTC with student strength **180** (1.5x 120) is needed.*

21.2.9 Health

At present there are 867 beds in various Allopathic hospitals. Out of 867 beds, 80 are in the private hospitals. Ayurvedic and homeopathic hospitals contribute 94 beds (70 in ayurvedic hospital and 24 in homeopathic hospital). This is fully in the government sector. There is a total of 881 beds in the government sector.

Assuming a standard of 4 beds per 1000 population, the number of beds needed by 2041 = (180000/1000) x 4 =720

The existing bed strength in the hospitals is sufficient for the future population of the town. But being the district headquarters the population of the surrounding areas also come to the town for higher order facilities. Speciality units may be provided in the existing General hospital, as the Medical College Alappuzha is nearly 20km away from the town.

21.2.10 Housing

As per the secondary data collected, the existing number of houses in Alappuzha town is 43638. While considering the condition of houses, the katcha houses are to be reconstructed. Average household size for the town is 4.19.

As per the standards, Number of houses needed by 2041 = 180000/4.19 = 42,959. So there is no shortage of houses as per calculation.

% of urban rented houses for Alappuzha district as per census 2001 is 5.18%. Assuming the same proportion in 2011 also, the rented houses in Alappuzha town can be assumed to be 43638 x 5.18/100 = 2260

Number of kutcha houses to be reconstructed as per the 10% sample survey conducted is 43638 x 0.8 = 3491 (8% of total HH sample is found to be kutcha)

1% removed due to developmental activities = 43638/100 = 436.3 (say 436)

Total houses to be built = 2260 + 3491+ 436 = **6187.**

A total of 6187 houses are to be built to meet the future requirement.

21.2.11 Recreational facilities

Table 21-11 shows the recreational facilities available and future requirement for 2041.

Table 21-11 Recreational facilities available and future requirement

Category	Standards recommended	Demand 2041
Park & open spaces (overall town)	10-12 sq.m /persons	175-210 Ha
Community level Park & open spaces	2-3 community level Park & open spaces	
Open spaces (variations by size of settlement)	1.4-1.6Ha/1000 persons	245 Ha
Community hall & Library	1/15000 persons	12 Nos (2000 m2 each)
Community hall & library	1/15000 persons	12 Nos (2000 m^2 each)
Recreational Club	1 for 1 lakh persons	2 Nos (1 Ha each)
	1 for 50,000 persons	4Nos (0.5Ha each)
	1 for 15,000 persons	12Nos (0.2Ha each)

PART III

SECTORAL PROPOSALS

&

LAND USE PLAN

22 TRAFFIC & TRANSPORTATION PLAN

Transport development plan for Alappuzha Municipality is prepared taking into account the existing traffic scenario and the future traffic projections. Transport development schemes cover all the available modes of travel and are formulated so as to reduce the severe strain put on the existing road network. All committed development schemes were taken into account while formulating the transport development plan.

22.1 Development Strategy

The town is well connected by road, rail and water transport. The development strategy for future is mainly focussed on strengthening the interconnectivity between these modes to achieve integrated multimodal transportation. It will facilitate smooth transfer between different modes of transport, and can be further integrated with different ways to achieve last mile connectivity. It is suggested to develop a public transportation system that is accessible to all. 'Mobility for all' is envisioned in the transportation sector to provide access to safe, affordable, accessible and sustainable transport systems. The development strategy is primarily focussed to achieve an inclusive access to all to the present system which can enhance the social, physical and economic life of its citizen with a consideration to environment and improving quality of life.

The existing road network within town is in the form of grid iron pattern. The strategy adopted for road network is strengthening the existing network and connecting the missing links to boost the existing pattern of road network. Water transport is suggested to be extended further to reach the areas which have access through waterway and is suggested to use in its full potential to extract the best of water way services. The rail network shall be connected to the central core and its integration to other modes shall be strengthened by providing more feeder services.

22.2 Road Network Development Strategy for the Horizon Year

The future pattern of road network is focused on strengthening of the existing grid iron pattern by widening of existing roads, improving the identified important roads together with developing new roads to connect the missing links. The terrain conditions and existing roads, which are in a planned manner connecting most of the central parts of the town gives advantage to the road network. Emphasis should also be given to improve the pedestrian facilities, junction improvements and public transportation facilities together with better traffic management. Provision of appropriate parking and pedestrian facilities will ease the traffic problems at the town core region.

The identifies reasons for traffic problems are narrow roads within the central area, poor geometrics of road at junctions, unorganized parking, heavy pedestrian crisscross movement, loading/ unloading activities on the roads, encroachments on road side by vendors and movement of inter-city bus traffic on congested urban roads due to the location of intercity-bus stand within the central area of the town. The main arterial road of this town is the section of National Highway 66, which has already exceeded its capacity. However, the newly constructed bypass will ease the traffic situation on NH section of central areas of town.

The various transport related problems faced by the town along with the development proposals made by various agencies have been taken into account while formulating the long-term development strategy for the town. As the level of service of urban roads are dictated to a great extent by the capacity of intersections, the development proposals should give importance to increase the capacity of major intersections by proper planning and design of these junctions. In order to reduce the number of private vehicle trips, the development strategy should give importance to provide an efficient public transport system for the town linking all major traffic generators, work centers, commercial activity centers. Special emphasis should also be given to improve NMT (Non-Motorized transport facility) like pedestrianisation and cycle tracks and in developing off-street parking lots.

22.2.1 Proposed Road Development Plan

On the basis of the projected volume of traffic and alternative network development schemes, a road development plan has been formulated for the town. The proposed network is focused to strengthen the existing grid-iron pattern road network. Four categories of roads are proposed for Alappuzha Municipal area. These are as follows:

- **Primary distributor road** – Providing connectivity to state and district headquarters. In Alappuzha, NH 66 and SH 40 (Thaneermukkom road) are the primary distributor roads.
- **Secondary distributor road** – Providing connectivity to neighboring towns within and outside district. In Alappuzha, SH 66 (Alappuzha-Arthungal Cherthala road) and SH 11 (Alappuzha- Changanassery road) are the secondary distributor roads.
- **Tertiary road** – providing connectivity to town centre and growth centres.
- **Local roads** – connecting residential areas with the above categories of roads.

In the absence of detailed engineering surveys, techno-economic feasibility analysis and environmental impact assessment studies, which are beyond the scope of the present study,

the alignments shown for the proposed road network map in Figure 22-5 are only indicative, and are subject to modifications based on actual ground conditions.

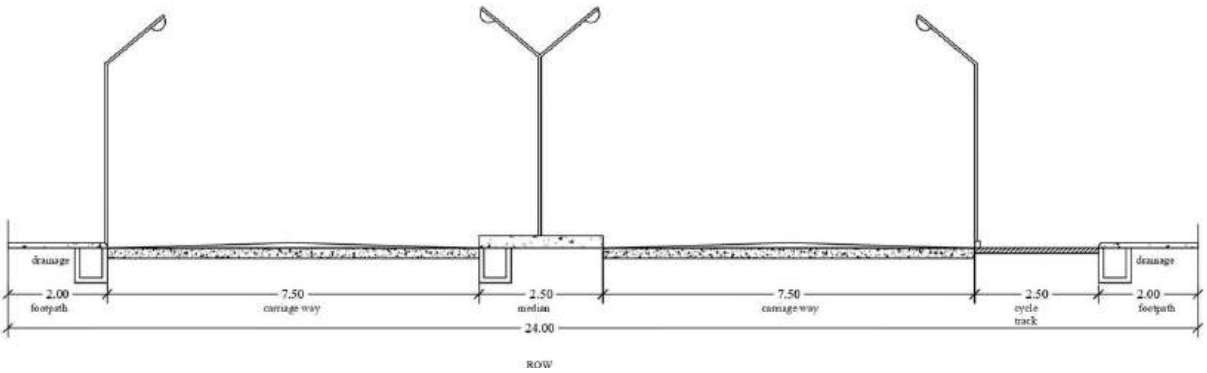


Figure 22-1: Cross section of 24m wide road-Four lane divided carriage way with cycle track

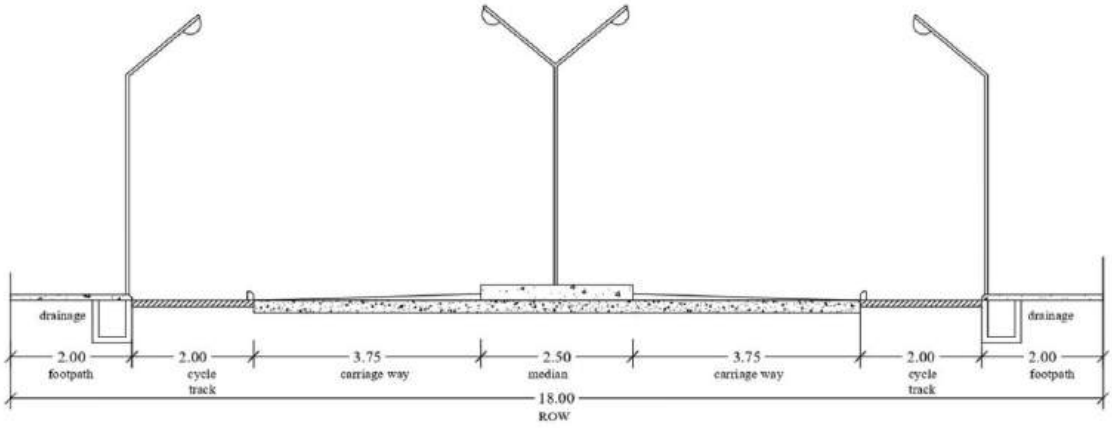


Figure 22-2: Cross section of 18m wide road with cycle track

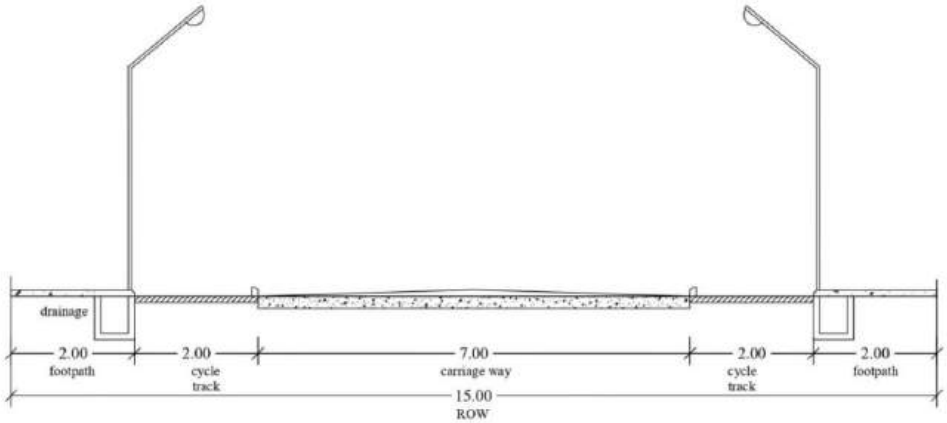
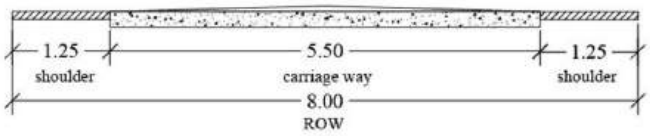
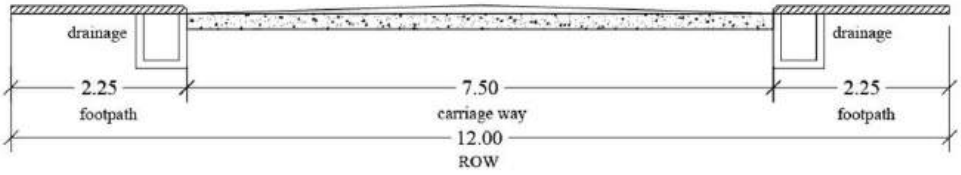


Figure 22-3: Cross section of 15m wide road with cycle track



(a) Cross section of 8.00m wide road



(b) Cross section of 12.00m wide road-two lane carriage way

Figure 22-4: Cross Section of 12m and 8m wide road

22.2.2 Proposed road network

The main roads of Alappuzha town especially within the Central Business Area are carrying traffic volume far beyond their capacity. The capacity of these roads needs to be augmented to ensure smooth and efficient movement of vehicular traffic. Towards this, some of the existing roads have already been widened to accommodate future traffic and some new roads are to be developed to connect the missing links.Table 22-1 shows the road stretches to be widened and developed:

Table 22-1: List of roads proposed to be widened / Proposed Roads

No	Name of the road	Length (m)	Existing width (m)	Proposed width (m)
1	NH 66	7812	18	18
2	SH 11	3036	9.3	18
3	SH 40	3279	11.5	18
4	Municipal Boundary - Thalavady Jn - Vayanashala Jn - Punnamada Jn - Finishing point (AC - NH Bypass)	4669	8	12
5	Police outpost - Pazhaveed Jn - Kaithavana Jn	3232	11.4	15
6	Kommady Jn - Kaichoondi Jn	1306	11.5	15
7	Thumpoly Jn - Thumpoly church Jn	1062	6.45	12
8	Thumpoly church Jn - Beach	700	7.93	12
9	Convent Square Jn - Dutch Square Jn - Beach	1165	7.5	12
10	SH 66 (Bapu Vaydiar Jn -Thumpoly church Jn - Municipal Boundary)	2541	6.2	12

11	SH 66 (Aleppy Beach Garden Road Strt. Pt. - Vadaipozhi Bridge)	1516	6.5	12
12	SH 66 (Vadaipozhi Jn - Malsyagandhi Jn - Municipal Boundary)	152	3	12
13	Alappuzha railway station road	1102	10.8	12
14	Collectorate Jn - Valiyakulam Jn	1186	8	12
15	Kothuval chavadi Jn - Pulayamvazhi Jn - Chudukad Jn	2246	9	12
16	Muppalam South Bridge - Palace road	416	10.55	12
17	Pazhaveed Jn - Gandhivilasam Bridge upto proposed road	638	4	12
18	Pazhaveed Jn - Thiruvambady Jn	819	5	12
19	Thiruvambady Jn - Veliyakulam Jn - Beach road	1760	8.5	12
20	Kaithavana Jn - Kalarcode Jn	791	10.8	12
21	Kalarcode Jn - Gurumandiram vadackal Jn - Municipal Boundary	706	8.5	12
22	Nehru Jn - Asramam Jn	1152	8.5	12
23	Asramam Jn - Chathanadu Library	1454	5	12
24	Arattuvazhy Jn - Malika mukku Jn	864	1.7	8
25	Mammod Jn - Thottathod Jn	1301	6	8
26	Vayanashala Jn - Vattikad Jn	2274	7.65	8
27	Vattikad Jn - Kaichoondi Jn	1035	7.65	8
28	Vattikad Jn - Thondamkulangara	836	8	8
29	Thodamkulangara Jn - Punnamada finishing point road	1199	5.2	8
30	Kidangamparambu - Finishing point road	1144	5	8
31	Thodamkulangara Jn - Arattuvazhy Jn	1496	4.5	8
32	Gurumandiram vadackal Jn - Malsyagendhi Jn	764	7	8
33	Thriveni Jn - Gurumandiram vadackal Jn	2015	4	8
34	Koyipally Jn - Proposed road I	223	3.3	8
35	Proposed road I- Punnamada finishing point road	357	4.9	8
	Proposed Roads			
36	Proposed road I- connecting Rd 34 and Rd 35	94	_	8
37	Proposed Road II - Finishing Point - SH 11 (AC - NH Bypass) proposed portion	3556	_	12
38	Proposed Road III - Vadaipozhi bridge - Vadaipozhi Jn	226	_	12



Figure 22-5: Proposed road network

The proposed connectivity between NH 66 and SH 11 is proposed to be developed to 12m wide road with widening of the existing road from Municipal Boundary - Thalavady Jn - Vayanashala Jn - Punnamada Jn - Finishing point (AC - NH Bypass). The proposed portion of this road from the finishing point up to SH 11 passes through residential areas, wetland, conservation zones and special zones which falls in flood prone zones. The portions of this proposed new road which passes through the wetland park (Special zone) is suggested to construct in stilts.

22.2.3 Improvement of Existing Roads and Bridges

Keeping in view the existing traffic and traffic volume projected for the horizon year, the improvement of the following are suggested to cater to the anticipated traffic in future.

i. The improvement of Iron Bridge and District Court Bridge

ii. The improvement and strengthening the following canal roads without widening to conserve the existing heritage buildings and street character.

a) Vadai Canal North Bank (VCNB) Road
b) Vadai Canal South Bank (VCSB) Road
c) Commercial Canal North Bank (CCNB) Road
d) Commercial Canal South Bank (CCSB) Road

22.2.4 Intersection/ Junction Improvements

Proper design of intersections is required to enable smooth, safe and efficient flow of traffic. A well-designed intersection can increase the capacity of the same and also adds on to the aesthetics of the area. The town has many commercial establishments and avenues of business and commerce. Adequate junction improvements need to be done for Kommady junction, where the traffic alignments are of very poor nature, which makes the operation of vehicles very difficult. The junction improvements would include improvement of junction geometrics such as provision of channelizing islands, acceleration/deceleration lanes, road markings traffic signs, lighting etc., and provision of appropriate traffic control systems. The following junctions in the town need to be taken up for detailed design and improvements considering the existing traffic situation and the future developments.

- Changanassery Junction
- Iron Bridge
- PitchuIyer Junction
- Outpost Junction
- Pulayanvazhy
- Vellakkinar

- Convent Junction
- Power House Bridge
- Kommady
- Kaithavana
- Stone Bridge
- Pazhavangady
- Chukadu Junction
- General Hospital Junction
- Civil Station
- Mullakkal Road Junction
- District Court Bridge
- Vazhicherry Bridge
- Kaichoondy
- Thumpoly Junction
- Thiruvambadi Junction
- Malikamukku Junction

22.2.5 Proposals by PWD (Public Works Department)

PWD has proposed for a fly over at District Court Bridge for which the land acquisition process is going on. Widening of Power House Bridge and Kommady Bridge is also included in the plan. The processing of the tenders of the two bridges is now completed. Since Power House Bridge is located in NH 66, widening of the bridge will help to reduce the congestion in that stretch to an extent. District Court Bridge and premises, which comes under the stretch of SH 40, is another congested place in the town which is on the way to KSRTC Bus stand and Boat Jetty. Construction of flyover in this region will be a great relief to the present traffic congestion in this area.

22.2.6 Traffic Management and One-way Traffic regulations

Since majority of the roads in town are narrow, the most important problem faced in the transportation network is the traffic congestion on NH 66 and in CBD area. This can be managed by regulating the traffic flow into one-way operation at roads stretches, based on the traffic management needs at certain areas. It will increase vehicular speed and capacity of the road and will further reduce traffic congestion in the town and can be used to reduce conflicts at junctions like Pitchu Iyer junction, Power house junction and District Court junction. The grid iron pattern of roads in town is very conducive of providing one-way regulations.

A systematic approach is needed to achieve this through attempting one-way operation at sections of road stretches. The grid iron pattern road in the interior and central part of town can be used for developing simpler one-way operation and thereby reducing traffic congestion. The canal bank roads are a very good favorite for providing one-way regulations. The canal bank roads with central canal can be considered as a single road with divided carriageway and VCNB and CCNB roads are suggested for one-way traffic operation for West to East moving vehicle whereas VCSB and CCSB are suggested for East to West movement of vehicle. Existing

bridges at intervals can be used as median openings for U turning of vehicles or change of direction.

22.2.7 Parking Mangement and Suggestions for Parking areas

From the road inventory and analysis of parking data, it is evident that the much of the parking problem is due to shortage of space and encroachment of the road way by shop frontages and advertisement boards. In the absence of a designated parking area, roadside parking is the norm and the 'no parking' signboards are ignored. Many commercial establishments do not have a required parking area; thereby customers tend to park their vehicles on roads leading to traffic blocks. Locations of auto rickshaw stand within the bell mouth of the junction are also a causative factor for causing traffic chaos in the town.

It is suggested to retain existing lands which are used for parking at present and hence are zoned as special zones as shown in Figure 22-6 which can be developed as parking zones in the future, together with provision for on street parking and multilevel parking facilities as described in the following:

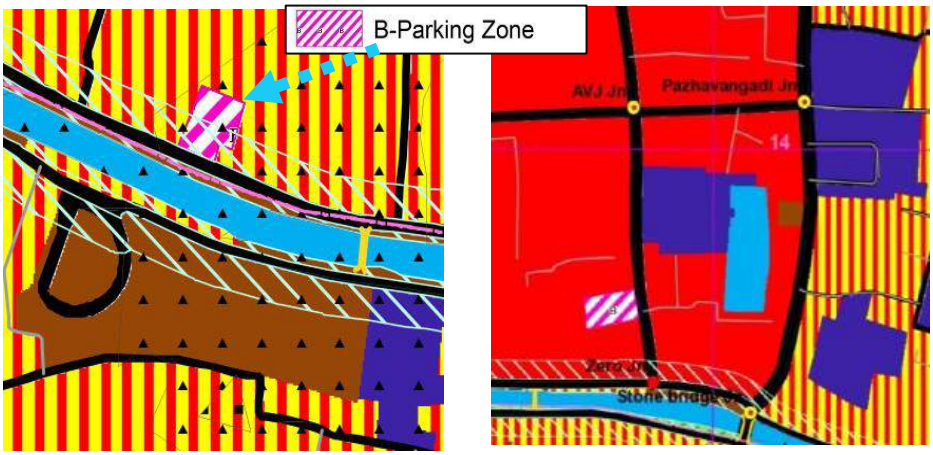


Figure 22-6: Locations of proposed parking areas

(i) 0.28 acre of land near venetia resort, opposite to KSRTC bus stand and North of Commercial Canal – The backwater tourism needs supporting infrastructure facilities including parking spaces for vehicles, that carry the tourists who comes to enjoy the 'Venice of the East' and its natural beauty through backwater cruises and boat rides which supports the economy of town. It will also provide parking during the boat-raze season. Such new spaces are to be identified and new parking facilities are to be provided.

(ii) 0.50-acre land located at a distance of 100m from Mullakkal temple - Pedestrian prioritization is suggested in the 'Mullakkal Street' and it can be achieved effectively only

through development of well demarcated parking spaces in the close vicinity to the street. One such land identified is demarcated as special zone.

(iii) Area under the NH 66 bypass flyover- The long stretch of sandy beach act as a social gathering space of town and it attracts all sorts of people. This area attracts lot of vehicular traffic that carry people, who comes to enjoy the beach during evenings, weekends and in festive and tourist seasons. Hence it is suggested to use the area under NH 66 bypass flyover for parking to vehicles to reduce the parking problems at this area.

(iv) Introduction of a multi-level parking facility helps to reduce parking problem to an extent. This parking system results in optimum space utilization as multiple cars can be parked in the same amount of space. A multi-level parking space is proposed at the Town square to satisfy the parking needs in this area. Recently in Trivandrum, a six-story parking facility has adopted that offers a parking space for 210 cars and 240 bikes. Currently, it has a parking space for about 100 cars and the next stage of work is in process. Similar models can be adopted at town center area and can be used for providing parking facilities for tourists and reducing congestion during festive seasons.





(v) Organized on-street parking is suggested together with providing one-way traffic regulations for reducing the congestion in the CBD area. Whereas considering the heavy parking demand along the major commercial roads, suitable off street parking lots need to be identified and developed at suitable locations.

(vi) Providing on street parking at canal banks together with one-way traffic flow will helps to reduce parking problem to a great extent. It is suggested to propose on street parking areas near to tourist destinations including heritage structures and shopping's areas. The main advantages of on street parking are; higher efficiency, improved aesthetics, increased safety and improved business. It gives shoppers the opportunity to make a quick 'stop and go' purchase, a tremendous boost to businesses. Find suitable locations by detailed study of the canal banks

and its road inventories. It is suggested to prepare a detailed study report on parking management plan with the help of ULB, State and Central Government Departments.







Central Makati is an oasis of well-managed on-street parking in Metro Manila

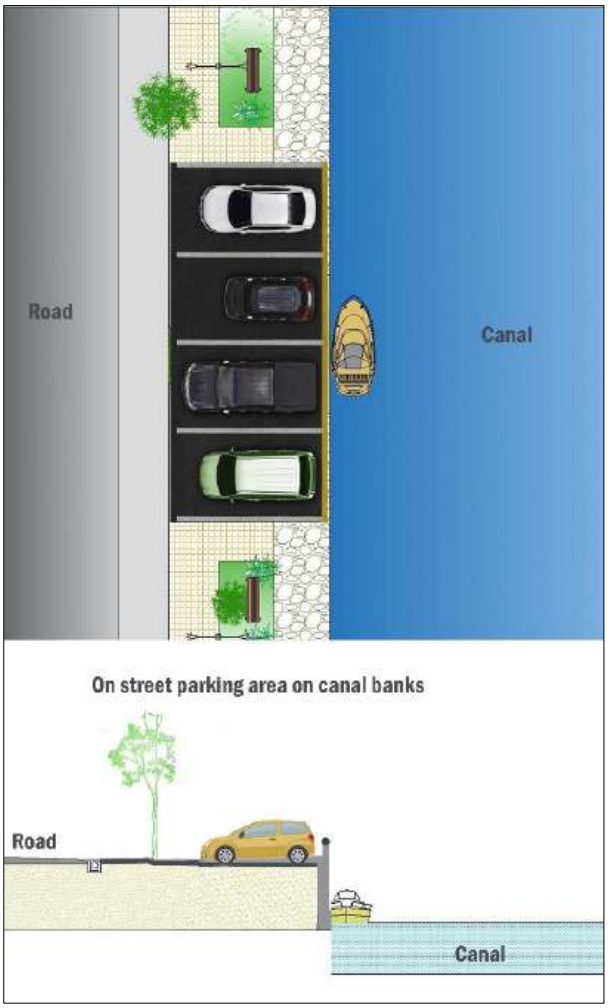


Figure 22-7: Conceptual image of on street parking at canal Banks

22.2.8 Identification & Development of encroached areas

Identifying the present encroachments in the Government lands adjacent to the major roads are to be done. Consider not only the encroachments in roads but also the canal sides. Development of these areas along the canal sides may be attempted by relocation and rehabilitation of street vendors. One such example is shown in Figure 22-8, and it shows the encroachment area along the South bank road of Veda Canal in between Dist. court Bridge and YMCA Junction. This area is proposed for the relocation of street vendors who is presently located around the Mullakkal street and other areas. According to resurvey records the Alappuzha town has lot of such encroached areas. Thus, it is suggested to conduct a detailed survey regarding the same even at least on the canal bank roads. The highlighted portion shown in the image is a pilot study regarding the same. The similar study and output shown below can be replicated to other parts of the town.

There is enough canal bank width in many areas alongside the Vadai canal and commercial canal, since the canal side protections are constructed in such a way that the canal widths are reduced and canal bank widths are widened. This will entertain the development of road widening as well as road edges. The expanded road edges can be utilized either for on street parking or can be converted as open spaces. Consequently, it is recommended to conduct a detailed study regarding the effective utilization of canal banks.



Figure 22-8: Encroached area for relocation and rehabilitation of street vendors

22.2.9 Eey Auto

To make the auto experience more enjoyable, as a PPP model implementation of the 'Eey-Auto' rickshaw scheme can be introduced in the town. The 'Eey Auto' system organizes rickshaws into a branded and marketed fleet, thus necessitating greater operational accountability, leading to quality, reliable service. 'Eey Autos' are driven by trained professionals and charge passengers' government-regulated fares on a meter basis. In addition, as part of the project, an on-call option can also be made available. Prospective passengers need only dial a number to arrange convenient pickup by one of the town's "Eey Autos". The system promises to be socially and economically sustainable as passengers are ensured fair, consistent fares, and auto drivers receive accident and health insurance, along with steady employment and income. Also, by incorporating new technologies such as online booking and online

customer feedback forums, the revolutionary 'Eey Auto' scheme promises to improve State's IPT sector. 'Eey Autos' shall preferably run on the clean-burning CNG fuel or on electric power, lessening the amount of harmful emissions compared to standard combustion engines.

22.2.10 Proposal for dedicated Bicycle lanes

Taking cue from the National Urban Transport Policy to promote public transport, walking and cycling has been encouraged for short-distance travel in the state. There is no pollution and emission from bicycles and they help improve the physical health of citizens and are ideal for last-mile connectivity from transit stations to home and work centers. The terrain condition in the town favors the use of bicycles. Cycle tracks offer a high degree of safety along busy roads as they physically separate the cyclist from the motorized traffic. On urban roads, a 2.25-m-wide two-way cycle track and 1.5-m-wide single track for small roads is ideal in Kerala where space is a constraint. Cycle track with 3-m-wide pedestrian walkway in two levels can be thought of in roads where there is space constraint. Although the track need not be fenced, markings and sign boards should be provided to ensure a bicycle-only lane.

Cycle Track is proposed along the major roads within the Municipality. Under this proposal, a public bicycle sharing system can also be established which includes bicycle docking stations near major transit nodes such as Railway station, Bus stands, Boat terminals and educational institutions. The bicycles can be taken on rent and be used for last-mile connectivity. Most of the tourists in Alappuzha prefer to ride bicycle rather than commuting in private vehicles. Thus, this proposal will enhance tourist activities which will in turn promote tourism sector.



Figure 22-9: Bicycle Lanes and Bicycle Rack

To encourage use of cycles in town, cycle lanes are suggested on along the canal bank road and school access roads. The minimum width of cycle track should be 1.80m. Bicycle rack

facilities are to be provided along the side of canal bank road to encourage the cycling by the visitors also. They can rent cycles from these points and return them in their destinations.

22.2.11 Provision of Bus Bays and Bus shelter

Well developed and maintained bus stops are important to facilitate easy, convenient and safe access to the service. On an average, bus stops may be located at a spacing of 500-600 meters. At traffic junctions, bus stop shall be located at 75m from the intersection. Segregated bus bays are absent in town center and in major arterial roads. Due to the same, buses are stopped on the carriageway itself, blocking the free flow of traffic. Bus stops need to be provided with bus bays and bus shelters. The bus shelters need to be designed scientifically so that they add to the aesthetic quality of the streetscape. Facilities like electronic passenger information system inclusive of time table and route details, fare information, Wi-Fi facility, etc. could be provided to benefit the commuters. Facilitated bus shelter will attract the waiting passengers to confine to the shelter rather standing on the carriageway or roadway.

22.2.12 Improvement of Pedestrian Facilities

Pedestrians are the most vulnerable category of road users. Segregation of pedestrians from motor vehicle traffic is the most important part in ensuring safe and comfortable movement for them. At present, footpaths are scarcely available or pedestrians are forced to use covered drains/ shoulders as footpaths and hence have a 'walkability index' of close to zero for the entire town. The target fixed for Walkability Index is 100%. The following measures are suggested for the improvement of walkability index.

Footpath along the sides of roads

The pedestrians are forced to walk on the carriageway due to encroachments on the footpath, thereby creating unsafe situations for the pedestrians. Sidewalks and walkways are "pedestrian lanes" that provide people with space to travel within the public right-of way, that is separated from roadway vehicles. Sidewalks are associated with significant reductions in pedestrian collisions with motor vehicles. For Alappuzha town, considering the scarcity of land availability, sidewalks with a width of 1.5m to 2.5 m is proposed for all types of roads including arterial, sub-arterial, collector and local roads. Concrete bollards are proposed at places where minimum width of footpath is 1.5m to prevent motorists/ bikes using footpath for driving/ parking.

- Footpaths need to be constructed on both sides of all the primary and secondary distributor roads as a minimum requirement. Additionally, footpaths need to be provided on all school access roads and residential roads wherever possible. It is mandatory to provide footpath on both sides along 24 meter and 18-meter-wide roads and at least one side of all new road developments.



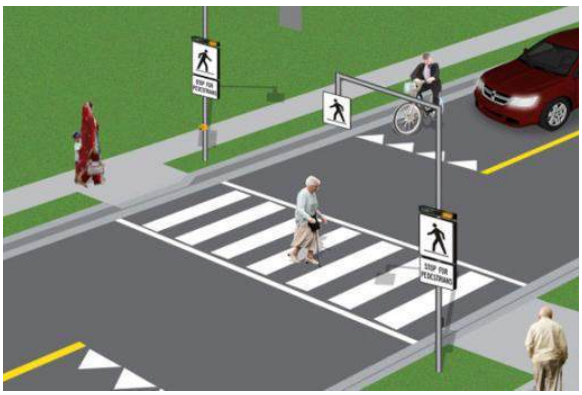
Figure 22-10: Cross Section of Canal Bank Road

- Taking into consideration differently abled persons, the absolute minimum width suggested for footpath is 1.8m.
- The height of the footpath should be not more than 15cm from the finished road level.
- Footpath should be continuous and free from any kind of obstruction.
- Guard rails should be installed on the footpath to segregate the pedestrian movement and also to restrict the entry of two wheelers onto footpaths.

Marked crosswalks and enhancements

Marked crosswalks indicate optimal or preferred locations for pedestrians to cross vehicular traffic. These are desirable to guide pedestrians along a preferred walking path. Also, pedestrian guard rails shall be provided on both directions along the edge of the footpath protecting corners of major intersections. For Alappuzha town, cross walk markings are desirable at all arms of the major intersections. Apart from these intersections, cross walk markings need to be proposed at major high pedestrian volume locations like educational institutions, hospitals and commercial centers.





22.2.13 Pedestrian Prioritization at Mullakkal street

Many of the commercial areas in the planning area are often unattractive and unsafe for the general public, due to congestion created by unsegregated and crisscross vehicle/pedestrian movement through the streets. Hence for making Mullakkal street pedestrian friendly, pedestrian prioritization measures like scheduled pedestrianization may be adopted along the street together with one-way vehicular traffic with due consideration to the resident population. Parking requirements of the individual buildings could be waived off in the case of a designated pedestrian corridor. Parking Plazas/ Shared parking spaces can be provided at various corners of the commercial area, to facilitate parking.

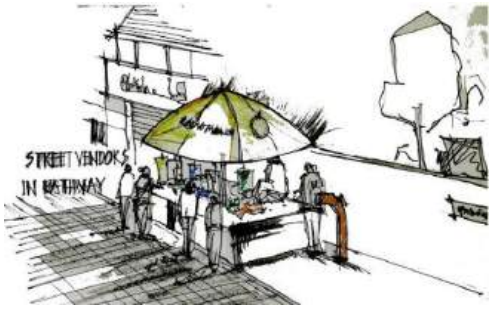


Figure 22-12: Space for Street Vendors

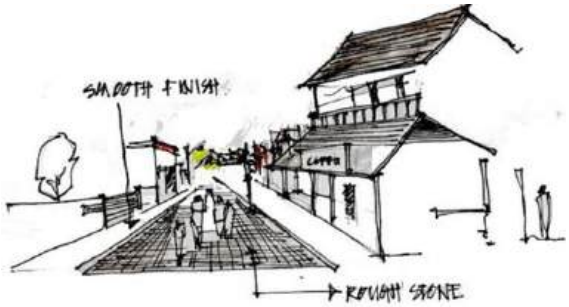


Figure 22-13: Smooth finish pathway for trolley movement

Architectural controls shall be introduced for maintaining the character of the area. To beautify the streets, overhanging cables should be made underground. Covered drainage with utility ducts, for electricity cable and water supply pipe lines can be provided along the side of the roads. Other facilities like Resurfaced Pavements, Sensors, CCTV Camera, Landscaping, Artwork, Dustbins, drinking water supply points, Public Toilet, Benches and other street furniture, etc. shall also be provided to support the pedestrians.

Spaces for street vendors can be provided along the street; where there is adequate space is available for vending activity without objecting the free flow of pedestrians. Segregation of vehicular traffic is to be done for minimizing conflicts between pedestrians and vehicles. There should be restriction of vehicular traffic during peak times (from 9am to 9pm) and festive seasons. Paving of road to facilitate easy movement of pedestrians should be done. Buggy and trolley path for those are in need are to be provided. Solar buggies can be used for aged and people with disabilities. Street lights should be provided for the whole street which illuminates and accentuate the character of the area.

22.2.14 Foot over bridges across National Highway

Major pedestrian vehicle conflict occurs during pedestrian cross movements. It is proposed to develop grade separated pedestrian facility at Kalarcode and Kommady junctions

by considering the anticipated heavy vehicular and pedestrian movement at these junctions after opening proposed flyover together with existing flyover on NH Bypass. These foot over bridges will provide safety for pedestrian cross movements at these junctions and will smooth the vehicular traffic flow.

22.2.15 Foot over bridge across National Wateray

Nehru trophy ward is an isolated area from the town. People residing here depends on small vessels and boats to come to the main land. These are unsafe and there are chances of getting accidents. These isolated flood prone areas are suggested to be connected to the main land through a foot over bridge. Hence a foot over bridge is proposed in Nehru trophy ward, near Nehru Trophy Starting point, across the Punnamada Lake. As it is a part of the National Water Way 3, the proposed foot over bridge shall be provided with adequate vertical clearance as per prevailing norms for movement of vessels.

22.3 Proposal for Mobility hub

The state government has decided to set up a mobility hub taking into account the demand for better traffic management facilities in the district. This is proposed to seamlessly integrate different modes of transportation and improve public transportation facilities; thereby commuters can choose their convenient mode of transport and can also easily change one mode to another. At present, Infrastructure Kerala Limited (INKEL) is working as the special purpose vehicle for executing the project. The project will be financed through the Kerala Infrastructure Investment Fund Board (KIIFB). The project components include development of a bus terminal along with construction of a multi-level car parking facility and commercial space, development of a boat terminal and repairing facilities for the irrigation department and state water transport department (SWTD), construction of SWTD directorate and construction of a bridge across Vadai canal. The hub will provide convergence of various transport systems. The project will materialize with the co-operation of the KSRTC, Water Transport Department, among others. New KSRTC complex is proposed at the existing location of KSRTC stand. Separate access areas will be provided at the proposed KSRTC complex for passengers, vehicles and feeder services. The proposed bus terminal will have a capacity to park about 26 buses at a time. A Multilevel Car Parking area is also proposed which has a capacity to park about 200 cars at a time.

22.4 Integration between Rails and Roads

Integration involves the combining of different modes of travel to maximize ease and efficiency for the user in terms of time, cost, comfort, safety, accessibility and convenience. A successful integrated transport system should result in higher demand for public transport, with a knock-on reduction in congestion and pollution. A successfully integrated transport system involves the coordination and optimization of timetables, to ensure that users do not have undue waiting times between different modes. The central aim should always be the decrease in time of the user's journey from the origin to destination.

In Alappuzha, it requires a minimum travel of 4.5km between railway station and bus stand. KSRTC bus services to the particular route are nil and people have to depend only on private buses to reach their particular destination. And the amount of private vehicle usage in the town is very high, resulting in the congestion of traffic. Providing sufficient amount of transport buses to that route may reduce the congestion of traffic and the usage of private vehicle.

22.4.1 Proposal for Road Over Bridge(ROB) at Mangalam Railway Crossing

During cluster meetings, the representatives from the wards suggested to incorporate proposals for road over bridge across the railway line at major locations to overcome the issues faced during emergencies due to closure of level crossing. One such location identified is Mangalam railway crossing. The SH-66 is a major secondary distributor road in town, which connects the northern coastal regions of the district with the town center. The present at grade level crossing in it results in traffic delay, frequent traffic jams and wastage of fuel whenever the trains pass through the crossing. Hence an over bridge is proposed to ease traffic congestion at the present railway level crossing in SH at the location shown in Figure 22-14, for the free movement of the vehicular traffic without any delay due to crossing of level-crossing gate. It is reported that the railway crossing is closed for road traffic about 28 to 30 times in a day. The proposed ROB will improve the smooth flow of vehicles and reduction in accidents due to haphazard movement of vehicles due to the level crossing.

Representatives from wards also suggested to increase the width of level crossing gate at the junction shown in Figure 22-15, which marks the starting of the road parallel to sea at beach area. This junction can be considered as an entry road to the beach from the north. The level crossing gate is on the east - west running road with a lesser width similar to that of the road. The beach road diverges to south from the west side road of the crossing at right angle

forming a conjested junction immedietly after the crossing. Similarly another junction is present on the east side of the crossing where another road is diverged out at right angle to north direction from the east side road. These bottleneck are to be considered for improvement and it is suggested to increase the level crossing gate width to accommodate the vehicles from all approach roads during crossing, and for smooth turing and movements of vehicles during opening of the level cross.



Figure 22-14: Location of proposed ROB

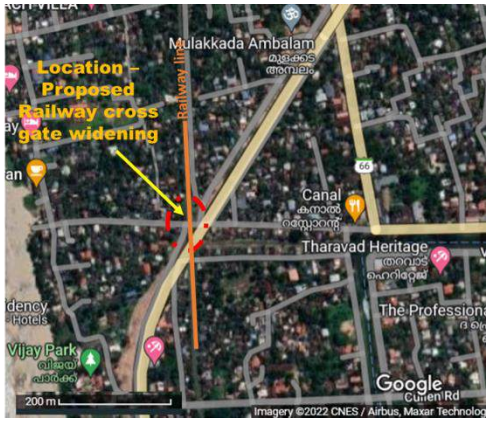


Figure 22-15: Location of proposed railway gate widening

22.5 Suggestions for Improvement of Waterway Transport

The boat jetty is located at Mullakkal near KSRTC bus stand. At present there are 104 round trip services operated daily from the boat jetty. The State Water Transport Department operates boat services to different places from Alappuzha such as Kottayam, Mannar, Kavalam, Kainakary, Kayalpuram, Nedumudy and Krishnapuram. Efficient transport through waterways can be achieved by increasing number of services, replacing old boats with new ones, providing safe operation by preventing overloading of boats and providing enough safety equipment's, and renovating the damaged boat jetties. Congestion on road caused by the goods vehicle can be reduced by providing sufficient number of vessels for carrying goods in the waterway. Though it takes more time than road, it may increase the capacity of the road thus reducing congestion.

Adopting solar powered boats will reduce the fuel consumption and enhance the quality of environment and reduce the pollution. It is suggested to provide Vega boat service to Kottayam from town by linking the existing local tourism destination points in between Kottayam and Alappuzha.

22.5.1 Re-establishing canal navigation

Navigation through the commercial canal, vadai canal and the link canals are proposed to be reintroduced by providing small boat cruise like water taxis. The inter town passenger boat operation can be done to reduce the acute traffic congestion on town roads. Two types boat traffic is proposed in canals. One is slow moving manual or solar boats for tourists and water taxis for town passengers. This can connect with other water transport routes and other modes of traffic. The proposed mobility hub includes boat terminal and bus terminal. This can facilitate shifting of modes. Boat landing centers at definite intervals are provided along the canal to facilitate the canal navigation.

The existing KSRTC stand and private bus stand can be connected through such water taxies. For achieving this, all the bridges which don't have minimum headroom are to be raised to give adequate vertical clearance for water taxis. All new bridge constructions across the canal shall be provided with minimum vertical clearance as per the prevailing norms to facilitate and boost the inland canal navigation and waterway transport.

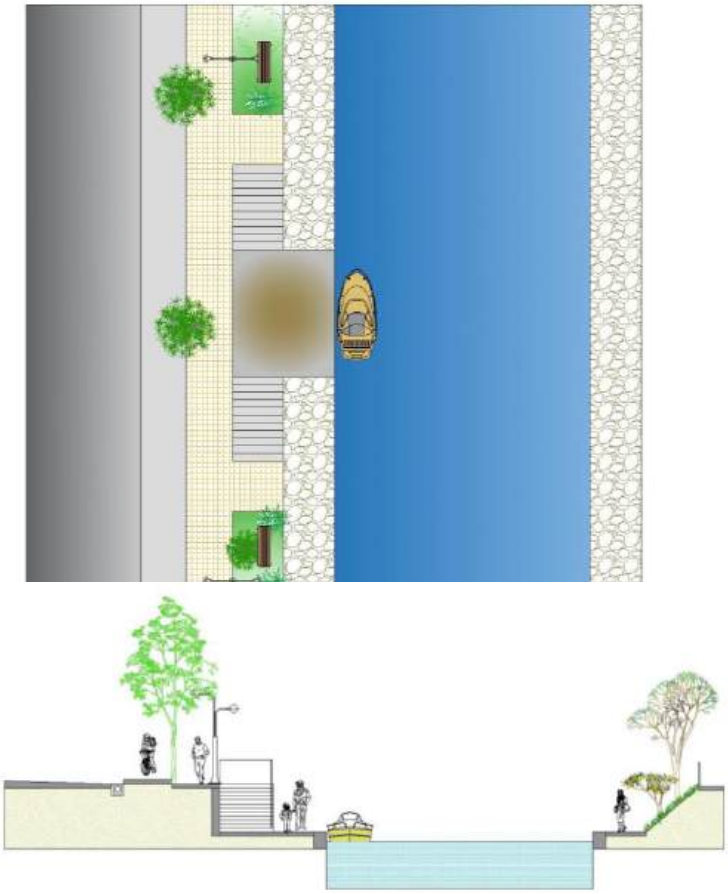


Figure 22-16: Boat Landing Centre

23 DISASTER RISK REDUCTION

The large-scale damages inflicted by natural hazards in the state in the recent past and the Rebuild Kerala Development Programme (RKDP) initiated by the State Government in response to the disasters, it is necessary that our cities are made resilient against the impacts of climate change, natural disasters and disease outbreaks. Risk-informed land use planning is one of the strategies envisaged in the programme for Disaster Risk Reduction.

Local Disaster Management Plans prepared by the Local Governments shall inform Disaster Risk Reduction strategies of a Risk Informed Master Plan.

23.1 Disaster Management in a Changing Climate

Disaster risk management involves measures to improve the understanding of disaster risk, foster disaster risk reduction and transfer, and promote continuous improvement in disaster preparedness, response, and recovery practices, with the explicit purpose of increasing human security, well-being, quality of life, and sustainable development. Disaster Risk Management can be divided to comprise two related but discrete subareas or components: disaster risk reduction and disaster management.

Disaster risk reduction denotes the strategic and instrumental measures employed for anticipating future disaster risk, reducing existing exposure, hazard, or vulnerability, and improving resilience. Disaster management refers to social processes for designing, implementing, and evaluating strategies, policies, and measures that promote and improve disaster preparedness, response, and recovery practices at different organizational and societal levels.

As shown in Figure 23-1 Climate extremes, exposure, and vulnerability are influenced by a wide range of factors, including anthropogenic climate change, natural climate variability, and socioeconomic development. Disaster risk management and adaptation to climate change focus on reducing exposure and vulnerability and increasing resilience to the potential adverse impacts of climate extremes, even though risks cannot fully be eliminated. Adaptation and mitigation are two types of policy response to climate change, which can be complementary, substitutable or independent of each other. Adaptation and mitigation can complement each other and together can significantly reduce the risks of climate change.

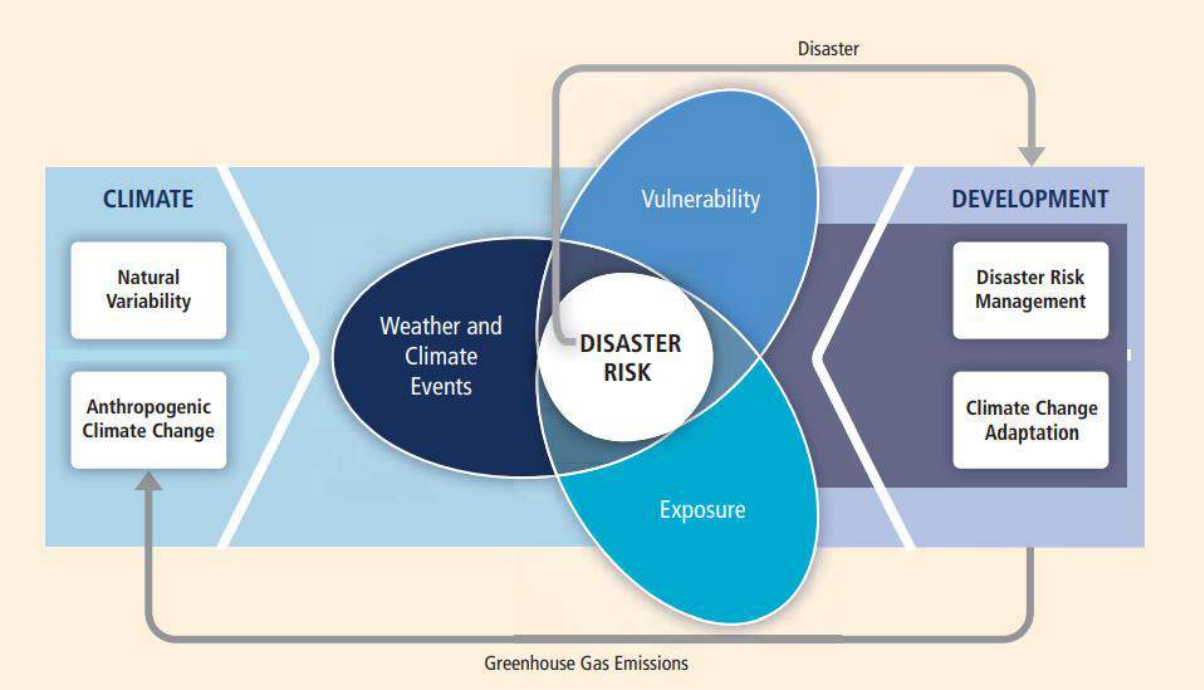


Figure 23-1: Schematical diagram representing the key concepts involved in disaster risk management and climate change adaptation and their interaction with sustainable development

Loss of ecosystem services can make urban settlements more prone to disaster, amplifying the risks of climate change and this calls for an integrated approach towards Climate Resilient Disaster Risk Reduction (CRDRR). Mainstreaming of disaster management along climate actions for adaptation and resilience have to go hand in hand since the players, actors, stakeholders and beneficiaries mostly common in the cases. Figure 23-2 shows a framework integration of CCA and DRR for sustainable development (Strengthening Climate Resilience through Disaster Risk Reduction, 2014).

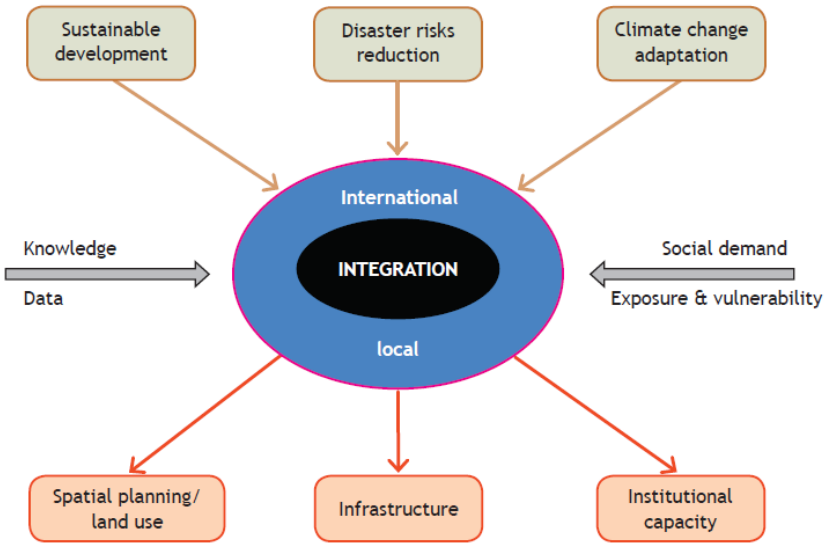


Figure 23-2: Climate Change Adaptation & Disaster Risk Reduction Integration Framework

Holistic management of disaster risk requires action to reduce impacts of extreme events before, during and after they occur, including technical preventive measures and aspects of socio-economic development designed to reduce human vulnerability to hazards. Approaches toward the management of climate change impacts also have to consider the reduction of human vulnerability under changing levels of risk. A key challenge and opportunity therefore lie in building a bridge between current disaster risk management efforts aimed at reducing vulnerabilities to extreme events and efforts to promote climate change adaptation (Strengthening Climate Resilience through Disaster Risk Reduction, 2014).

23.2 Disaster Management Framework

The objective of Kerala State Disaster Management Policy is to establish directive principles for effective disaster risk and crisis management in order to minimize human, property, environment and livelihood losses and to contribute to the sustainability of development and better standards of living for poor and vulnerable sections. It aims to establish an optimum system for dealing with disasters, avoiding disruption of economic activity and ensuring continuity in developmental activities without damaging the environment.

Kerala State Disaster Management Authority is the apex decision-making body and facilitate, co-ordinate, review and monitor all disaster related activities in the state including capacity building. As per the National Disaster Management Act, 2005 the District Disaster Management Authority shall act as the district planning, coordinating and implementing body for disaster management and take all measures for the purposes of disaster management in the district in accordance with the guidelines laid down by the National Authority and the State Authority.

The District Disaster Management Plan for Alappuzha 2015 provides a necessary framework for the district administration to facilitate, coordinate and monitor disaster management tasks by mobilizing the resources and taking the expertise of relevant Governmental departments at central and state level, local self-governments, private sector, non-governmental organizations and community in every phase of disaster management. it is mandatory that all local authorities are to be prepared for disaster management as per directions of the District Authorities.

The traditional perception relating to the management and mitigation of natural disasters has been limited to the idea of “calamity relief,” which is seen essentially as a non-

plan item of expenditure. However, the impact of major disasters cannot be mitigated by the provision of immediate relief alone, which is the primary focus of calamity relief efforts. The need of the hour is to chalk out a multi-pronged strategy for total risk management, comprising prevention, preparedness, response and recovery on the one hand, and initiate development efforts aimed towards risk reduction and mitigation, on the other. Only then can we look forward to "sustainable development".

As explained in Chapter 13, the major hazard affecting Alappuzha town is flood. So, managing flood is given primary importance while formulating disaster risk reduction strategies for Alappuzha town, which has been attempted as a two- step strategy i.e., Prevention & Mitigation and Preparedness. Strategies for mitigating other types of probable hazards in Alappuzha town are also included in a broad level, though they have limited implication in land use.

23.3 Preparedness

Preparedness refers to as "the knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to and recover from the impacts of likely, imminent or current hazard events or conditions." (UNISDR)

During an emergency situation, preparedness consists of mechanisms and systems put in place in advance to enable an effective and timely emergency response to humanitarian crisis based on analysis of the risks in particular context, considering regional capacities. The approach of Risk informed planning aims to reduce the risks of shocks and stress on people's wellbeing, their communities and systems, contributing to resilient development.

23.3.1 Preparedness measures

At a community level

Before a Flood

- Understanding the flood risk, areas that frequently flood.
- Building or restocking the emergency preparedness kits.
- Gather information and prepare a list of special categories in the locality including pregnant ladies, differently abled, geriatric, patients and children, older people etc. and make them realize about the various difficulties they have to face at the time of a disaster.

- Familiarize everyone with the local level DM plans. Make them aware about the escape routes and how to get to the higher grounds, the highest level of a building, or to evacuate.

During a Flood

- Monitor the weather updates, emergency instructions or evacuation orders, if necessary.
- In case of water rising, keep in coordinated with municipal level disaster management team taking precautions and moving to higher grounds.
- Ensure each and every one affected by the disaster gets medical attention
- Ensuring sign boards to indicate water inundated areas, control vehicular movement and keeping sign boards to avoid downed power lines.

After a Flood

- Instruct people to return back home only when authorities say it is safe.
- Clean and disinfect anything that has come in contact with flood water.
- Photograph damage in the areas and property for relied and insurance purposes.

At a Household level

Before a Flood

- Make them aware about the geographical, social, economic and weather-related conditions of your locality which can increase the risk of a disaster.
- Make them aware on how each family member should act during different types of disasters to save their own life and that of the family members.
- Teach them how to make an emergency kit with things mentioned in the Figure 23-3.



Figure 23-3: Contents in an emergency kit. Source: KSDMA

During a Flood

- Give constant alerts through radio, TV or the internet for weather updates, emergency instructions, or evacuation orders.
- Give instructions to evacuate if needed.
- Give them instructions about the flooded areas and areas via which the vehicles can be drove to reach shelter hubs.

After a Flood

- Make sure the property of the people is safe and give instructions to return home when it is safe.
- Clean and disinfect anything that has come in contact with flood water.
- Give instructions to photograph damage to their property for relief and insurance purposes.

23.3.2 Disaster Response

The response phase in a disaster focus on immediate and short term needs after a disaster. In the National level, National Disaster Response Force (NDRF) is the specialized force for disaster response which works under the overall supervision and control of the NDMA. At the State Level the State Disaster Management Authority (SDMA), headed by the Chief Minister, lays down policies and plans for disaster management in the State. In the district level the District Disaster Management Authority (DDMA) is the planning, coordinating and implementing body for disaster management. It will, inter alia prepare the District Disaster Management Plan and monitor the implementation of the National and State Policies and the National, State and the District Plans. DDMA will also ensure that the guidelines for prevention, mitigation, preparedness and response measures laid down by the NDMA and the SDMA are followed by all departments of the State Government at the district level and the local authorities in the district.

In the context of the catastrophic effects of the 2018 floods, Disaster management plans were formed by LSGs across the state as part of the Nammal Namukai Project during the year 2019-20 (http://dmp.kila.ac.in). As the response phase is critical in every disaster situation, tackling the situation immediately and effectively is an important requisite. It is important to cater and develop the indigenous knowledge and competency of the local people through adequate and appropriate training.

For prior identification of hazard, preventing and responding to each type of disaster each specified authority may need to prepare sub- action plans. There is a "Level" (L) concept that has been developed to define different levels of disasters in order to facilitate the responses and assistances to the area. (NDMP,2019).

Level 0 – L0

- Normal or ground Zero situation, which will be utilized for close monitoring, documentation, prevention and preparatory activities.
- Training on search and rescue, rehearsals, evaluation and inventory updation for response activities will be carried out during this time.

Level 1 – L1

- Specifies inundations that can be managed at the site level; however, the State and Centre will remain in readiness to provide assistance aid if needed.

Level 2 – L2

- Situations those require assistance and active participation of the State, mobilization of its Resources for management of floods

Level 3 – L3

- Flooding situation of large scale where the Local area, District, and State authorities have been overwhelmed and require assistance from the Central Government for reinstating the State and District machinery as well as for rescue, relief, other response and recovery measures.
- In most cases, the scale and intensity of this level of disaster is determined by the concerned technical agency like CWC, IMD are sufficient for the declaration of L3 disaster.

Table 23-1: Institutional Responsibility for Preparation and Implementation based on Prevention mechanisms, Response mechanisms and Recovery mechanisms for Flood hazard

Level of Flood hazard	Example of inundation/flood Situation	Responsible Authorities for Sub Action Plans
L0 Level	Normal time and water related accidents	User Agency (KSDMA, DDMA) with support of State Fire and rescue services department, Health Department, Police, District administration, Pollution Control Board, NGOs/CBOs

L1 Level	Inundation, Waterlogging, Epidemics-water related, boat capsizing etc.	Site level: User Agency (TDB –IMD, KSDMA, DDMA), NGOs / CBOs, Health Department Local Panchayat/ ERT members, Police, Pollution Control Board, NGOs/CBOs with support of State Fire and rescue services department, Health Department. State Level: District Administration, Nearby Districts Administration, Health Department.
L2 Level	Epidemics, Inundation, Flooding	User agency and state – CWC, IMD, KSDMA, DDMA State Level: District Administration, Nearby Districts Administration, Health Department, Police Department, Fire and Rescue of nearby areas, NGOs/CBOs,ULB, 13th Working group/ steering committee/ ERT members
L3 Level	Flooding	User Agency with support of State and Central Specialized Departments (IMD, research organizations, CWC, KSDMA), Central Support and Adjoining States – NDRF/Military forces etc.

An SOP is laid down by the KSDMA in the form of orange book every year before the Monsoons. The Standard Operating Procedures (SOP) covers the roles and responsibilities of the respective nodal agencies and concerned departments on how they should function during three phases of disaster management for effective and efficient response to flooding event especially during the monsoon season. The following contents are covered in these SOPs.

- Pre-Monsoon Phase:
    - Preparedness: Planning for Disaster Reduction – Mitigation activities
- During Monsoon Phase:
    - Early Warning – Constant monitoring and make sure the systems are in working condition.
    - Effective Response and Management – Passing on the relevant and accurate information to the concerned officials in various levels
    - Relief planning and execution – Making sure proper measures are taken for shelter management, evacuation and relief activities
- Post-Monsoon Phase:
    - Restoration and Re-habilitation

*The roles and responsibilities of concerned departments and officials are mentioned and detailed out in the Orange book release by the KSDMA every year - https://sdma.kerala.gov.in/guidelines/

23.3.3 Emergency Response Teams and Working group on DM at Local Self Government Level

The Local self-government department vide GO (MS) (As per GO – 2462/2018/LSGD and No. 156/2019/LSGD, laid down the roles and responsibilities of the working group on Biodiversity, environmental conservation, climate change, and disaster management along with the process involved in the formulation, formation of disaster management plans at the local level. It also highlighted the formation and responsibilities of ERTs (Emergency Response Team), responsibilities of the Local Resource Group (LRGs). As per the GO, every ward in an LSG need to have 8 members in each of the 4 ERT adding up to minimum of 32 members in a ward.

Emergency Response Teams:

- Search, rescue and evacuation
- Early warning dissemination
- First aid/ basic life skills
- Shelter camp management

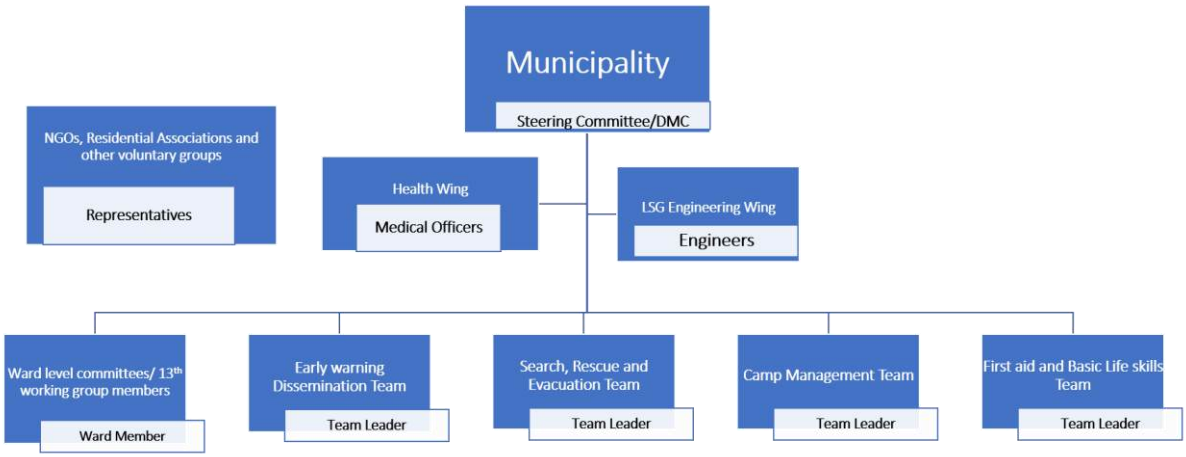


Figure 23-4: Structure of DM functions at Municipality level

Pre Monsoon preparedness is crucial and equipping ERT members to prepare and respond to adverse situations.

23.3.4 Relief Camps

Relief shelters and rehabilitation camps shall be setup in order to accommodate people affected by a disaster. The camp shall be temporary in nature, with basic necessities. People in

the camp shall be encouraged to return to their respective accommodation once the normalcy is returned as per NDMA guidelines.

Relief camps should be located outside areas known to be flood-prone/ risk areas, including areas within the 50-year floodplain. Shelters in flood-prone areas will be susceptible to damage from hydrostatic and hydrodynamic forces associated with rising flood waters. Damage may also be caused by debris floating in the water. Most importantly, flooding of occupied shelters may well result in injuries or deaths. Furthermore, shelters located in flood-prone areas, but properly elevated above the 50-year flood elevation, could become isolated if access routes were flooded. As a result, shelter occupants could be injured and no emergency services would be available. The State Govt/District and local self-government administration sometimes may not be able to implement all the basic guidelines recommended by NDMA from the day one of the disaster and therefore, the following method shall be followed.

- First 3 days – basic norms to possible extend may be followed.
- 4 to 10 days – Efforts should be made to follow most of the norms recommended by NDMA in the guideline. (Minimum standards of relief, 2016).
- 11 days and above – NDMA's prescribed norms shall be followed.

The factors like terrain, climatic conditions at the site of disaster etc. will also impact the requirement and ability of the administration and other stakeholders to deliver relief. These constraints should also be kept in view while prescribing minimum standards of relief in the prescribed shelters.

Present status of shelter/relief camps in Alappuzha

In Alappuzha, during the 2018 and 2019 floods, there were a number of shelter camps identified, mostly schools, colleges and auditoriums. The following Table 23-2 shows the year, number of camps, camp type and number of inmates in each of these camps.

Table 23-2: Camps in Alappuzha Municipality during 2018, 2019, and 2020

Year	Number of camps	Camp Type	Number of inmates
2018	43	Schools(25), Auditoriums(18)	17483 (Male -6450, Female – 7495, Children – 3538)
2019	6	School(6)	5978 (Male – 2342, Female-2521 ,1115 children)
2020	2	School (1), College (1)	290 (Male – 106, Female - 130 ,54 children)

Except one site, all other camps are situated in safe locations. But during 2018 and 2019 floods, the makeshift shelters were more in the schools which lead to late reopening of the schools and colleges. This stresses the need to replace the schools/colleges to separate camps/shelters. In Alappuzha, there is an influx of people from the Eastern side (Kuttanad Taluk). Due to this reason, it is difficult to identify the catchment area and number of expected people to be accommodated in each of the camps. Hence it is required that more camps are to be placed near the areas of high risk.

Potential Shelter/Relief camps

Based on the Flood hazard risk profile and the number of people exposed/at-risk, shelter camps can be assigned as one shelter for 80 people (FEMA standards). Based on this, the potential shelter camps are identified for every 3 risk wards. People exposed to floods outside the town but may have to be sheltered within Alappuzha town are not considered in this. Figure 23-5 shows the proposed potential shelter camps and the evacuation routes to these camps. These are community shelters that could accommodate a large number of people – mostly auditoriums, community halls etc. The parking slots in these areas could be utilized for livestock occupancy and the auditoriums could be made more accommodative by expanding them and providing sufficient water and sanitation facilities.



Figure 23-5: Map showing the potential relief camps, proposed location for multipurpose shelter camp

Table 23-3: Potential Relief Camps

Sl. No	Ward Number	Potential Shelter Camp Name	Camp Type
1	1	Thumpoly Church Auditorium	Auditorium
2	5	Rajadhani Auditorium	Auditorium
3	21	Prince Auditorium	Auditorium
4	49	Royal Auditorium	Auditorium
5	23	St Michaels School, Thathampally	School
6	15	SNDP Sangam, Thathampally	Auditorium
7	23	SDV School Complex	School
8	14	Aiswarya Auditorium	Auditorium
9	45	Mount Carmel Cathedral Parish Hall	Auditorium
10	25	Govt. Girls Higher Secondary School	School
11	26	Nandavanam Auditorium	Auditorium
12	37	TMA Auditorium	Auditorium
13	41	SNDP Auditorium, Kuthirapanthy	Auditorium
14	29	Parish hall – Matha Nikethan	Auditorium

Schools listed are sites that are used frequently as relief camps over last 3 years. Since these camps are majorly educational facilities, this affects the reopening of these facilities and hence must be considered as an option only if other options are not viable. This could be retained as relief camps only in case of a shortage of space and resource facilities in the other potential relief camps.

Multi-Purpose Rescue Shelters

A standalone shelter may serve as a shelter only, or it may be designed as multipurpose hubs.



Figure 23-6: Proposed area for multipurpose shelter – Ward 43

These are few designs for flood locations, from other places, in which buildings are on stilts or plinth level raised with open ground floor. These open areas can be used as space for the livestock or vehicular parking facility during non-flooding times. Safe Parking Zone, Livestock Shelter and mass gathering venues





Figure 23-7: Images of buildings with raised plinth level (Source: Chennai development authority, NCRMP, Bangladesh flood mitigation handbook)

23.3.5 Safe Parking Zone, Livestock Shelter and mass gathering venues

Safe parking zones:

Safe zone parking is a necessity in case of continued flooding/inundation. In the identified safe zone parking locations as indicated below, the area could have permeable pavements. This enables rain and flood water to pass through the surface of the paving into the soil below. Geotextiles could be incorporated into the structures allowing rainwater to soak away from the surface where it falls. The Figure 23-8 shows the areas identified for safe parking.



Figure 23-8: Map showing the Livestock shelter, Safe parking zones and mass gathering venues

Livestock Shelter:

During the flood warning situation, the animals need to be transported to a safe location. The following needs to be taken care of in these centers:

- Separate emergency plan that include the contact details of resource persons one might need during and after the emergency

including employees to take care of these animals, veterinarians, livestock transport facilities, medicines, and feedstock.

- The team at these shelter camps need to ensure animal identification and maintain a register of animals
- Restrict access to dangerous areas nearby,
- Supply of food and water,
- Removal of potential contaminants
- Hygiene and proper waste disposal system.

The Figure 23-8 shows the potential locations for temporary livestock hubs are identified.

Mass gathering venues:

During flooding and when there is emergency, these locations can be utilized as mass disbursal centers like for relief kit distribution etc. These locations must be accessible to all the floodable areas, helipads and other storage/go down facilities. Figure 23-8 shows the areas identified as areas that could be utilized as mass gathering venues during emergencies.

Evacuation routes and measures

In Alappuzha, there is an influx of displaced population from the Eastern side (Kuttanad Taluk and other gram panchayats in this area). Hence it is required that the roads connecting these areas and the paths leading to the relief camps must be flood resilient and flood proof especially during the monsoon season. The following Figure 23-9 shows the all-weather roads that are identified and must be made flood resilient.



Figure 23-9: Proposed all weather roads

23.4 Prevention & Mitigation

Mitigation is defined as "sustained action that reduces or eliminates long-term risk to people and property from natural hazards and their effects." It describes the ongoing effort at the national, state, local and individual levels to lessen the impact of disasters upon our families, homes, communities and economy.

In practice, mitigation can take many forms. It can involve actions such as:

- Promoting sound land use planning based on known hazards
- Buying flood insurance to protect your belongings
- Relocating or elevating structures out of the floodplains
- Developing, adopting, and enforcing effective building codes and standards
- Engineering roads and bridges to withstand hazard

Preventive damage control is done through a strict licensing policy for building in flood-prone areas. Floodplain, wetland and coastal barrier restrictions and land use regulations, such as zoning, can be used to steer development away from sensitive or natural areas. Engineering standards will need to be revised to account for the hazard risks and future climatic conditions. The development of engineering standards can follow a risk management approach and balance the potential consequences of failure with the cost of risk reduction measures. Elevating or flood proofing new buildings and retrofitting existing ones, developing and enforcing construction standards and building codes at the local level are some of the measures.

Develop awareness materials on safe construction practices for different zones and make them available at the Municipality. An eco-sensitive and risk-informed approach needs to ensure that buildings are reconstructed using disaster resilient techniques, at the right location, away from flood plains and slopes. According to the Kerala State Disaster Management Policy, physical reconstruction must consider the hazards of the particular location, resources and capacities people involved in the rebuilding, and the adoption of designs that offer resilience against floods, cyclones, earthquakes, and droughts.

Based on the analysis of flooding pattern three types of causative factors influence flooding in Alappuzha town. Eastern wards are characterized by riverine flooding, along the Western coast flooding occurs due to tidal variations and in some other wards situated in between, urban flooding due to drainage deficiency is seen.

23.4.1 Room for River

Approaches such as 'room for the river' and 'making space for water' may be adopted to enhance flood protection instead of creating dams for water storage and embankments. Removal of sand deposited in rivers and river banks should be undertaken only after site-specific studies have been conducted and expert suggestions taken on board.

Adopting 'Room for the River' principles to lower floodwater levels in rivers by increasing the wet areas of the rivers, i.e., giving them more room or space. Strengthening or increasing crest heights of embankments and bunds, outward shifting of embankments/bunds or digging embankments to increase channel wet areas, lowering of the floodplains or flat areas next to the river, dredging out the river and canal beds, restoring and preserving the natural rivers and Channels, diverting high flows around developed areas, creating retention areas by linking lakes, irrigation canals, and kayals to temporarily store water, storing excess runoff with on-site detention measures etc. different measures that can be adopted for the providing 'Room for River'.

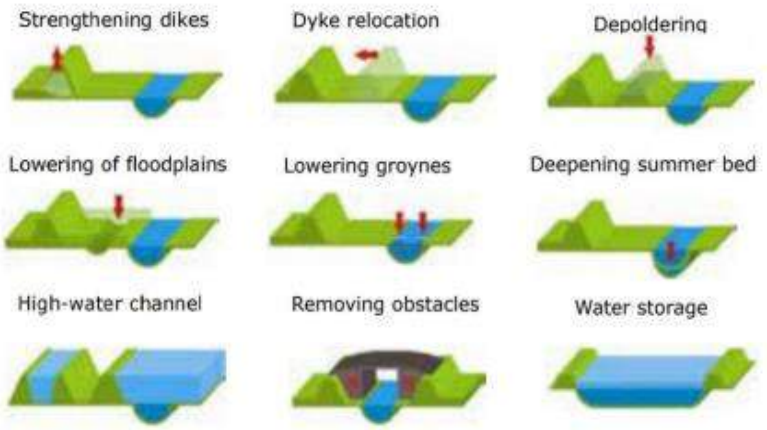


Figure 23-10: Room for River principles

Channel Improvement

Channel improvement as a flood control measure can be used to reduce the River / Stream peak flow at a specific point in the reach. A river/ stream can be made to carry higher discharges at lower levels by improving its hydraulic conditions. Various methods of channel improvement, such as (i) increase in size of cross section of the channel, (ii) increasing velocity of flow in the channel and (iii) increasing waterways at crossing, can be used.

- Increase in size of cross section of the channel

By widening and excavation of stream bed, removing existing encroachments to the channel and removal of bottlenecks are some of the methods that is necessary for improving water flow through channels in Alappuzha town. Improving the channel health helps to store more flood water during peak flow.

- Increasing velocity of flow in the channel

The velocity of flow in channel can be increased by deepening the stream, reducing the width or by shortening the channel lengths at bends by artificial cutoffs, removing barriers in the channel section, removing roughness offered by sand bed, weed growth etc. and lining the channel to improve its smoothness. A detailed technical study is proposed for developing channel network system for Alappuzha town.

Figure 23-11 shows locations of some of the problem areas identified in the drainage network in the town during field survey. Detailed survey should be conducted to identify locations of similar problems in the entire municipal area to address the specific issues. These problems can be addressed at individual project level and the Municipality has to develop an action plan for identifying and resolving such issue areas.

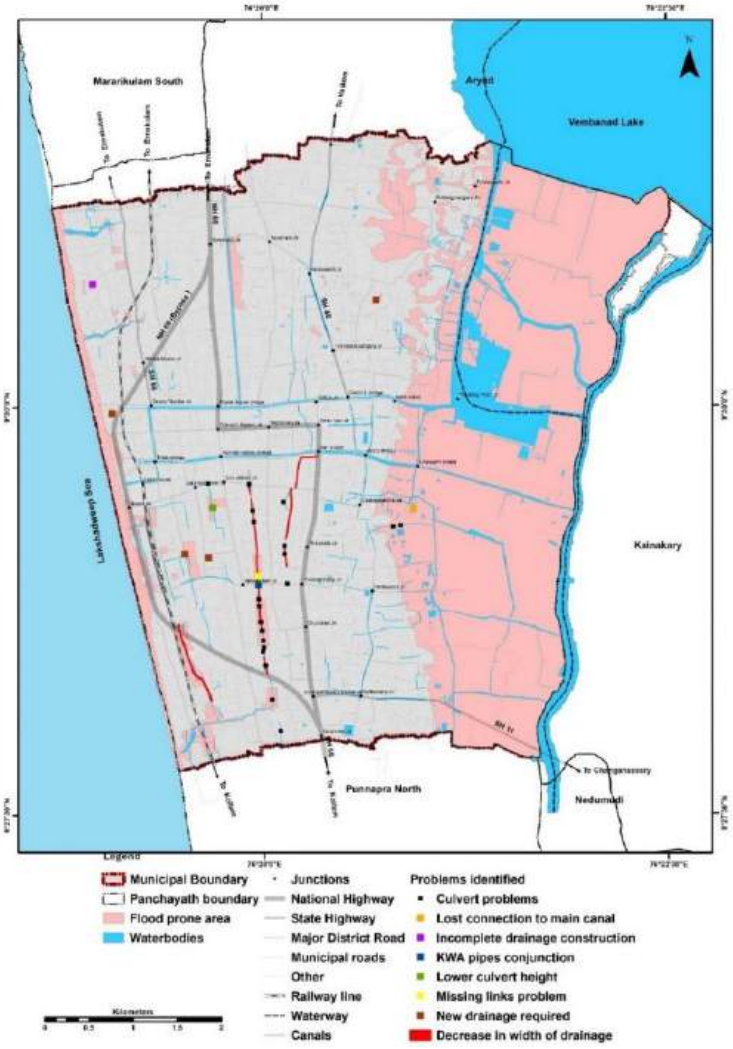


Figure 23-11: Problems identified during field visit

- Increasing waterways at crossing

Generally, there are a number of crossings at river, such as bridges, culverts and aqueducts. The inadequacy in the waterways of bridges, culverts, canal cross-drainage works etc. may result in aggravating the flood situation. To avoid this problem, adequate waterways should be provided at crossing after proper evaluation of the ultimate drainage requirement of the basin at the time of any proposed crossing across the drainage line. It is seen that some of the culverts and other water crossing structures in the town are posing serious concern to the water flow and can be reasons for worsening of flood. This factor shall also be addressed in the action plan for channel improvement.

Restoration of Streams & Channels

Stream restoration or river restoration, also sometimes referred to as river reclamation, is a work conducted to improve the environmental health of a river or stream, in support of biodiversity, recreation, flood management and/or landscape development.

A stream is in equilibrium when slope and channel characteristics adjust themselves to create a velocity that will transport the water, sediment, and debris supplied by a watershed. A stable stream will neither aggrade nor degrade its channel, but will transport the flows and sediment coming from its watershed while maintaining channel dimension, pattern, and profile. When channel shaping variables change, whether by natural or human intervention, the stream will adjust its shape—meandering, adjusting its sinuosity or slope, or shifting its channel—to re-establish equilibrium. Channel shaping variables include water velocity, roughness of the bed, slope, width, depth, discharge, size of sediment and debris, and the amount of sediment.

The goal of stream restoration is to recreate a stable channel based on the hydrology and hydraulics that shape natural channels. This is commonly thought of as returning a stream to its natural, pre-disturbance condition. Frequently, however, the channel shaping variables have been modified by the land use changes that initiated the disequilibrium in the first place. It is therefore impossible to achieve a pristine condition. Instead, natural stream designs restore stability and habitat based on the morphological potential of a stream and the present-day realities of the communities and infrastructure surrounding it.

Left on their own and unimpeded by human intervention, most streams will restore their pattern, dimension, and profile in time. But that time might be 10, 50, or 100 years or more. In many natural or wilderness areas, such a time frame and the movement and changes of the river over land is acceptable. In areas where human use or management shape the landscape and limit the river's path, communities with resources at stake do not have time for the river to repair itself or the tolerance for its encroachment on their homes, roads, and businesses.

That's where our natural restoration approaches come into play. Designing to maximize a stream's potential, then implementing projects to achieve it, provides numerous benefits to the watershed and our local economy:

- Strategy involves not just uplifting the water quality, but also improving the physical dimensions of the river.
- Restoration of missing links of natural streams & drains

- De-weeding stream& De-silting of the stream
- Recreational urban space in embankments
- Removal of clay and deepening of water bodies will improve the water holding capacity and infiltration.

There were many natural streams or drains existed in Alappuzha town, which helped to drain out the water to nearby river or other waterbodies. But on examining the existing land use, it is seen that most of these natural drains are missing now or reduced its width due to encroachments. The existing drainage channels have to be restored and revived for the proper draining out of flood water/ rain water from each watershed. A detailed study of the streams identified as shown in Figure 23-12 shall be carried out and interventions may be made to restore them.

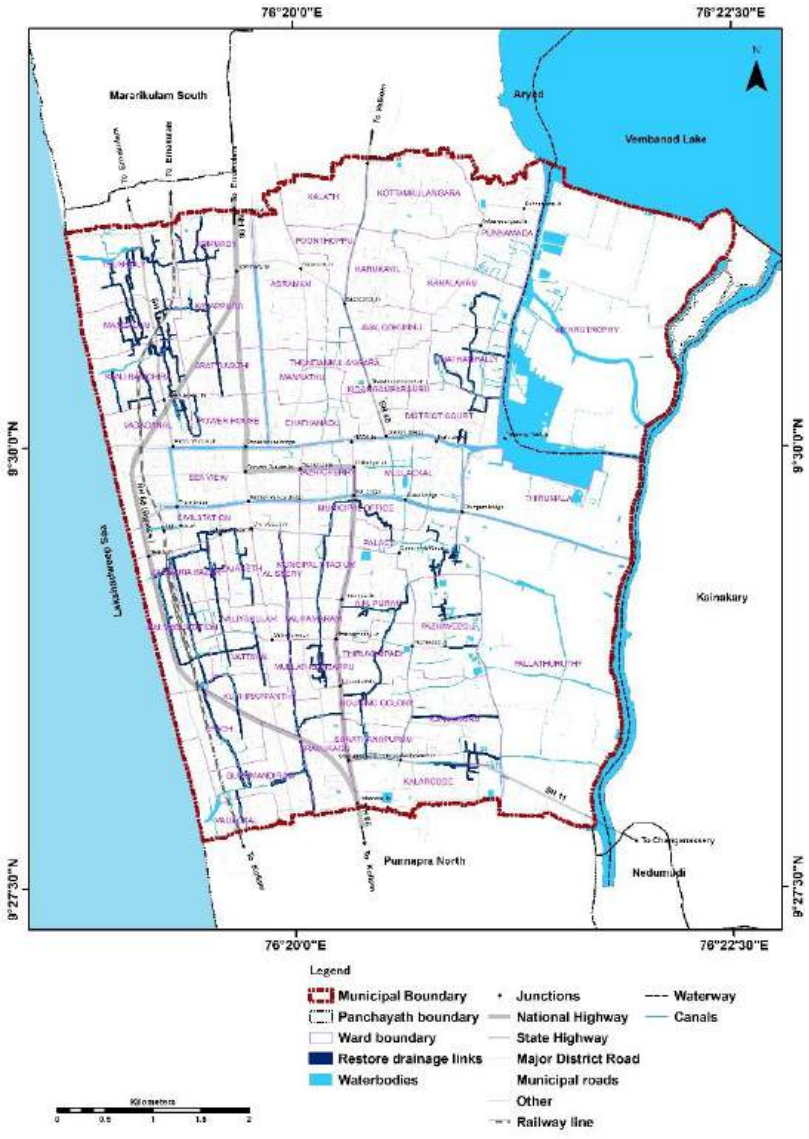


Figure 23-12: Streams identified for restoration

Interventions to Vembanad Lake

- Increase the capacity of Vembanad Lake to accommodate more quantity of water which would reduce the severity of future floods. For this dredging and clearance of accumulated waste from the lake is to be initiated first followed by suitable stability treatments along the banks of the lake.
- The boundaries of the Lake and the canal networks should be demarcated using detailed satellite imagery and protected from encroachment and reclamation. All illegal encroachments should be vacated and a 4 to 6 m wide strip of "ecotone", planted with mangroves or coconut trees, should be put in place between the main land and the Lake.

Interventions to Thottappally Spillway &Thanneermukkam Bund

- Increasing the width and depth of the leading channel of Thottappally Spillway
- Modernization of the Spillway shutters
- Deepening and side bund protection of the leading channel
- Improved management of spillway operation

23.4.2 Sponge City Approach

The general objectives of the concept entail "restoring" the city's capacity to absorb, infiltrate, store, purify, drain, and manage rainwater and "regulating" the water cycle as much as possible to mimic the natural hydrological cycle. Hence, a "Sponge City" is a city that has the capacity to mainstream urban flood risk management into its urban planning policies and designs. It should have the appropriate planning and legal frameworks and tools in place to implement, maintain, and adapt the infrastructure systems to collect, store, and purify (excess) rainwater. In addition, a "sponge city" will not only be able to deal with "too much water", but also reuse rain water to help to mitigate the impacts of "droughts".

The anticipated benefits of a Sponge City are: (i) a reduction of the economic losses (due to flooding), (ii) an enhancement of the livability of cities, and (iii) the establishment of an environment where investment opportunities in infrastructure upgrading and engineering products and new technologies are created and fostered. This can be achieved through different project level interventions:

- Green buildings
- Wetland park

- Sponge roads – with permeable asphalt & Concrete
- Urban parks with sunken gardens
- Artificial wetlands
- Green roofs

Sponge infrastructure helps to reduce flooding by, for example, serving as a storage reservoir for what would otherwise become runoff, instead allowing water to infiltrate slowly. It can also increase the water supply through retention of precipitation via green roofs and rain gardens, improve water quality by acting as a natural filter for sediment and impurities, and help to improve air quality – both directly by removing pollutants and indirectly by reducing the energy requirements for water treatment, thus reducing emissions. Green infrastructure can also contribute significantly to human well-being by providing healthy, green public spaces within dense cities, the positive social and environmental outcomes of which are well-documented. Urban green spaces can help to mitigate the effects of climate change by operating as carbon sinks – natural systems that absorb and store carbon compounds – and can help citizens to adapt by offering a cool local microclimate. Besides runoff control and water environment improvement, sponge city construction can alleviate the urban heat island effect and promote building energy consumption reduction.

Alappuzha's unique geographical context, soil profile, ground elevation, and water table propose unique challenges to developing sponge strategies for water retention. However, the city already possesses natural sponge areas that have been subject to intense development pressure over the past few decades. While investment is definitely required on a storm water/drainage system, there are opportunities to implement Tactical Sponge Strategies (TSS) at plot-, facility- and Municipality scale. Such strategies can help reduce the immediate cost of DRR infrastructure, while reducing hazard risks, and serving as proof-of-concept projects for the entire city.

Sponge strategies emphasize the 'full utilization of the natural absorption and infiltration capacity of pervious areas to effectively control storm water runoff, thereby minimizing water system problems caused by the damage of urbanization-induced hydrological effects. Such strategies aim to retain, detain, purify, infiltrate/utilize and slowly discharge storm water/silage water; this is unlike the traditional understanding of storm water/sullage water management which aims to transport water outside of urban settlements

as fast as possible. This change in understanding has been spurred by numerous developments, including rising drought, saline infiltration and urban flooding.

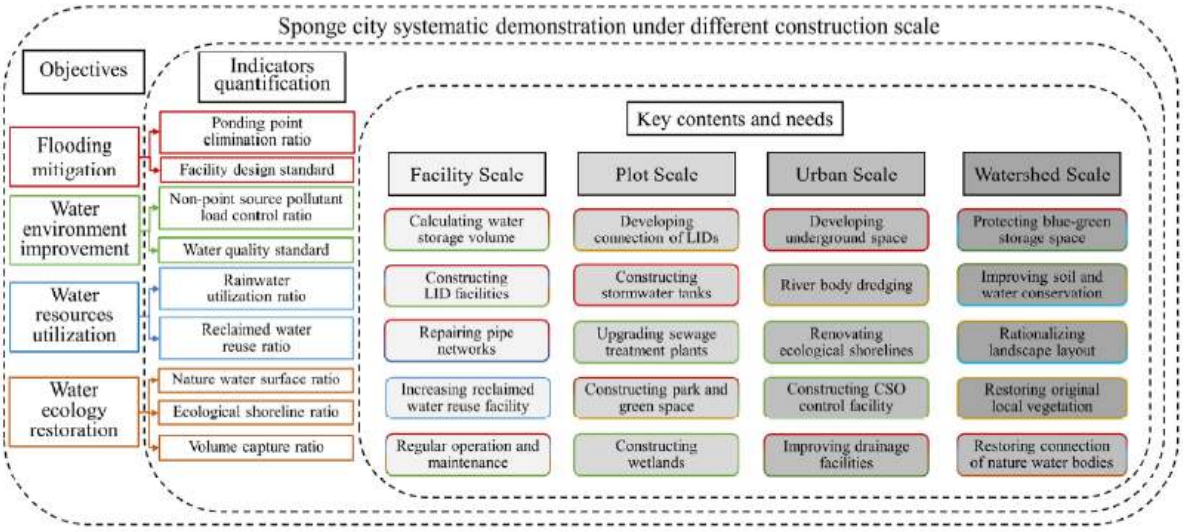


Figure 23-13: Objectives, indicators, key contents and needs for systematic demonstration of spongecity

23.4.2.1 Sponge Strategies in Alappuzha

The primary strategy to follow for Alappuzha is to develop a Green Infrastructure (GI) network using its natural system of canals, wetlands and paddy. The system would involve a three-pronged approach:

1. First, to map the natural drainage system in the area: Several water bodies with in the Municipality have been encroached upon, or filled, decreasing rainwater percolation. This has led to a problem of urban flood in the interiors of the Municipality area. Urban flooding primarily results from blocking water-flow, decreasing canal depth due to silt and pollutants, and decreasing the width of the water-way due to encroachments and illegitimate construction.
    a) Restoring the flow of the water, and reviving missing drainage links, is the primary demand in such situations.
    b) Preventing further encroachment upon the floodway by built form
    c) Preventing dumping of plastic waste, ensuring purification of water from industries, and installing filter traps at crucial bottlenecks can help retain the depth of the waterway.
    d) Widening canals at certain points, and equipping the canal banks with natural filtration media can help restore the quality of water, while slowing down the canal.
    e) Creating a mechanism for septage waste disposal from residences and houseboats is imperative.

f) Plot-level strategies such as mini earthen bunds; bioswales along roads and compound walls; using pervious materials to construct private access roads, etc. can improve water retention, and prevent areas near canals from getting inundated during storms. These may be implemented by private plot owners, and incentivized by the Municipality.

g) Strengthen connections between natural water bodies where possible, and protect the blue-green storage space in the watershed to maximize water storage and drainage capacity.

2. Second, to include Institutional/Corporate Social Responsibility mechanisms

   a. Facility-level interventions include the creation of community/institutional greens, Miyawaki forests, natural water recycling facilities, raingardens, etc. and involving employees/students to carry out such activities.

   b. Institutional buildings can develop underground space to store excess storm water when a storm event occurs, and then slowly discharge or reuse it after the event.

   c. Large institutional buildings can aid in-situ runoff dissipation and control; measures include bio retention facilities, permeable pavement, green roofs, and sunken green spaces.

   d. In the absence of large institutional plots, such organizations may alternatively achieve their CSR targets by supporting wetland habitat conservation in city wetlands, acquiring and conserving land along lagoons and paddy fields where watersheds remain undeveloped, etc.

   e. The town must encourage funding for large-scale marsh & dune restoration

   f. Facilitating multi-partner initiatives to increase native plants and trees in riparian, developed, preserved, agricultural and coastal lands can solve the fund requirement for such large-scale projects.

3. Third, nourish existing wetlands to regain their water carrying capacity through a city-level vision. Riparian and habitat restoration is most effective at a large scale, which maximizes the ability of these systems to reduce flood risk and enhance habitat value for people, fauna and flora; Alappuzha's Municipal body is best placed for such interventions.

   a. Preserve and reclaim the floodplain and flood ways for integrated flood control, recreation, natural habitat, and open space. The city must invest in habitat restoration demonstration projects, and a similar project has been identified herewith.

b. Regular dredging and ecological shoreline rehabilitation of urban rivers and lakes can be implemented for better water ecological restoration. It is necessary that such activities adhere to timelines, that funds be made available for such activities on priority, and that the activity itself be service level benchmarked.
c. Align transportation system to waterway functions to manage runoff.
d. Create smaller greens through tactical urbanism strategies; these can include retrofitting parking lots and other paved areas with plantings, incorporating pervious paving to lower impact of runoff on drainage systems, creating bioswales/earth berms along road dividers, or mandating rain gardens within government sites.

23.4.2.2 Urban Scale

At the urban scale, it is necessary to build an ecological, safe, and sustainable urban water circulation system to improve the overall level of water resources security, disaster prevention and mitigation capabilities. In the new and renewal projects of urban greenspace, buildings, roads, squares, etc., not only should various storm water infiltration and storage facilities be constructed according to local conditions, but urban permeable pavement also need to be promoted to expand the urban permeable area.

Two locations are identified at the town level for developing as urban sponges, which are detailed out at conceptual level.

Urban Park Proposal

An urban park has been proposed on the Eastern fringe of ward, at the ending point of the Nehru Trophy boat race. A conceptual proposal was prepared for the site considering its prominent nature, and its proximity to the tourism circuit. Since the site is ecologically sensitive, and accessible mainly via water, the decision was taken to provide a ferry point at the highest level of the site (4 m above MSL). The site slopes towards the Northwest into the water; at the lowest point, an artificial wetland has been proposed.

Considering the context of the site, it was decided to provide temporary exhibition areas and food stalls at the higher contours; additionally, viewing areas were created along the Northern and Western fringes of the site. From here, people could watch the boat races or enjoy the busy harbour. The viewing areas also buffer the site from flash floods; they act as a polder-and-dyke system to restrict water entry into the site, except along the artificial wetland.



Figure 23-14: Urban Park Proposed in Thirumala ward

Architectural Interventions:

- Designing a flood adaptive landscape that can be used as a recreational space for the local community
- Creating an iconic viewing spot where the community can watch the Boat Races
- Creating cultural spaces that can be used to engage tourism and youth of Alappuzha
- Designing flood resilient structures that can be used by the people in case of a flood emergency

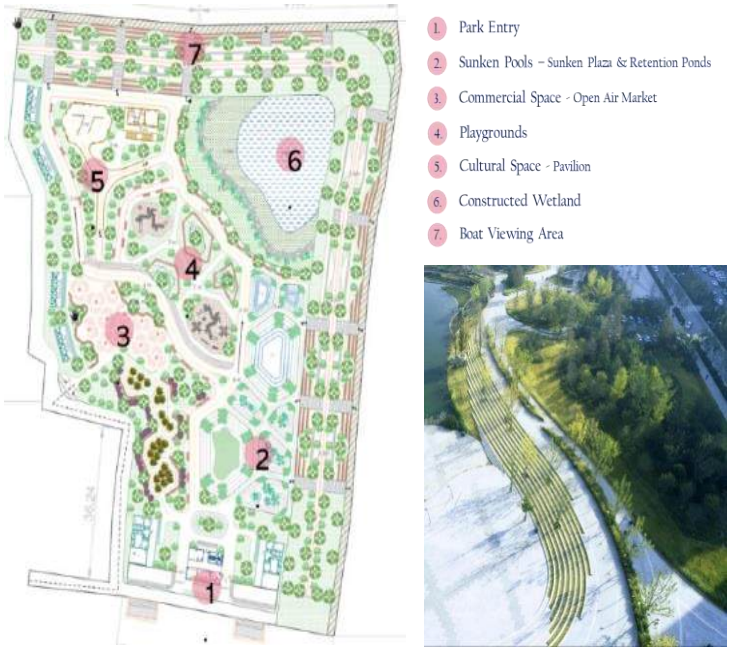


Figure 23-15: Conceptual view of the proposal for urban park

Riverside Recreational Space



- Terraced embankment, with flood adaptive landscape and viewing area.
- Riprap embankment, floating viewing decks.

Flood Resilient Cultural Pavilion

Designing a Pavilion with temporary exhibition spaces and can be used by people as a shelter during flood or rain.



- Flood resilient construction – Stilt structure
- Eco sensitive, lightweight materials that can with stand floods

Open-Air Market & Food Stalls

- Designing semi-permanent food stalls and open-air market stalls.







Constructed Wetland

- A constructed wetland is an organic wastewater treatment system that mimics and improves the effectiveness of the processes that help to purify water like naturally occurring wetlands.



- Constructed wetlands are becoming increasingly popular as low-cost, energy-efficient, natural methods of treating sewage, industrial and agricultural pollutants, and storm water runoff while also providing various advantages.

Wetland Park

Accordingly, a wetland site has been identified along the Western bank of Ambalappuzha Thodu; it acts as a buffer for a High Hazard Area in the Eastern part of the Municipality. The low-lying area is in proximity to the stream, and may provide an opportunity to capture floodwater during inundation, or storm water/sullage water in dry periods.

The wetland has been proposed to carry out three functions:

- Become a model wetland regeneration project
- Use a natural filtration mechanism for storm water and grey water
- Develop an artificial wetland to clean and dispose of black water to be used for floriculture and cultivation of non-food produce.

Conceptual image of the project is shown in Figure 23-16.



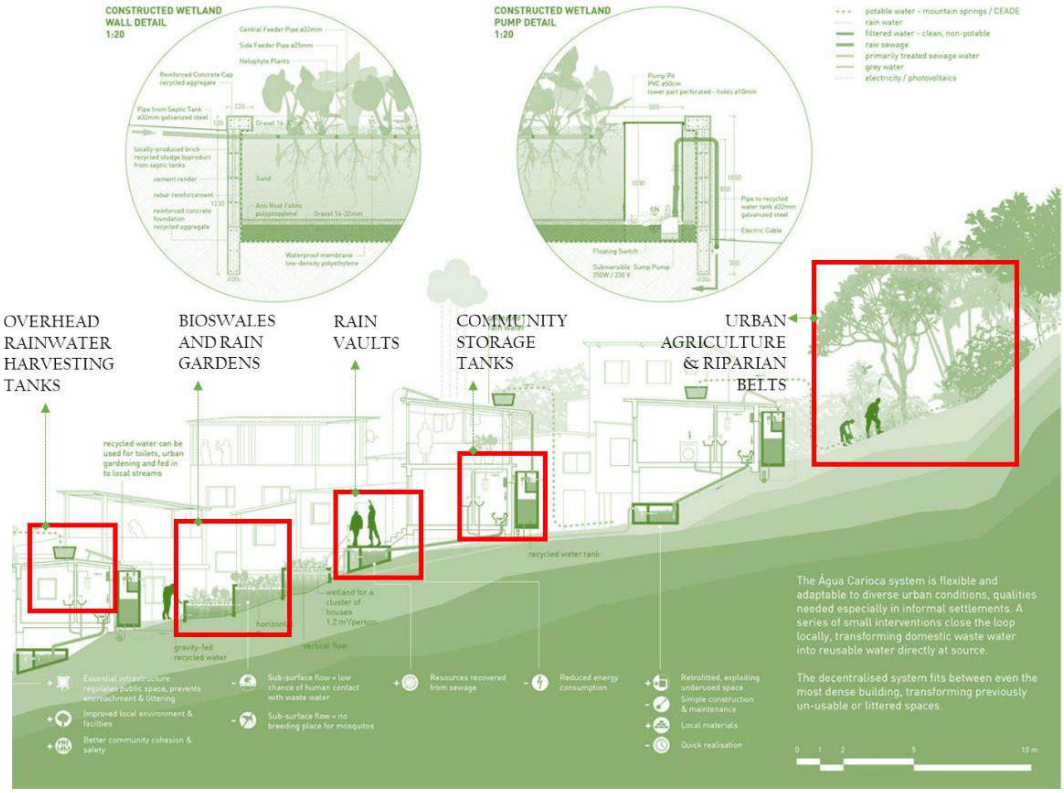
Figure 23-16: Conceptual image for the proposed wetland park

23.4.2.3 Plot Scale

Measures such as "infiltration, retention, storage, purification, utilization and discharge" should be fully implemented as apriority to solve the problem related to the storm water and sewage networks. In the construction of sponge city at the plot scale, the joint utilizations of different types of green, gray and blue infrastructures can greatly improve the runoff quantity and quality control capacity. With the construction of sponge cities in multiple plots, the sponge effect of the whole urban can be improved.

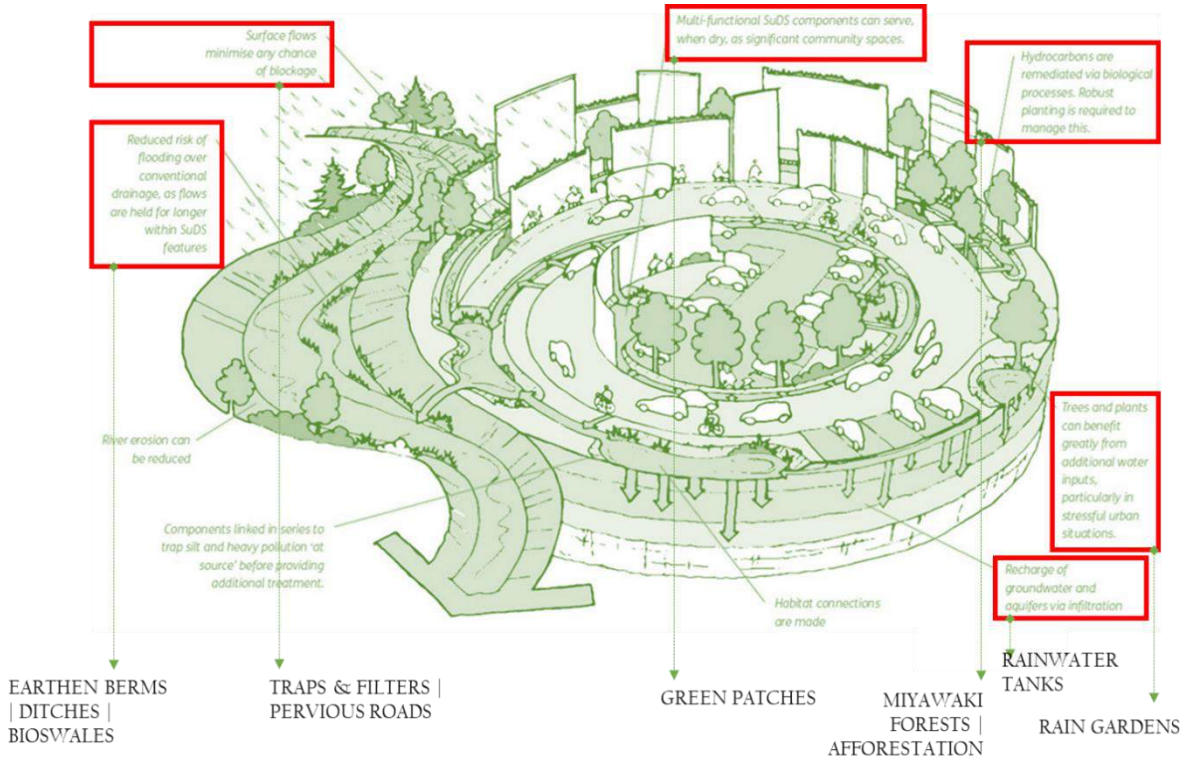
Interventions:

- Construction of bios wale ditches/rain water vaults to store water underground or ensure on-site management, rather than allowing water to pool on site or flood downstream.
- Stilt-based and raised construction in moderate, high and very high hazard areas
- Creation of neighborhood-level or plot level pacchathuruthu/Miyawaki greens to allow for water to be absorbed
- Restrict paving /coverage of all houses in moderate and high hazard zones
- A management plan for construction debris shall be created at the Municipality level, and enforced from site to site.



23.4.2.4 Facility Scale

The facilities mainly include green infrastructure (LID facilities at the source) such as raingardens and green roofs, gray infrastructure (transit facilities at mid-way) such as drainage pipe networks and pumps, and blue infrastructure such as receiving water bodies (terminal storage facilities). Compared with flooding and water quality control, it is also important to increase unconventional water resources (rainwater and reclaimed water) utilization.



Facility Scale Strategy at Government Vocational Higher Secondary School, Aryad

Government Vocational Higher Secondary School, Aryad possess large unpaved areas, and is located close to wetland areas. It also possesses vacant areas around the institution site, which can help increase the efficacy of sponge strategies implemented within the institution. A concept plan is prepared for the School, Aryad as shown in Figure 23-17. It includes the following components:

1. **Miyawaki/Pacchathuruthu groves:** Trees and other vegetation can be used as sponges, drawing enormous quantities of water into the earth, preventing erosion, limiting floods and recharging groundwater supplies for times of drought. Miyawaki Forests can be deployed in ecologically unsound areas to reduce erosion and break the force of wind and water. The method can be useful in restoring groves lost to

deforestation. Groves play a significant role in regulating environmental health and supporting local biodiversity. The Miyawaki method and its strategies are extremely effective in developing forests on small landholdings (as small as 10-20 cents).

2. **Earthen berms:** These are compacted earth or gravel ridges, excavated channels or a combination of ridge-and-channel designed to direct runoff away from, or around, disturbed areas; they also serve to intercept and prevent sheet runoff. Berms may be used below steep grades where runoff begins to concentrate, along roadways and facility improvements subject to flood drainage, or at the top of slopes to divert run-on from adjacent or undisturbed slopes (City of Springfield – Missouri, 2008).

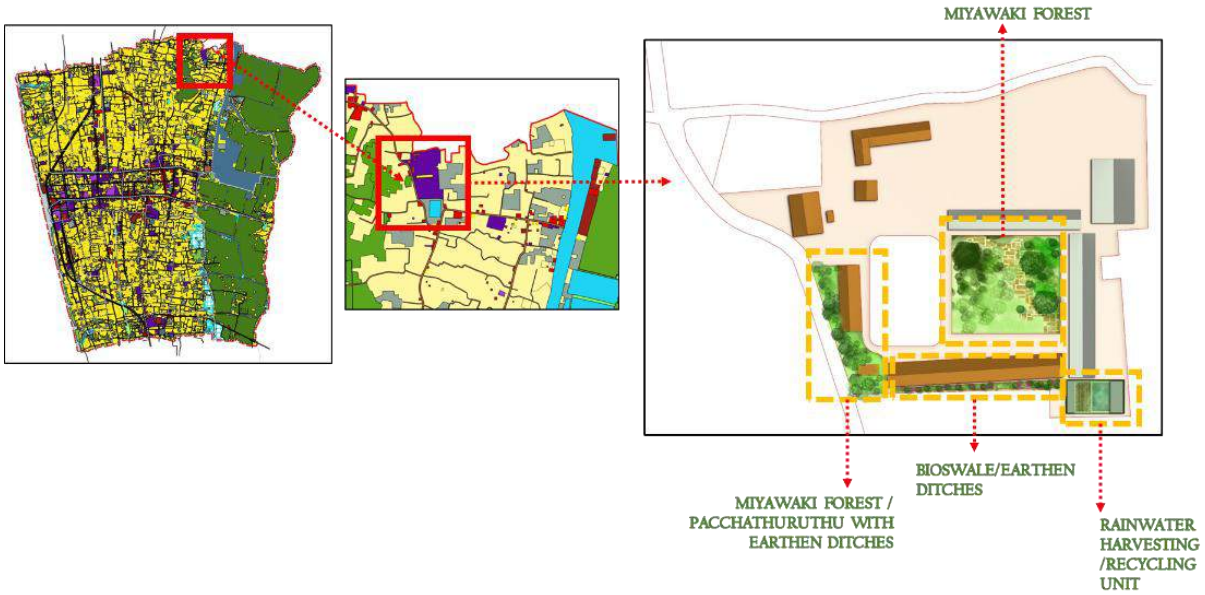


Figure 23-17: Conceptual plan for Aryad School

3. **Bioswale:** Bioswale channels are vegetated and maintained swales specifically designed to convey storm water at a low velocity, promote natural treatment and infiltration. A bioswale is a ditch with vegetation and a porous bottom. The top layer consists of enhanced soil with plants. Below that layer is a layer of gravel, scoria or baked clay pellets packed in geotextile. These materials have large empty spaces, allowing the rainwater to drain off. The layer is packed in geotextile to prevent the layer from becoming clogged by sludge or roots. An infiltration pipe/drainpipe is situated below the second layer. To prevent the bioswale from overflowing its banks during heavy rainfall, overflows are added that are connected directly to the infiltration pipe/drainpipe (atelier GROENBLAUW, 2006).
4. **Portable Natural Biological System**: Promoted by Down to Earth's Centre for Science and Environment, the PNBS is a modular, flexible, long-lasting, cost-effective, easy to install, energy-free water-treatment technology. The technology is based on the

combined action of a tailored mixture of substrates, differing hydrologic profiles, and the combination of biotic and abiotic elements, which transforms through natural forces and thermodynamic principles. The pollutants contained in the wastewater into sequestered and inactive forms, without fuel energy, surpass standard wastewater treatment plant schemes. The solution treats wastewater from 4 to 40 m3/day to the highest legal standards for discharge and irrigation reuse, breaking the water-energy nexus.

Facility Scale Strategy at EMS Stadium, Vellakkinar

Stadiums are other crucial areas where implementing sponge strategies can have monetary benefits as well. A conceptual note was prepared for EMS Stadium to demonstrate such a possibility. EMS Stadium is bounded by a canal on its Western boundary. This proved an apt place to locate sponge interventions.

The proposed scheme provides for a jogger's park with earthen berms and rain gardens. Water collected from such areas can be diverted into natural filtration bioswales, filtered, UV-treated and supplied to swimming pools located at the rear of the site. This water can then be reused for gardening, or released into the canal at a controlled rate.

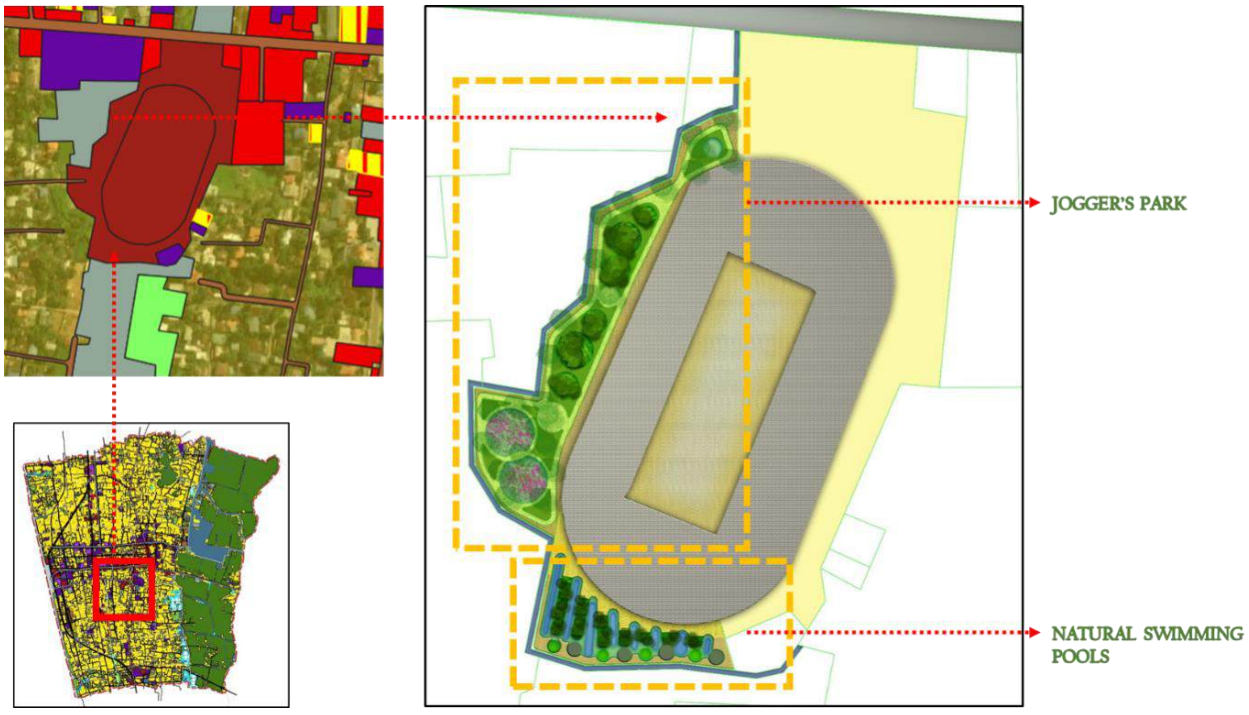


Figure 23-18: Conceptual image of proposal at EMS Stadium



Facility Scale Strategy at SD College, Kalarcode

Similar to schools, colleges can pilot several sponge strategies as student awareness campaigns, involve the student body in sponge creation, and reap the benefits of institutional level green spaces. Such an opportunity has been fleshed out in SD College, given that Kalarcode ward is moderately affected by flood inundation and possesses wetland and paddy land uses. Sponge strategies within the college could provide an intermediate detention/retention area that could control the amount of water reaching the wetlands along the Eastern boundary of the ward.

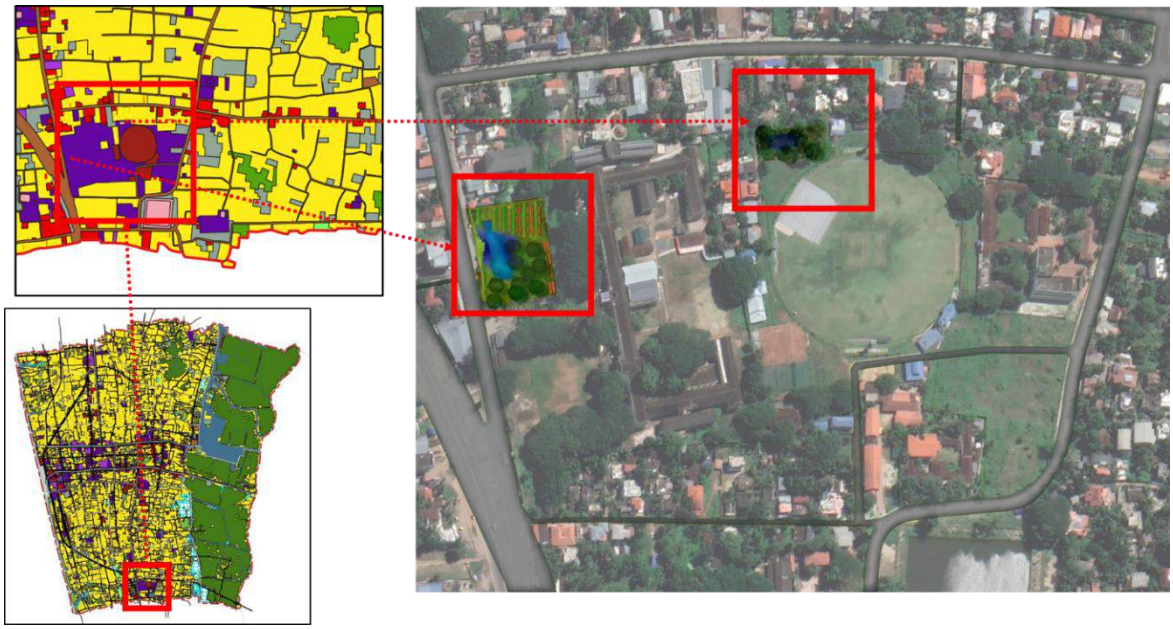


Figure 23-19: Proposed locations at SD College

The proposed scheme identifies two existing water bodies on the college premises. The water bodies have been demarcated as green detention areas, and developed into institutional green spaces using Miyawaki, bioswales, and earthen berm strategies. These have been clubbed with pedestrian walkways, lotus ponds, and seating areas to serve as a recreation spaces for the community at large.

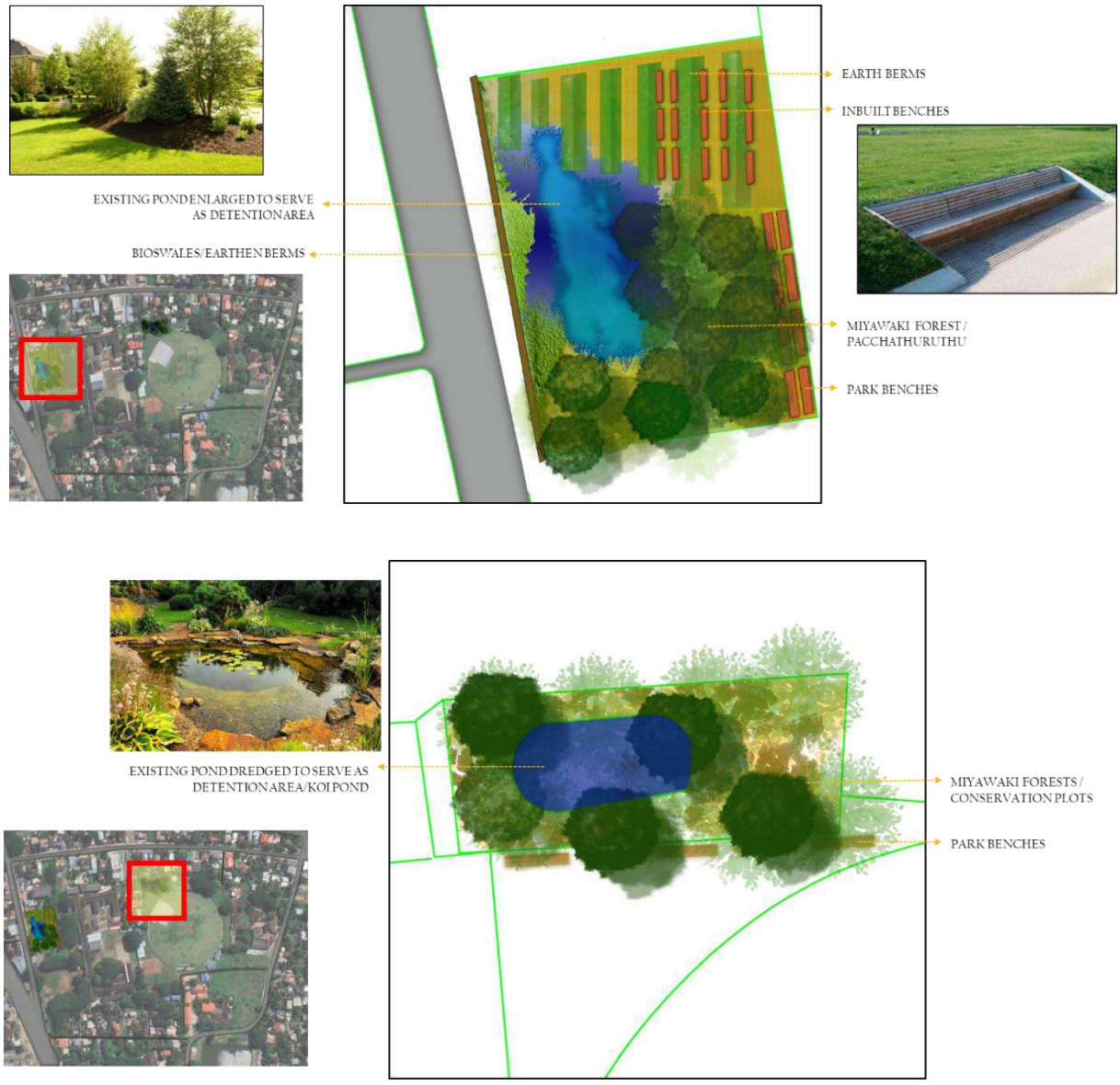


Figure 23-20: Conceptual image for the proposals at SD College

23.4.3 Flood water Retention & Management

A new land-use policy which enables the re-deployment of available land to maximize its natural ecosystem functions should be created. Paddy lands could be conserved and managed as wetlands for ground water recharge, biodiversity conservation, and greenhouse

gas emission reduction. Along with the existing paddy lands, some other areas are proposed to be demarcated as storage basins for flood control.

23.4.3.1 Basins for Flood Water Retention

So, for the detention of flood water, several basins were identified, mainly in areas of coastal flooding and urban flooding. These are existing paddy fields or marshy areas in the Municipality. These identified basins can be dug to a depth of 1m to increase the water storing capacity. By limiting the depth to 1m will help to accommodate the farming and recreational activities in these areas. During flood, these basins will retain some amount of water and allow this drain slowly to the restored channels to the river, thus reducing peak flow. This will prevent the flooding of adjacent land or reduce the flooding in those watersheds. Basins identified for water retention are shown in Figure 23-21. Mangrove areas, existing paddy fields, waterbodies, wetland parks etc. will also act as a retention/ detention basin in the Municipality there by reducing the intensity of flood.

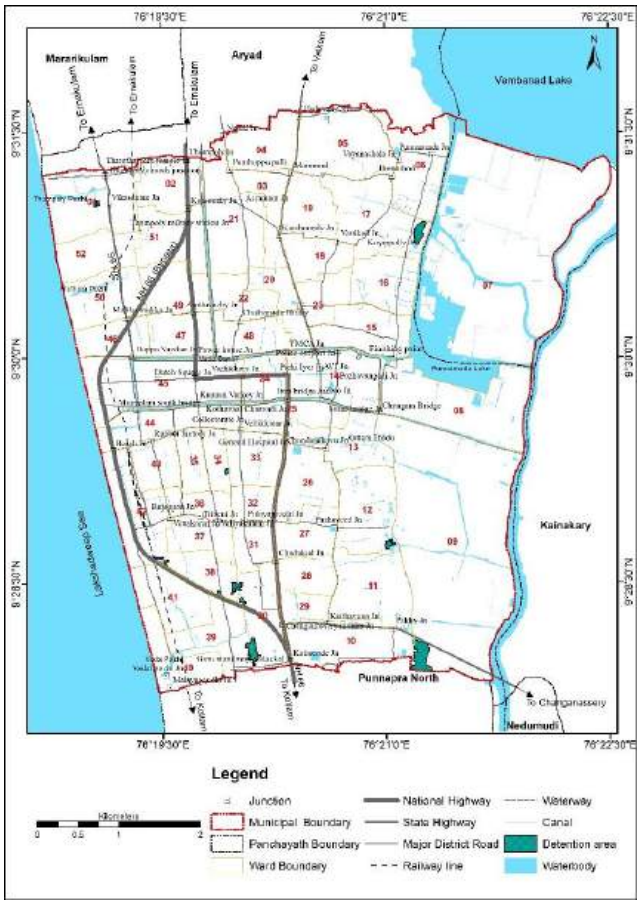


Figure 23-21: Flood Water Detention Areas

Artificial recharge structures like percolation pits, gully plug, sub-surface dykes, rooftop rainwater harvesting etc. can also be introduced to increase the ground water recharging of the area and will help in reducing the volume of water accumulating in lowlands there by creating water logging in those areas.

23.4.4 Storm Water Management

- An inventory of the existing storm water drainage system will be prepared on a GIS platform. The inventory will be both watersheds based to enable proper hydrologic and hydraulic analysis and ward based to enable coordinated administrative management.
- Pre-Monsoon Desilting of Drains should be completed before March 31 every year

- Removal of Solid Waste

There is unauthorized public disposal of solid waste into surface drains. Blocked drains may create insect breeding sites and encourage disease transmission. These drains need to be cleaned on a regular basis to permit free flow of water. Suitable interventions in the drainage system like traps, communitors, trash racks can reduce the amount of solid waste going into the storm sewers.

- Removal of Sediment

The duration of local flooding increases proportionately, with the extent to which the cross-section of the channel was filled with sediment. All waste removed both from the major and the minor drains should not be allowed to remain outside the drain for drying, instead the wet silt should be deposited into a seamless container and transported as soon as it is taken out from the drain. Completion of work will be certified by representatives of local Residents' Welfare Associations (RWAs)/ Municipal Ward Committee members besides third party certification.

De-silting of minor drains will be carried out as part of a regular preventive maintenance schedule. The catchment will be the basis for planning this, as a part of the watershed de-silting Master Plan. Cleaning of minor drains will be taken up from the outlet end to upstream side.

- Drain Inlet Connectivity

Inlets should be provided on the roads to drain water to the roadside drains and these should be designed, based on current national and international practices. Indian Standard IS 5961 provides the design details for cast iron grating for drainage.

- City road levels

Plinth level of the houses was historically defined with reference to the adjacent road level. However, a recent trend that has emerged is that the roads are being resurfaced without removing the older layer. As a consequence, over the years, the new road levels, in many instances, are now much higher than the approved plinth level of the adjacent properties. This prevents drainage of the houses and during periods of rainfall, storm water runoff causes flooding of these properties even with lower rainfall intensity.

All road re-leveling works or strengthening/ overlay works will be carried out by milling the existing layers of the road and recycling of materials obtained as a result of the milling so that the road levels will be not be allowed to increase.

- Lined Channels

Channel linings should be provided in urban drainage channels to achieve channel stability because most soil erodes under concentrated flow. Linings maybe "flexible" – for example stone pitching (riprap), vegetation, manufactured mats or a combination of these or "rigid" – for example concrete or asphaltic concrete.

Rigid lining will be implemented in high density urban areas where space is a constraint, and Flexible linings will be provided in medium and low-density areas and new urban developments, as this permit infiltration and are environmentally friendly, providing habitat for flora and fauna and are less expensive.

- Encroachments

Encroachments on nallahs/ drains/ watercourses have to be removed by providing alternative accommodation to the low-income people residing in such places and appropriate rehabilitation package for all categories of people considering the merit. The nallahs/ drains/ watercourses/ flood plains should be clearly delineated and boundaries fixed in new developments. There shall be strict enforcement of the relevant byelaws/regulations in the new layouts. Any encroachment on the drain should attract penal action and be treated as a cognizable offence, both against the encroachers and the officials responsible for enforcement of the byelaws/ regulations.

23.4.5 Coastal Protection

In order to mitigate coastal erosion, the coastal protection measures are broadly classified as soft and hard solutions and also combination of both. Soft solutions are vegetation, beach nourishment, sand bypassing, flood proofing, sand dune formation, zoning, retreat etc., Hard solutions are: Seawall / revetment, groynes, offshore reefs, detached seawalls etc. Innovative methods comprise sand filled Geotextile tubes/containers/bags/mats, Stone filled gabions, artificial reef balls etc.

23.4.5.1 Conserving/Restoring Mangroves

In muddy coastal environments or within the tidal zones of estuaries, mangrove forest and other indigenous shrub species are commonly found. Most erosion in these zones is

attributable to the removal of the mangroves and other trees. To overcome this problem, replanting is necessary because these trees can regenerate and serve as coastal defense structures.

Restoration remains an important option in areas where mangroves have been lost – interventions to enhance sediment supplies, or using permeable barriers to reduce erosion, may help mangroves to become re-established. In all settings, mangroves may be able to keep up with sea level rise, provided that the sediment and fresh water balance enable mangroves to thrive. Therefore, they are an adaptive solution that may help to cope with climate change impacts.

In urban settings, where space is limited, even small areas of mangroves offer some protection from waves, reducing construction and maintenance costs for hard infrastructure behind them that in those settings are the primary defense. In all these settings, mangroves add additional value in the form of enhanced fisheries, carbon storage, forest products and recreation. Mangroves thus support food security, climate change mitigation and human wellbeing and can enhance recovery after major hazards. Areas identified for mangrove restoration is shown in Figure 23-22.

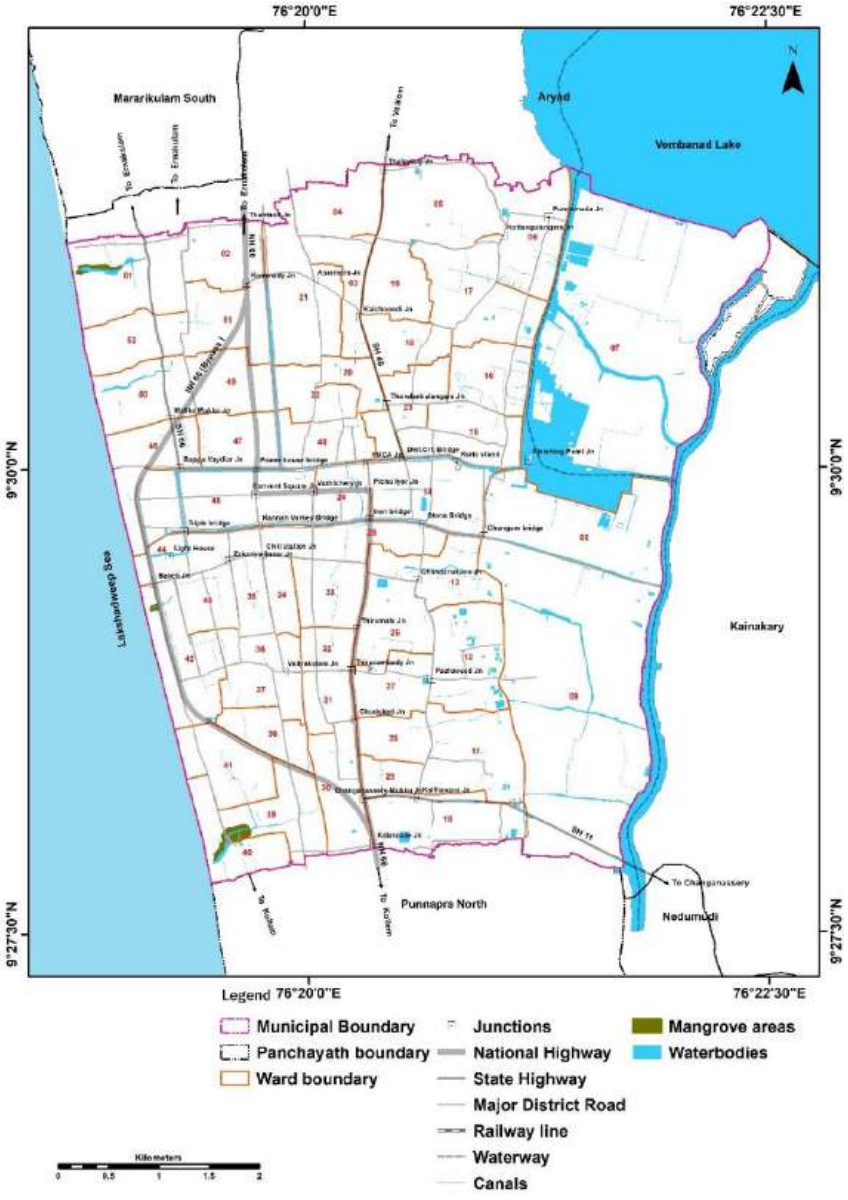


Figure 23-22: Areas identified for protection of mangroves

23.4.5.2 Shore protection using Pine buffer strip (Beach oak/ Kattadi)

Based on studies and scientific results, the presence of vegetation in coastal areas improves slope stability, consolidates sediment and reduces wave energy moving onshore; therefore, it protects the shoreline from erosion. The pine/beach oak tree and related species can grow well on the most infertile soils and also has the ability to extend its roots deep into the ground. The pine is therefore able to cope well with storms coming off the sea. Area identified for the conservation of pine forest is shown in Figure 23-23.

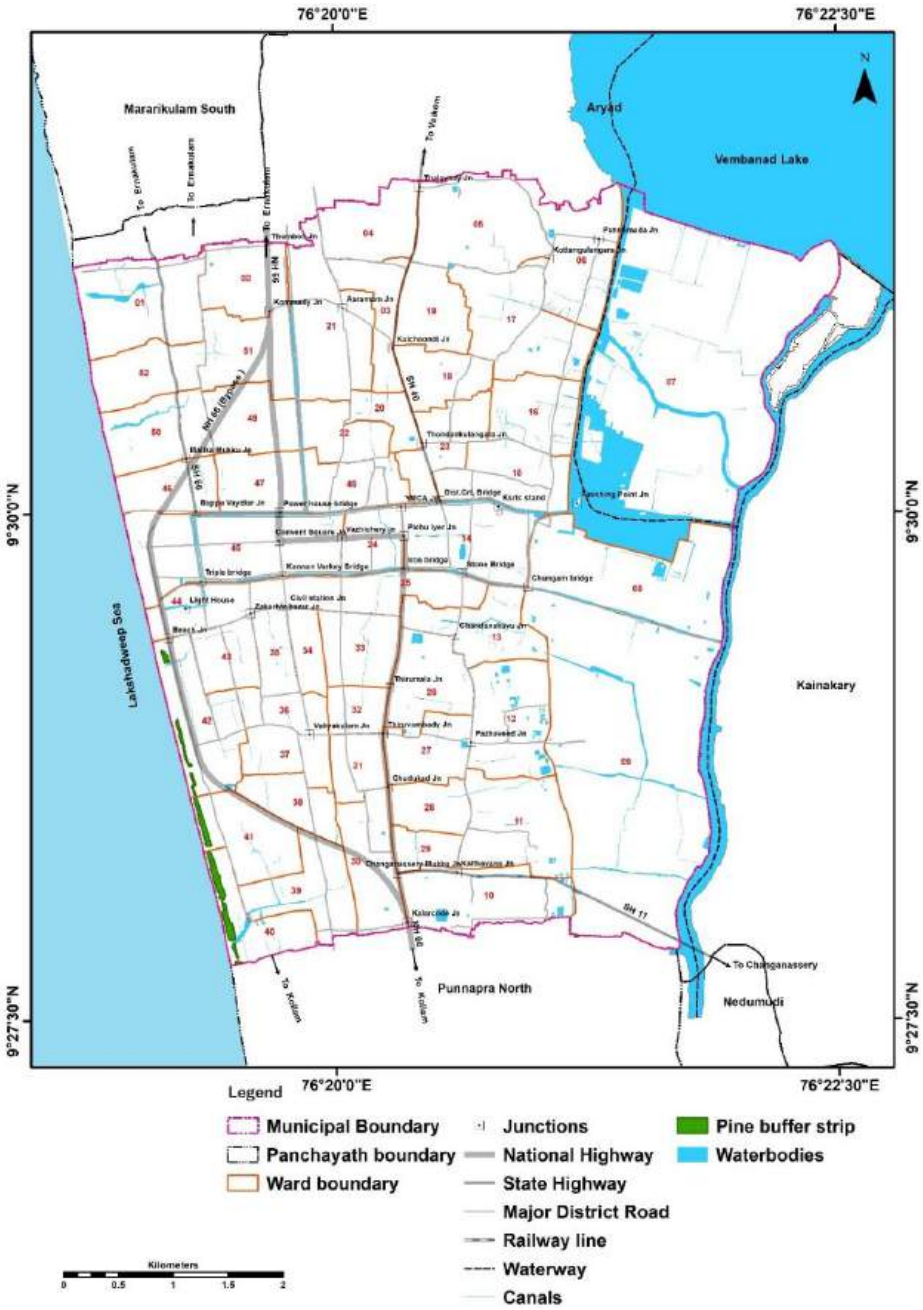


Figure 23-23: Areas identified for Pine Forest Conservation

23.4.5.3 Salinity Protection Measures

a) Scientific Monitoring and Assessment

Scientific monitoring and assessment form an essential starting point for effective management of saltwater intrusion. To properly assess the threat of saltwater intrusion, specific monitoring programs (programs dedicated to monitoring movement of the saltwater-freshwater interface) are required. Monitoring and assessment contributes to a thorough understanding of existing conditions in coastal aquifers and constitutes a necessary first step in determining both the severity of any saltwater intrusion and the best approach in adapting to the impacts of climate change.

b) Regulation

There should be legislative action to ensure sustained water quality and quantity over the long term. Such action seeks to ensure the preservation of freshwater sources through both supply-related and demand-related policies. Supply-related policies seek to secure adequate groundwater supply by optimizing the locations and rates of withdrawals and by controlling land use and development around coastal aquifers. Demand-related policies seek to curb demand through economic and moral incentives.

c) Engineering Techniques

- Artificial recharge consists of adding water to an aquifer through man-made systems (e.g., recharge basin, injection well) to increase the amount of freshwater and to control or prevent the intrusion of saltwater.
- Barrier systems are subsurface in nature; they fall into two categories: physical barriers and hydraulic barriers. Physical barriers consist of a low-permeable material (such as steel or concrete) that acts to block the intrusion of saltwater into the aquifer. Hydraulic barriers consist of injecting freshwater and/or pumping saltwater to prevent the landward movement of the saltwater-freshwater interface.

23.4.5.4 Strict implementation of CRZ notification

CRZ guidelines put forth by MoEF envisages to ensure livelihood security to the fisher communities and other local communities, living in the coastal areas, to conserve and protect coastal stretches, its unique environment and its marine area and to promote development through sustainable manner based on scientific principles considering the dangers of natural hazards in the coastal areas, sea level rise due to global warming etc.

As per the approved Coastal Zone Management Plan (CZMP), Alappuzha town comes under CRZ II, as it is a statutory town. The fragile ecosystem of the coastal area consisting of sand bars in the beach, intertidal zone, mangroves and mangrove buffers are eco-sensitive areas that are mandatorily no-construction zones. Along with these areas there are areas within hazard line that is marked in CZMP which has the probability of flooding due to sea level rise. So, developments should not be promoted in these areas.

23.4.5.5 Beach Nourishment

Beach nourishment can include scraping of sand from the intertidal zone to accelerate recovery of the upper beach, and/or importing additional sand to increase the overall volume. Imported sand can be sourced from off-shore, near shore banks. It can mitigate coastal hazards at specific sites for a number of years. A routine beach nourishment program can often be a more cost-effective adaptation option (with added recreational/aesthetic benefits) for mitigating coastal hazards than defense structures like seawalls. Beach nourishment should be included as a part of the active shoreline management processes at several locations along the coastal area.

Beach nourishment is typically combined with dune maintenance, to enhance the level of protection against erosion and inundation. Beach nourishment has the benefit of providing increased protection from coastal hazards while maintaining the natural and recreational values of the beach and coastline. Beach nourishment is typically achieved through sand scraping or importing sand. Sand scraping involves mechanically moving sand from the intertidal zone to the dune or upper beach zone, mimicking the natural beach recovery processes. Importing sand to nourish the beach involves sourcing and distributing sand to increase sand volume and build up the dune system.

It is suggested to conduct a detailed beach nourishment assessment, technical feasibility study and EIA for Alappuzha town to evaluate site specific issues and potential impacts on environment and coastal processes, whenever beach nourishment actions are planned and implemented.





23.4.6 Protection and Compartmentalisation of Paddy Fields

The methodology detailed out in the report of 'A special package for Post-flood Kuttand' by the Kerala State Planning Board can be adopted for the paddy fields in the Municipality. Each padasekharam, or a set of small padasekharams, is envisaged as a single group consisting of an outer bund and a series of small canals that take water into the individual paddy fields. The outer bund would serve the function of flood protection and have inlets for entry of water into the compartment or padasekharam. They would have a height above the normal/maximum flood level.

Figure 23-24 shows an illustration of how a padasekharam or a group of padasekharams may look like inside a compartment. Water from the main river is let into the main canal inside the compartment through a sluice gate in the outer bund, from where water flows to the fields through the distributing canals and the field canals. Thus, the outer bunds can serve two potential functions. One, it will help the existing second crop of paddy by protecting it from floods, by allowing inward flow of monsoon water to fill the smaller canals with fresh water and by storing this water even after the monsoons. Two, it will help protect the puncha crop from the entry of saline water even if the Thanneermukkam Bund is kept open after December.

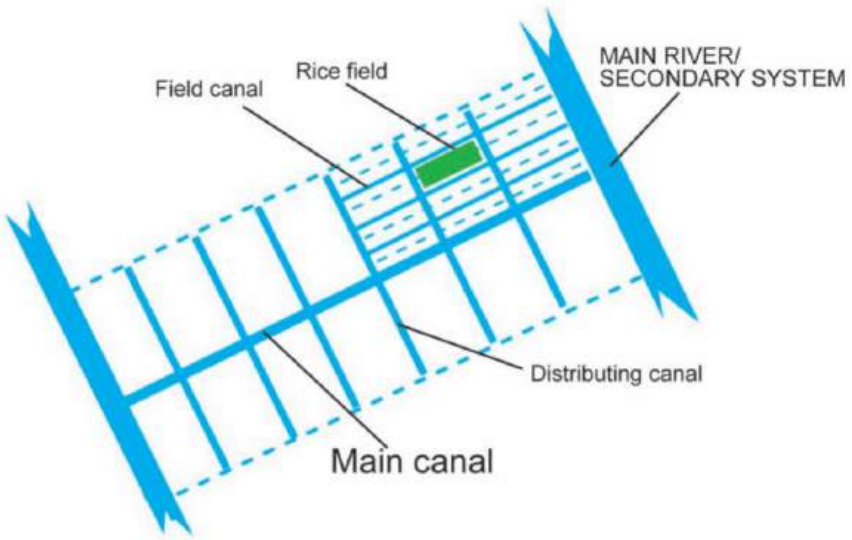


Figure 23-24: A representation of the water distribution network inside a compartment/ padasekharams

Concurrently, it would become possible to address the issues related to declining marine fish population and growth of aquatic weeds like water hyacinth. The smaller canals within the outer bunds would serve the function of internal water distribution, drainage and storage of water. Arrangements to pump out water, when required, can be built into this level

of hierarchy. Thus, there is a need to arrive at a logical clustering of padasekharams level, which could be called compartmentalization.

Compartmentalisation or clustering of paddy fields can reduce the surface area that will be vulnerable to flooding in case of a single flood event. Figure 23-25 shows a representative diagram depicting compartmentalization. In the first scenario, the entire area inside the dyke is flooded. In the second scenario, only one part of the area inside the dyke is flooded and the remaining parts are protected from floods by a bund of required height and strength.

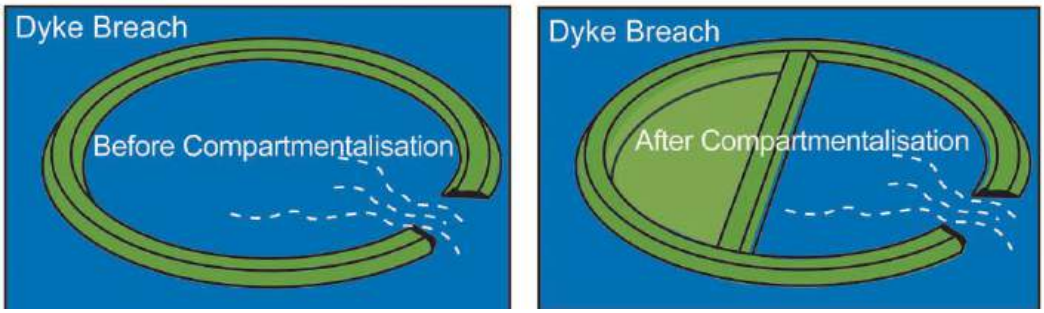


Figure 23-25: An illustration of compartmentalisation

Compartmentalization is an exercise to be undertaken scientifically, democratically and ensuring that there are no adverse ecological implications. First, the new compartments have to be large enough in size for efficient water storage and distribution. Secondly, the size and shape of each compartment would have to be decided with the consent of, and after detailed discussions with, the concerned padasekharasamithies. Thirdly, it would be best to align the bunds of the compartments with the existing river bunds and main roads.

If compartmentalization becomes possible, all bunds everywhere will not require to be raised, or be constructed with the same material. Only the outer bunds of the compartment would require to be higher (i.e., above the normal/maximum flood level) and stronger (i.e., with pile & slab). The inner bunds may be of lesser height and may function as retaining walls. As a result, the total cost of bunding can also be brought down. Bio protection of bunds can be implemented wherever possible. Different species of grasses may be used (including fodder grasses and other appropriate grass/ shrubs) for bio-protection, which may be firmed up using geo-textiles as a binding material.

23.4.7 Flood Proofing Measures

Flood proofing is any temporary or permanent feature of a building or its surroundings that reduces the potential for damage caused by flowing or standing water. Beyond improvements to building drainage (from roofs, foundations and yards), and improvements to

utility connections (back flow prevention valves, etc.), Dry and Wet flood proofing strategies can be adopted to reduce the potential damage due to flooding.

Flood-resistant construction incorporates design measures aimed at preventing water from entering a building and can mitigate the damage floodwater causes to buildings. Conventional forms of building construction are not inherently resistant to sustained hydrostatic pressure. Flood resistant construction necessitates a specialist technical input to the design and specification of the external building envelope. Preferably, measures to resist hydrostatic pressure (commonly referred to as "tanking") should be incorporated on the outside of the building fabric. The main entry points for floodwater into buildings are doors and windows (including gaps in sealant around frames), vents, air-bricks and gaps around conduits or pipes passing through external building fabric. Floodwater may also arise through sanitary appliances as a result of backflow through the drainage system.

One way to protect a structure and its contents from flood damage is to seal the building so that flood waters cannot enter. This method, referred to as "**Dry Flood Proofing**," that encompasses a variety of measures:

- Applying a waterproof coating or membrane to the exterior walls of the building
- Installing watertight shields over doors, windows and other openings
- Anchoring the building as necessary so that it can resist floatation
- Installing backflow valves in sanitary and storm sewer lines
- Raising utility system components, machinery and other pieces of equipment above the flood level
- Anchoring fuel tanks and other storage tanks to prevent flotation
- Installing a sump pump and foundation drain system
- Strengthening walls so that they can withstand the pressures of flood waters and the impacts of flood borne debris
- Construct non-supporting, break-a-way walls designed to collapse under the force of water without causing damage to the house or its foundation

Wet Flood proofing includes permanent or contingent measures applied to a structure or its contents that prevent or provide resistance to damage from flooding while allowing floodwaters to enter the structure or area. Generally, this includes properly anchoring the

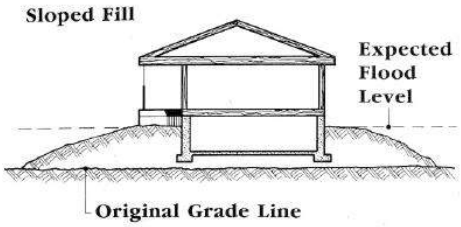
structure, using flood resistant materials below the Base Flood Elevation (BFE), protection of mechanical and utility equipment, and use of openings or breakaway walls.

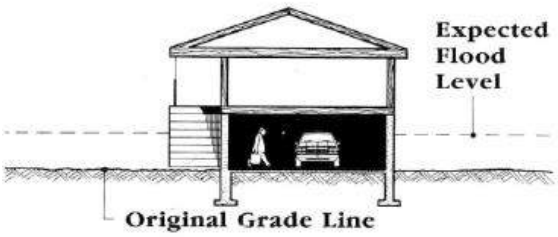


Figure 23-26: Dry Flood Proofing Techniques

23.4.7.1 Elevated Buildings

Raising a building above the flood level may reduce potential damage to a building and its contents in the event of a flood. Even if the flood water is higher than expected and enters the building, the flood damage will be reduced.





Buildings constructed on a Raised Foundation, Piers or Columns will ensure that the living area of a building is raised above the anticipated flood level.

Freeboard is a safety margin to account for uncertainties in water-level prediction and/or structural performance. It is the difference between the height of the flood defense or floor level and the design flood level. Freeboard should account for uncertainty in hydrological predictions, wave action, modelling accuracy, topographical accuracy and the quality of digital elevation models. Floor level heights for buildings should be set a minimum 30 cm above the applicable flood level.

Freeboard should be provided according to the flood levels of the area. From the flood hazard analysis of the Alappuzha town, we can categorize area into four zones according to the design event. i.e. up to 0.6m, ›0.6m to 1.5m, ›1.5m to 2.5m and ›2.5m inundation. These zones according to inundation are shown in Figure 23-28. So, the freeboard suggested for those areas are as listed below.

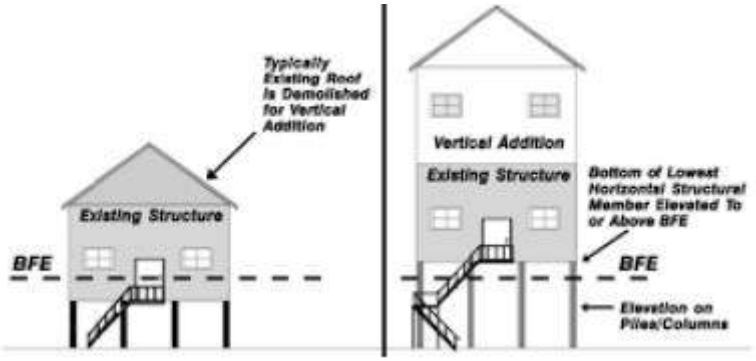


Figure 23-27: Freeboard Flood Design

- ‹0.6m: Freeboard of at least 90cm
- ›0.6m to 1.5m: Freeboard of 1.8m needed
- ›1.5m to 2.5m: Freeboard of 2.8m needed
- ›2.5m to 3.5m: Freeboard of 3.8m needed

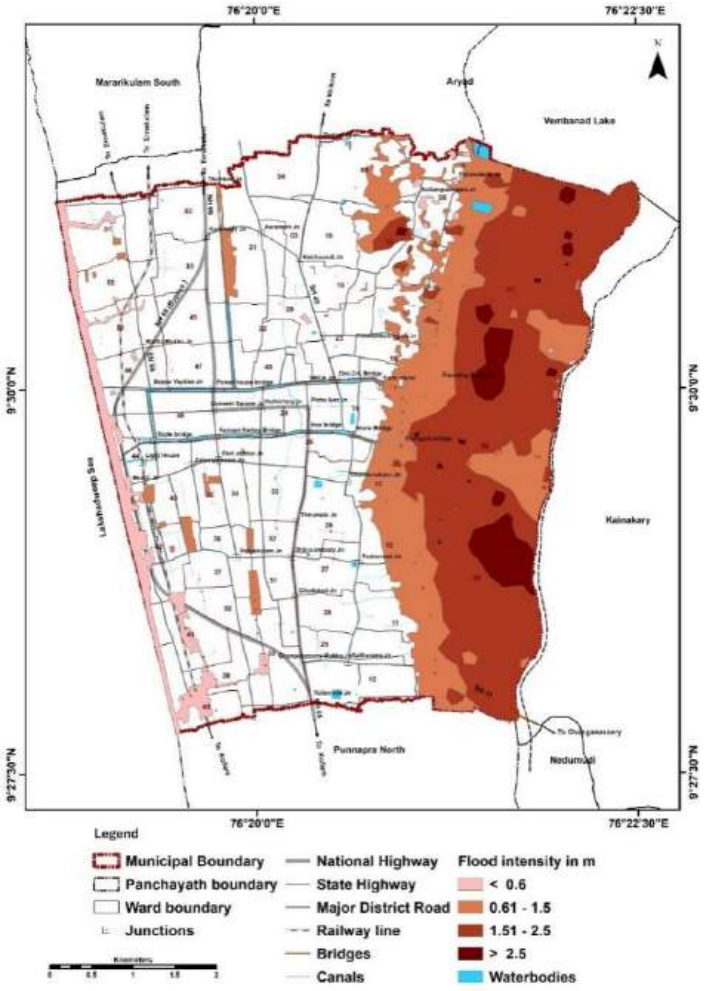


Figure 23-28: Flood Level Map

23.4.7.2 Relocation

If flood risk is severe and alternative locations are available, relocation of facilities to a higher elevation may be the most effective flood proofing option. Type of building, condition of the structure, route between the existing site and the new one, elevation above flooding, safe access during flooding, ability to provide services such as well and septic system, etc. should be considered to check whether relocation is a feasible option.

The areas where the inundation levels are more than 2.5m, it is preferable to relocate the people residing here to safer locations as the return probability of flood is also more here. In long term, this is more cost effective than providing relief annually. Buildings which are exposed to flood inundation above 2.5m is shown in Figure 23-29. This area is overlaid in existing land use map and is shown in Figure 23-30.

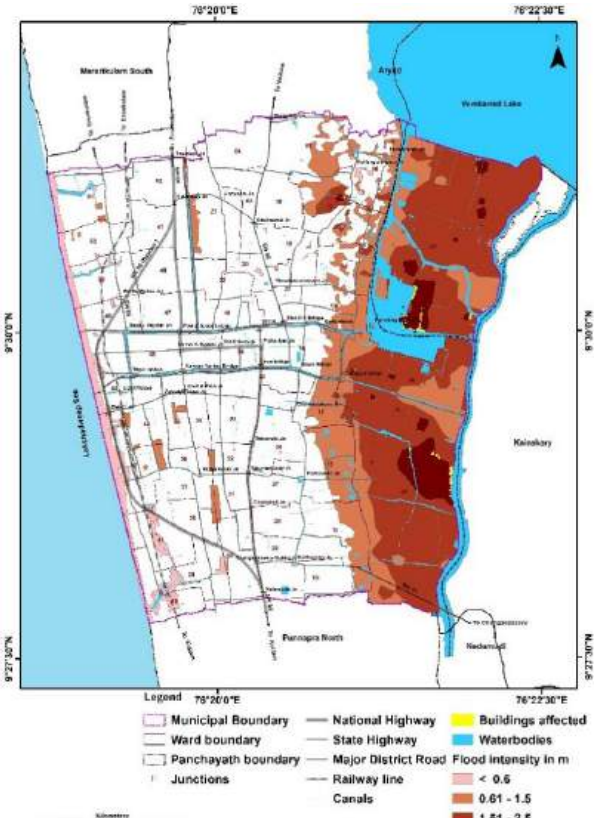


Figure 23-29: Buildings identified for relocation



Figure 23-30: Buildings identified for relocation vs Existing Landuse map

23.4.7.3 All Weather Roads

Major roads that lie within the flood prone area can be made as all-weather roads, after detailed study and analysis. An All-Weather Road is a road that is trafficable in all weather conditions. Typically, this means a road that is constructed in such a way that excessive rain does not cause it to be flooded or sodden to such an extent that vehicles travelling over it are likely become bogged.

Here roads connecting the relief camps and major arterial roads are selected as all-weather roads. Roads and access to healthcare facilities need to be designed to provide safe access and possibly multiple routes of evacuation.



Figure 23-31: All Weather roads

23.4.7.4 Modifying Critical Infrastructure

Modifying infrastructure is a practical way to mitigate the risk (likelihood and consequence) of hazards. Modifying infrastructure is a relevant option to all localities.

- Upgrades can be made to critical infrastructure that cannot be readily relocated out of a hazard zone. Typical upgrades include raising floor levels to reduce inundation risk and changing infrastructure design and materials, will reduce the consequence of inundation.
- Critical infrastructure can be relocated out of the high hazard zone.

- Improving drainage networks in the areas immediately surrounding infrastructure and in the main settlement areas can reduce the duration and consequence of inundation. This should be considered as part of the adaptation strategy and asset management plan for the Municipality.

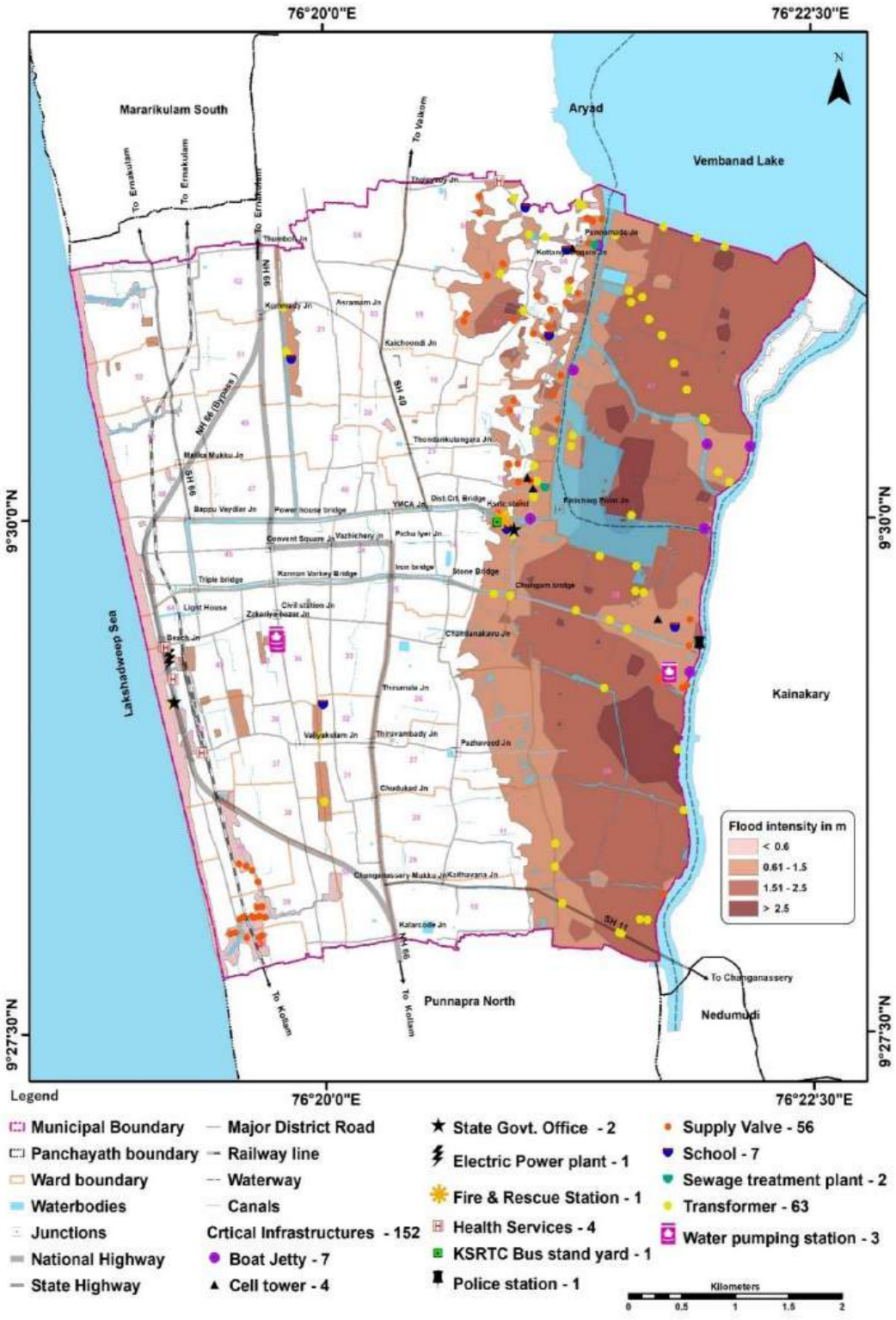


Figure 23-32: Critical Infrastructure vs Hazard zones

Table 23-4: Details of critical infrastructure at various hazard zones

Critical Infrastructures	Very High Hazard Zone	High Hazard Zone	Moderate Hazard Zone	Low Hazard Zone
Hospital			1	2
School			7	
PHC				1
Police Station			1	
Fire & Rescue station			1	
Bus Stand			1	
Boat Jetty		1	6	
Sewage Treatment Plant			2	
Water Pumping Station			3	
Transformer	2	14	31	1
Transmission Tower		9	4	2
Cell Tower			4	
Electric Power Plant				1
Total	**2**	**24**	**61**	**7**

23.4.7.5 Compulsory installation of Septic tanks with Control valves and Inspection chamber

Entry of flood water into septic tank, leach pit etc. and the diffusion of septic wastes into open wells and ground water is a common problem that occurs during flood times. Even though, constructing a centralized sewerage network offers a permanent and effective methodology to solve the sanitation issue in the town, the principal investment required for such an infrastructure is enormous. Hence the solution suggested here is at the individual plot level. The Municipality shall consider development of a sewerage network for sanitation in a long run. At plot level, this problem can be prevented to a certain extend by the compulsory installation of septage tank with control valves. It shall be manually operated to prevent the entry of flood water through water closet and soak pit. Valves should be installed between inlet and outlet of septic tank. An Inspection chamber needed to be constructed forth installation of Valves. When it seems that flood water will rise above ground level, the occupants should close these valves before leaving the buildings.

For this purpose, installation of septic tank with proper anchoring and regulatory valves should be made mandatory before issuing occupancy to new buildings in areas demarcated as flood plains.

In this project, all existing leach pits, pit latrines etc. should be replaced with septic tanks with regulatory valves and all existing septic tanks should be equipped with regulation

valves. A detailed survey and subsequent estimation should be prepared forth implementation of this project. In addition to this, pre-monsoon cleaning of all septic tanks should be ensured by the local body to remove as possible as septic wastes.

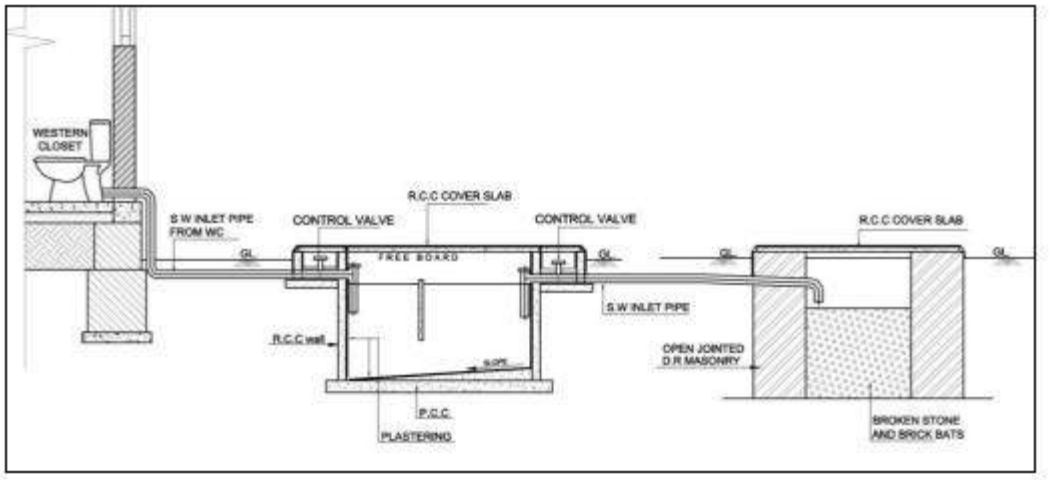


Figure 23-33: Septic tanks with control valves and Inspection Chamber

23.4.7.6 'No Shock flood'-Project

The overhead electric lines usually get damaged during flood season by the felling of trees and branches and sometime in turn fell down on flood water and which may cause threat to the life of people and animals. Replacing of overhead electric lines with Under Ground cables in whole of the flood plain area is the best solution to avoid this problem. This will also lead to energy conservation by avoiding transmission loss.

Similarly, all transformers in the flood prone areas should be raised above HFL with raised platform or should be shifted to elevated places nearby.

23.4.8 Reducing Vulnerability

Vulnerability represents the degree of loss resulting from the occurrence of the hazardous phenomenon. By including vulnerability in our understanding of disaster risk, we acknowledge the fact that disaster risk not only depends on the severity of hazard or the number of people or assets exposed, but that it is also a reflection of the susceptibility of people and economic assets to suffer loss and damage. Places having same degree of hazard impact can have different vulnerability levels depending upon the quantum of affecting population, socio-economic profile of the people and their livelihoods, availability of basic services etc.

To incorporate vulnerability factor into risk assessment, vulnerabilities with respect to social, physical, basic service, economic, environmental/heritage and coping capacity in the flood prone areas were studied. Understanding vulnerability helps to formulate response

plans in a judicious manner so that priority can be given to areas that have more vulnerability. Strategies and plans to reduce vulnerability can be created considering the type of vulnerability of exposed population based on the information generated based by assessing vulnerability.

Approaches to vulnerability reduction include the following policies:

- Emphasising economic diversity and resilient livelihoods
- Implementing building codes
- Knowledge and awareness raising
- Insurance and Risk Transfer

The policy objective of disaster risk reduction (DRR) emphasizes understanding people's capacity to resist and recover from disasters, as well as enhancing the overall resilience of people, society and systems. The local and traditional knowledge vulnerable communities possess to respond to disasters should form the basis of outside interventions to reduce disaster risk.

Developing sustainable DRR capacities at local level requires that capacities are locally generated, owned and sustained. Capacity development requires not only building technical capacities but also the promotion of leadership and other managerial and functional capacities. Finally, capacity development requires an enabling environment i.e. strong political ownership and commitment at the highest level.

Socio-economic vulnerability of an area is mainly related to the economic conditions and social fabric of the population living in the area under consideration. Reducing the socio-economic vulnerability is on a long-term perspective. In arriving at the measures required for the area to make it less vulnerable due to urban floods, policy decisions related to the area need to be taken involving political leadership of the area, institutionalizing participatory approaches and supporting community-based organizations (CBOs). It will also cover economic development plans duly diversifying the income sources and implementing flood insurance schemes.

23.4.8.1 Emphasizing economic diversity and resilient livelihoods

The socially and economically vulnerable people, who are dependent on primary sector activities and marginal work are among the most affected section of the society during flood hazards. The spatial distribution of such people in Alappuzha town is concentrated in high hazard areas: in Eastern wards encompassing agricultural fields and coastal wards. The

affected people that are severely affected due to riverine flooding and coastal flooding are majorly agricultural labourers and fishermen. Along with these natural causes, affected population due to urban flooding is mainly low-income groups and marginal workers who settle in places where land value is less. Their livelihood and income are affected during flooding and there is necessity to diversify sources of income and make resilient livelihoods.

- Providing microcredits and cash transfers to low-income and socially and economically weaker sections of people residing in area exposed to flooding for making resilient buildings and constructions shall be ensured by banks and other financial institutions.
- Saving groups and self-help groups in the form of town level Kudumbasree units can be formed in such areas for MSME, industrial & business development and subsidised financial assistance can be given by financial agencies
- Vocational training can be given to people in such areas, especially to women and teenagers for household business and industrial development (coconut shell, coir, screw pine artefacts, paper bags, paper pens, soap and detergent making etc.).
- Technology transfer to farmers for improved seed varieties and agriculture practices in collaboration with a research institutes to increase rainfed production yields can facilitate savings for flood season. This has been combined with the promotion of dry-season gardening, training on production techniques and food stocks to reinforce cereal bank security stocks.
- Changes in the farming practice in the short-term (e.g. changing crop type or variety), exploiting the spatial and temporal diversity of the landscape (e.g. using irrigated, lowland, uncultivated land) and commercialising livelihoods through individual and collective action (e.g. specialising in a particular marketable crop or livestock product)
- Livestock typically plays a key role in the livelihood strategies as a source of cash income, savings, asset accumulation and buffer against HH shocks such as crop failures. Animals also provide fuel for cooking and fertiliser.
- Economic diversification of coastal fisher folk through methods such as seaweed farming for nutritive and fuel value, establishment of logistics and cooperative cold-storage chains, seafood processing, value-addition through cosmetics or gourmet, security force for mangrove protection, etc.

- Sea-food alternatives (for example, plant-based sea food) through food technology, and sea gourmet food outlets can create low-capital alternative sectors to absorb coastal fisher folk who depend exclusively on the sea. Field-to-fork mechanisms must be adopted to seafood to create sea-to-spoon networks; Alappuzha can be a pioneer in such activities. It will serve the dual purpose of bringing industrial jobs within the municipal boundary while also ensuring diversification from artisanal fishing.

23.4.8.2 Implementing building codes and standards.

Physical vulnerability occurs mainly due to poor design and construction of buildings, unregulated land use planning, etc. The regulations for construction and development of buildings and land is described in 'zoning regulations' section of the Master Plan. Some general strategies to reduce physical vulnerability in Alappuzha town are specified below.

- Promote construction of pucca houses having more than one storey, as upper stories can act as safe haven during flooding. Terrace and staircase to upper floors shall be made mandatory.
- Technology transfer by industry and research fraternity for usage of water-resistant materials in construction. CSR funds can be used for such research and provision of materials in subsidized rates.
- Ensure plinth beam (belt) construction which reduces effects to foundation settlement.
- Construction of double chambered septic tanks with one side valves
- Construction of storm water drains as part of road construction
- Building all weather roads to connectivity leading to critical infrastructure like hospitals, relief shelters, fire station/ police station and other such buildings
- Ensure construction of critical infrastructure in areas outside flood hazard zone.

23.4.8.3 Knowledge and awareness raising

- Citizens shall be given awareness about the chances of hazard they are exposed to and be given training to respond to a hazardous event.
- Campaigns and workshops shall be conducted at the community level to impart knowledge about SOPs during a hazard and maintaining emergency kit at homes.
- Seek out ways to access the local knowledge about hazards, disasters, and disaster recovery, for example, by engaging directly with women elders. Focus group

discussions at the ward-level can help accumulate local knowledge of how women in Alappuzha have traditionally managed the household during a disaster.

- Municipality shall prepare response plans based on the risk information available. Response plans shall be made keeping in mind the spatial distribution of sensitive population like children, old aged, differently abled and sick, transgenders, socially and economically backward population etc.

23.4.8.4 Insurance and Risk Transfer

Besides public and individual measures, insurance can be an important factor in increasing the awareness and reducing the financial risk for individuals, enterprises and even whole societies where natural hazards are concerned. Proper insurance can considerably mitigate the effects that extreme events have on them and can prevent them from being ruined.

Every household in a hazard-zone should be insured. The insurance agencies should train their inspectors to carry out multi-hazard risk assessment of buildings and calculate premiums accordingly. The premium for the low-income households could be subsidized or be paid for by the government. People may be incentivized to move from hazardous zones to safety. Disincentives could be in terms higher taxes or ineligibility for any relief or compensation in the event of future natural hazards. Where resettlement is needed, the government should also explore the transfer of development rights (TDRs), with the government acquiring lost/ hazard-prone land, at market rates to ensure that the vulnerable locations are not encroached upon in future.

One very important contribution the insurance companies can make towards loss reduction is to raise the willingness of home and business owners to defend their property against flood damage. With adequate incentives, however, insurance is a powerful means of motivating the insured to take measures aimed at loss reduction. Incentives can be an increase of premium or deduction of refunds in case certain precautionary measures are not implemented. The goal is to reduce the vulnerability of objects located in flood exposed areas by adequate measures. Credit institutions should use flood plan mapping or zoning to verify their rates of interest and lower the rates if buildings are enforced effectively against flood damages.

23.4.9 Hazard Zoning

For regulating the development activities, the flood prone region in the town is divided into four, based on the possible inundation level, and is categorized as Very high flood prone

zone, high flood prone zone, moderate flood prone zone and low flood prone zone. These areas are clearly marked in the proposed Land use map for Alappuzha town.

23.4.9.1 Very High Flood Prone Zone

Very High Flood Prone Zones are areas with inundation depth greater than 2.5m. These areas are zoned as regions with limited human interventions. No new developments are allowed here. Permitted and Restricted activities in these areas are explained in Zoning Regulations.

23.4.9.2 High Flood Prone Zone

The High Flood Prone Zones are areas with inundation depth above 1.5 m and up to 2.5m. These areas are zoned as regions with regulated human interventions. New developments with area limits are allowed here. Permitted and Restricted activities in these areas are explained in Zoning Regulations.

23.4.9.3 Medium Flood Prone Zone

These are areas expected to have an inundation level above 60cm and below 1.5m. This area comes under regulated human intervention. Permitted and Restricted activities in these areas are described in Zoning Regulations.

23.4.9.4 Low Flood Prone Zone

These are areas expected to have an inundation level below 60cm. These areas also come under regulated human intervention. Permitted and Restricted activities in these areas are detailed in Zoning Regulations.

23.4.9.5 Design flood prone scenario for the town

The flood prone zones in the town are shown in Figure 23-34. It is seen that, the small linear patches of moderate flood prone zone in the residential areas of Avalookkunnu ward (Ward no 18) as shown in the Figure 23-35 are affected by flooding due to absence of proper storm water drainage in the roads near them, which are at a higher elevation than the demarcated area. This urban flooding can be eliminated by construction of storm water drains along the road adjacent to this demarcated area. It is suggested to develop storm water drains along all the existing and new roads and priority should be given to such problematic areas identified during the preliminary surveys. On constructing proper storm water drains along the side of the roads, these linear patches of moderate flood prone zones in Ward no 18 can overcome the effect of urban flooding and hence they may be excluded from the design flood

prone scenario for the horizon year. The flood prone zones in the town are further classified into 0.5 meter intervals as shown in Figure 23-36.

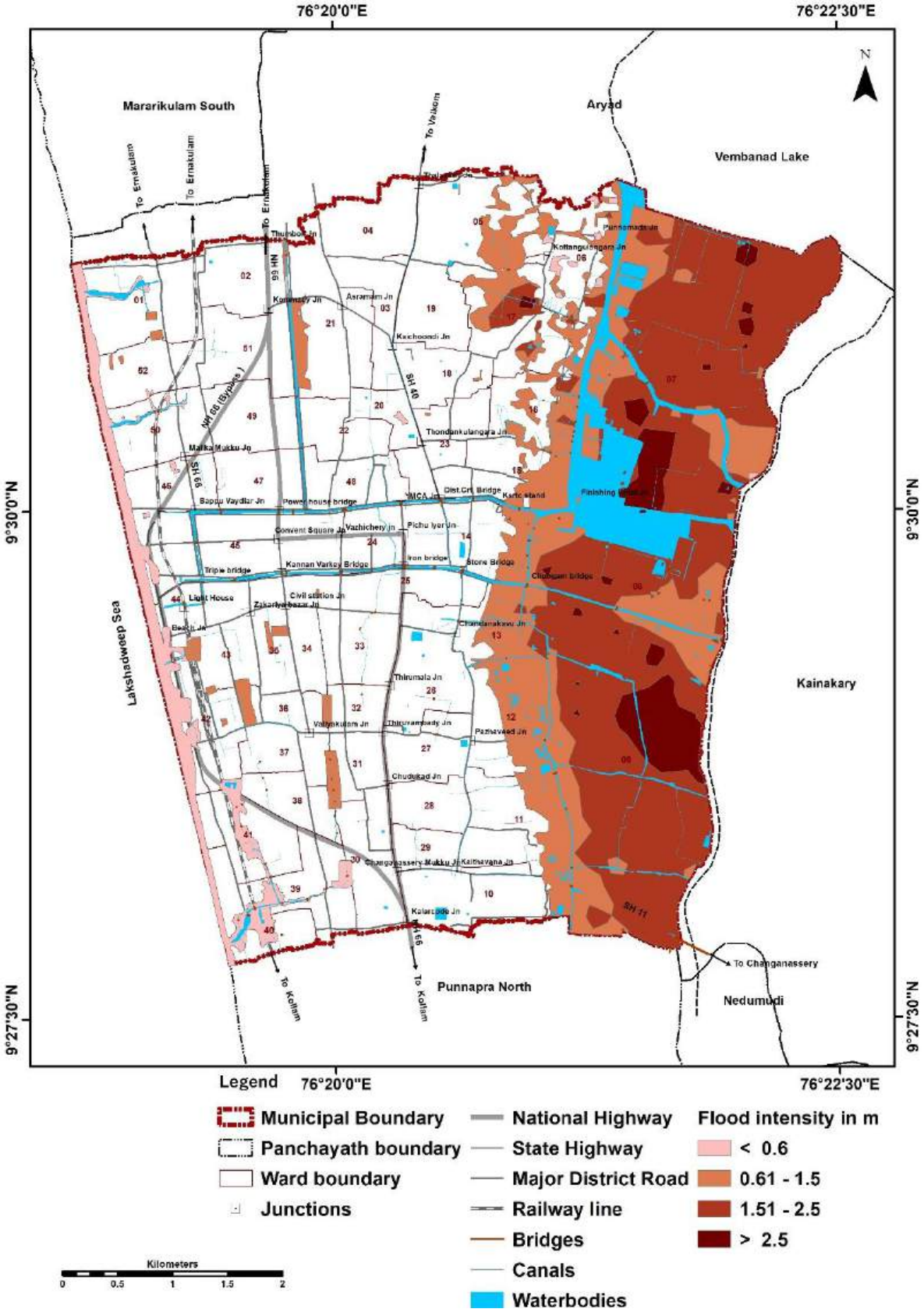


Figure 23-34: Map showing the Flood Prone Zones in the Town

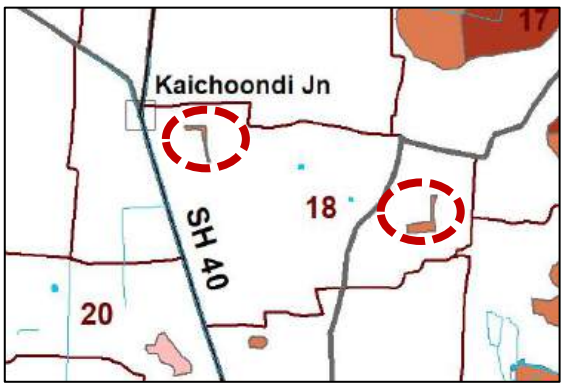


Figure 23-35: Image showing linear patches of moderate flood prone zone in Ward 18

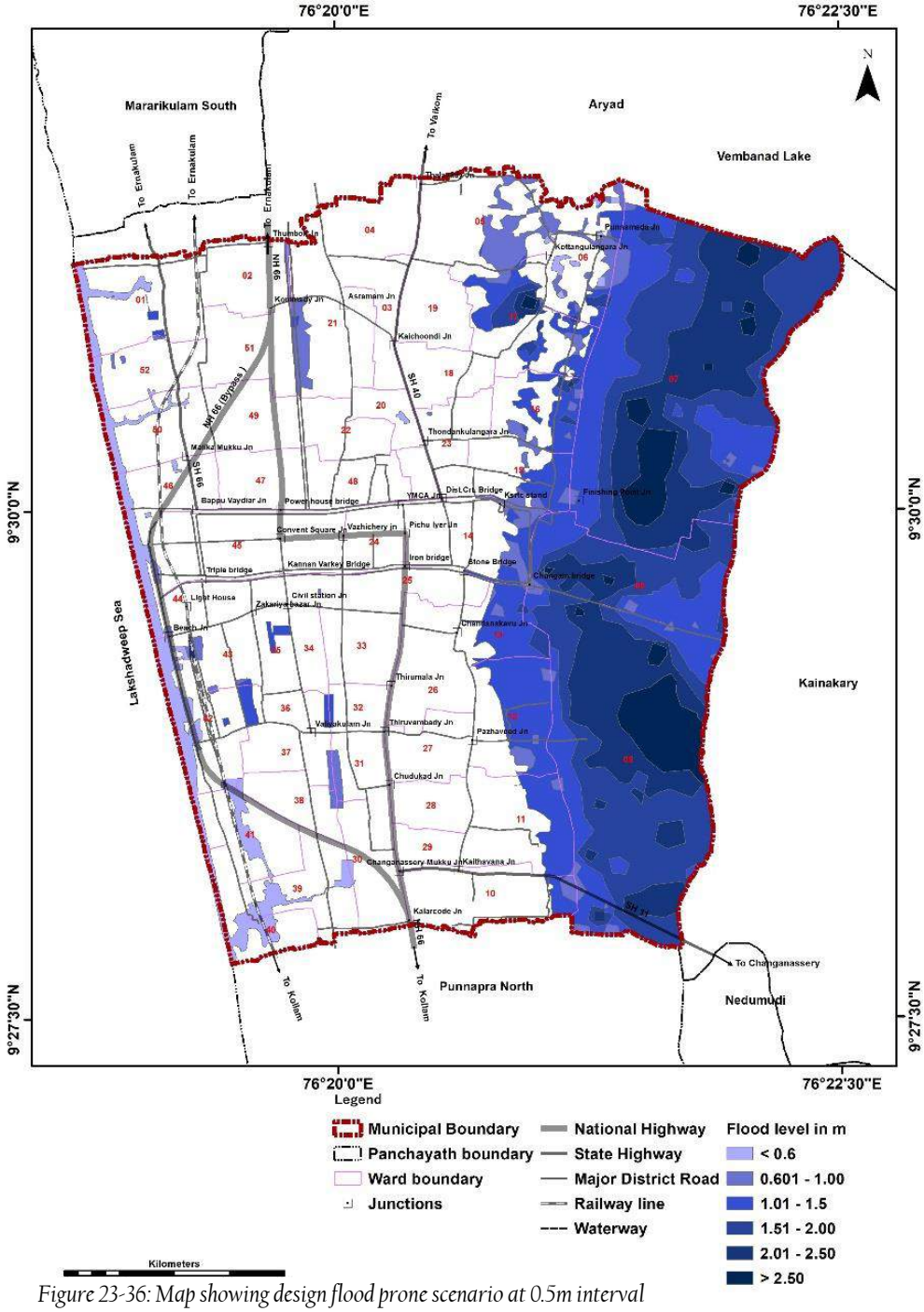


Figure 23-36: Map showing design flood prone scenario at 0.5m interval

23.5 Mitigation of Climate Change

Mitigation is a human intervention to reduce the sources or enhance the sinks of greenhouse gases. Mitigation refers to the amelioration of disaster risk through the reduction of existing hazards, exposure, or vulnerability, including the use of different disaster preparedness measures. Making development more sustainable by changing development paths can make a major contribution to climate change mitigation, but implementation may require resources to overcome multiple barriers (Climate Change 2007: Mitigation of Climat Change). Various options for achieving reductions of global GHG emissions are:

- Changes in lifestyle and behaviour patterns can contribute to climate change mitigation across all sectors. Changes in lifestyles and consumption patterns that emphasize resource conservation can contribute to developing a low-carbon economy that is both equitable and sustainable. Education and training programs can help overcome barriers to the market acceptance of energy efficiency.

- Biofuels might play an important role in addressing GHG emissions in the transport sector. Providing public transports systems and their related infrastructure and promoting non-motorized transport can contribute to GHG mitigation. Taxes on vehicle purchase, registration, use and motor fuels, as well as road and parking pricing policies are important determinants of vehicle-energy use and GHG emissions.

- Energy efficiency options for new and existing buildings could considerably reduce CO_2 emissions with net economic benefit. Energy efficient buildings, while limiting the growth of CO_2 emissions, can also improve indoor and outdoor air quality, improve social welfare and enhance energy security.

- Upgrading the facilities in industrial sector can deliver significant emission reductions.

- A large proportion of the mitigation potential of agriculture arises from soil carbon sequestration, which has strong synergies with sustainable agriculture and generally reduces vulnerability to climate change. Improved agricultural management can reduce net GHG emissions. The most prominent mitigation options in agriculture include; improved cropland management, restoration of degraded lands, rice management, livestock management (including improved feeding practices, dietary additives, breeding and other structural changes) and improved manure management.

- Existing waste management practices can provide effective mitigation of GHG emissions from this sector. Waste minimization, recycling and reuse represent an important and increasing potential for indirect reduction of GHG emissions through the conservation of raw materials, improved energy and resource efficiency.
- Afforestation can reduce wasteland, arrest soil degradation, and manage water runoff. It can generate rural employment and create rural industry.

Though the above-mentioned strategies have to be implemented at a policy level, some of the short-term strategies that can be adopted at the municipal level for alleviating the effects of climate change are listed below.

- Usage of solar system for street lighting
- Target based shifting to renewable energy sources by institutions owned by Municipality and government
- Retrofitting of local and governmental institutions with rain water harvesting and recycling of waste water.
- Ensuring implementation of solid waste management measures

23.6 Adaptation to Climate Change

Adaptation is a process through which societies make themselves better able to cope with an uncertain future. Adapting to climate change entails taking the right measures to reduce the negative effects of climate change (or exploit the positive ones) by making the appropriate adjustments and changes. It involves efforts to limit our vulnerability to climate change impacts through various measures, while not necessarily dealing with the underlying cause of those impacts. It should reduce the vulnerability of people and their resources to the risk of natural hazards associated with climatic variability and extreme events.

The impacts of climate change are spread over all sectors of the economy and every strata of the society. The various physical effects such as increased temperature and rainfall, sea level rise etc. creates hazards and vulnerabilities on different sectors. Adaptation needs identified for the vulnerable sectors and solutions to fulfill the needs are shown in Table 23-5. Each adaptation option may involve several actions which are practical measures of adaptation that help to build up the adaptive capacity and reduce vulnerability in each sector.

Table 23-5: Adaptation Needs & Options for Various Sectors

Impacts	Adaptation Needs	Adaptation Options
Agriculture, Fisheries, Animal Husbandry		
▪ Decline of crop/ Animal/ Fish Productivity ▪ Crop Damage	▪ Enhance the resilience of crops, animals, fish and agro - ecosystems against heat and water stress.	▪ Promotion of resource efficient farming systems.
Water Supply		
▪ Decreased Availability of safe water ▪ Salt water Intrusion	▪ Enhance the resilience of systems for water supply, management and use to overcome the scarcities caused by climate change impacts. ▪ Decreased water quality.	▪ Improvement of watershed management. ▪ Capacity development of storage facilities. ▪ Promote efficient practices of water management and use. ▪ Improve salinity protection measures in coastal areas.
Coastal Area / Environment		
▪ Damages to coastal protection structures ▪ Decline in beach stability ▪ Loss of eco-system services	▪ Enhance the resilience of coastal area. ▪ Enhance the resilience of natural ecosystems against climate change impacts.	▪ Strengthening the coastal protection and management ▪ Enhance the participation of local communities in management of eco system. ▪ Conduct awareness programs on sea level rise and extreme events to coastal communities to empower them for facing the risks of climate change.
Tourism / Recreation		
▪ Decline of scenic attractions and aesthetic value ▪ Decline of cultural assets ▪ Loss of recreation opportunities Damages to tourism infrastructure	▪ Increase the preparedness of tourism and recreation operations to extreme weather conditions.	▪ Changing of promotional strategies ▪ Identify tourism facilities in vulnerable areas and make arrangements to increase the climate resilience of them.
Infrastructure		
▪ Increased Severity /Frequency of cyclones/Wind, Flood, Drought etc.	▪ Increased incidences of diseases and injury. ▪ Increased demand for health and sanitation facilities.	▪ Promote climate resilient building designs.

23.7 Way Forward

Aspect	Issues	Way forward
Flooding	Urbanisation and sprawl into the flood plains Loss of wetlands, marshlands and reclamation of water bodies	Preparation of an integrated unified storm water drainage map which offers a blueprint of the existing canals/water bodies, preventing further reclamation and providing conservation status to it. For the future, the room for water concept with the help of green infrastructure could be adopted by integrating the pampa river and other natural drains and the wetland and farmlands surrounding it.

	Unpredictable rain patterns Silted and garbage laden canals	Elevating / flood proofing/ advising of free board for buildings coming within the flood plains. Development must not be allowed on properties where the depth and flow of flood waters would create a hazard.
Biological threats	Pandemics/ epidemics- containment of spread. Known vector diseases	Dedicated areas/ makeshift areas for treatment, isolation and quarantine are less and therefore needs to be identified within each ward as assets which could be used in emergencies. A fool proof strategic plan for future pandemic spread should be developed for the Municipality.
Drought	Variations in Rainfall pattern and extreme rainfall events, along with depreciation. Ground water depreciation	Rejuvenation of water bodies, natural drains like thodu, chal, ponds and wetlands. Rainwater harvesting and subsequent ground water replenishment through quarries ponds and other water bodies. Guidelines for water conservation and training at ward level in water conservation.
Climate change	Change in temperature and precipitation can change local human and natural ecologies Fluctuation in rainfalls can lead to loss of fertile lands, drinking water depreciation, vector born diseases, economic setbacks etc.	An updation of District Disaster Management plan 2015, to handle further disasters like extreme rainfall events, landslides, floods and pandemics which are of recent occurrence by the DDMA is advised. A hazard vulnerability assessment and developing a municipal disaster management plan mapping out areas that are hazard prone, relief areas, and emergency routes which can be accessed using web portal with live updation in case of an emergency can be done with the help of technical universities. Plans to improve the efficiency of energy use, especially in governmental functions, in order to reduce impacts of possible future energy price increases. Community based disaster mitigation programme can be conducted within the Municipal area, training volunteers in emergency responses like first aids, search and rescue, emergency camps etc. Early warning systems plan within the town to integrating public addressal systems and telecommunication without giving room for unnecessary panic and spread of fake news and to give out transparent information easily. Local bodies play a key role in reaching out to the people during a disaster and therefore training of local body members needs to be done for immediate deployment. Training for strengthening differently abled against vulnerability to disaster. Urban forests with endemic species of carbon sequestration capacity could be adopted as a model by the town which could be adopted elsewhere.

24 SECTORAL PROPOSALS

24.1 Agriculture

24.1.1 Promote Paddy Cultivation

It is proposed to promote, encourage and sustain paddy cultivation for maintaining the environmental balance. More over Kuttanad region is popularly known as the rice bowl of Kerala and is also included in the Special Agriculture Zone within the state by the Department of Agriculture. Interventions to promote paddy cultivation by providing assistance to undertake fallow land cultivation, upland cultivation, conversion of single crop to double crop and promotion of specialty rice will help to achieve increase in rice production.

- In Alappuzha most of the paddy fields are managed by the padashekhara samithis in which farmers group together and cultivate the rice in the pooled paddy area. For the efficient and profitable paddy cultivation it is suggested to strengthen the group farming activities in paddy fields.
- Supplying high yield variety seeds, adopting new farming techniques etc. shall increase the productivity of the existing paddy fields. The availability of seeds suitable to the locality can be ensured through the Registered Seed Growers Programme (RSGP) of the Department of Agriculture.
- One of the main reason for not cultivating paddy is the labour cost and shortage of labour. Hence it is proposed to provide adequate labour supply through labour bank system. Labour banks may constitute labourers from different parts of the town, district as well as the state. Migrants from outside the state can also be utilized as labour force by providing proper training to them.
- The assistance of AUEG workers can also be adopted during the initial stages of land preparation, for creating micro irrigation canals around the paddy fields etc. which will help to reduce the cost of cultivation. The help of Kudumbashree collectives can also be adopted to increase the crops cultivation.
- Rice mills and parboling units to undertake local processing, packing, branding and marketing of rice and rice products including mini rice mills and special mini rice mills to process specialty rice varieties are also proposed be established through Padasekhara Samithis/ Co-operatives/ NGOs/ Farmer entrepreneurs.

- A crop calendar is suggested for the cropping pattern for the area, as per the suggestion of M S Swaminathan Commission report to ensure supply of machinery for planting and harvesting and also to fix the dates of opening the Thannermukkom regulator for salt water intrusion.
- Proper utilization of Rice Innovation Fund of the Department of Agriculture for supporting innovative activities like attracting youth towards rice farming, linkage with environment conservation, organising rice sports, promoting rice arts, rice and culture and other novel activities.
- New eco-friendly and sustainable technologies may be adopted to improve paddy production.

24.1.2 Promote Coconut Cultivation

It is proposed to promote integrated coconut cultivation within the municipal area through better agro management practices and promotion of multi species cropping and farming systems.



- Keragramams are proposed to increase the production and productivity through the activities such as replanting, integrated pests and disease management, integrated nutrient management, promotion of inter cultivation, improving irrigation facilities, promotion of value addition, ensuring availability of quality planting materials and employment generation.
- Farmer Producer Organizations (FPOs) need to be formed, trained and facilitated to take up the production and distribution of quality planting materials. They are to be facilitated to take up production and marketing of organic products and incubation support provided to them through appropriate entrepreneurship programmes.
- It is proposed to promote the production of value-added products like desiccated coconut, beverages, shell-based products, coconut cream, Neera, coconut milk, coconut sugar, coconut chocolates etc. with appropriate tie up with credit and marketing agencies.
- Empower local entrepreneurs, women SHGs and FPOs through skill development in production and marketing of value-added products.

- Organise capacity building programmes on eco-friendly crop protection technologies for coconut to benefit extension personnel, farmers, palm climbers and agriculture labourers.



Figure 24-1: Coconut Products

- Implement farmer participatory extension interventions to enhance adoption of eco-friendly crop protection technologies in coconut.

24.1.3 Promote Homestead Farming/ Roof Top Farming

Homestead farming is an operational farm unit in which a number of crops are grown, mainly for the purpose of the farmer's basic needs. It is proposed to promote homestead farming within the Municipality to attain self-sufficiency in vegetable production. In view of the rapidly growing demand for the organic food and home-grown vegetables, variety of food growing models can be adopted in high rise residents in urban areas. Vertical and homestead models of cultivation in pots, grow-bags and rows etc. should be promoted which allow families who stay in congested urban areas to grow anywhere between 20-40 plants on a single stand that can easily be housed on balconies or small terraces. Terrace farming also innovatively use water, with sprinkle, drip and stick irrigation systems that are highly eco-friendly.



Figure 24-2: Roof Top Farming Practices

24.1.4 Promote Organic Farming

Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. Many techniques used in organic farming - such as inter-cropping, mulching, and integration of crops and livestock - are practiced under various agricultural systems. What

makes organic agriculture unique is that, under various laws and certification programs, almost all synthetic inputs are prohibited and "soil building" crop rotations are mandatory. Properly managed, organic farming reduces or eliminates soil and water pollution and helps conserve water and soil on agricultural lands. Organic farming is one of several approaches to sustainable agriculture. Most studies have found that organic agriculture requires significantly greater labor input than conventional farms. Therefore, the diversification of crops typically found on organic farms, with their different planting and harvesting schedules, may distribute labor demand more evenly, which could help stabilize employment.

To attain self-sufficiency in case of vegetables it is proposed to promote organic farming. Possibility of exporting vegetables also to be explored. Integrated farming practices (Fish rearing and fodder cultivation in coconut plantations, vegetable plantation on top of fish ponds) are also proposed which will assure livelihood security by integrating enterprise and resource utilization. It will enhance the productivity and profitability to the farmers.

24.1.5 Promote Floriculture

Floriculture has a vital role to play in the socio economic upliftment in terms of its capacity for employment and income generation particularly for women. Commercial cultivation of high value flowers as a group activity especially in small homesteads, has lot to offer in empowering the women and youth both with sustainable income and self-employment opportunities.



Figure 24-3: Integrated Farming Practices

- A flower growing zone can be promoted which will provide sustainable source of income to the farming community.
- There should be initiatives from the Municipal administration and agriculture department to give sufficient awareness and know how among the farmers about the cultivation of flower crops.

- They should also be supplemented with sufficient infrastructure, Good quality planting materials, proper marketing channels and financial assistance. It will also help in promoting commercial cultivation of flowers in homesteads, open fields and poly houses for income generation.
- The flower crops such as Jasmine, Marigold (*Chendumalli*), *Parijatha* or Indian Magnolia, Different types of Hibiscus, crown flower (*Erukku*), Nerium Oleander(*Arali*), Ixora coccinea (*Chethi/Thechi/Thetti)*, Saraca Indica *(Ashokam)*, Gomphrina Globosa (*Vadamalli*), Chrysanthemum (*Jamanthi*), *Pichakam / Pichi*, Michelia Chempaca*(Chempakam)*, *Leucus aspera (Thumpa)*, *Nandyarvattam, Tulsi, Koovalam* etc. can be cultivated. Also '*Dasapushpams' (Karuka, Mukkutti, Nilappana, Krishnakranti, Povamkurunnila, Thiruthali, Kayyunyam, Cheroola, Uzhinja, Muyalcheviyan)* can be cultivated which are used for festivals and during important occasions.

  The following kind of farming systems can be adopted:

  - Inside protected structures like poly houses and rain shelters
  - Open fields
  - Homesteads
  - As inter crop in coconut plantations



Figure 24-4: Floriculture

- Clusters can be formed by grouping each of the above mentioned farming systems such as poly house cluster, open field cluster, homestead cluster and grow bag / pot cluster. Each cluster should have a specific number of farmers. There should be a leader for each cluster. Preference can be given to women farmers, unemployed youths and SC/ST farmers.
- Good quality seed / planting materials should be provided to the farmers from the authorities at subsidized rate if possible.

- A flower marketing society and collection center can be established for the procurement and marketing of flowers. It will facilitate collection, post-harvest management, packing and marketing of flowers inside and outside the town, depending on the requirement and ensure sustainable returns to the farmers.

24.1.6 Proposal for Agro Service Center

Agro Service Center (ASC) is proposed to facilitate integration of services like mechanisation, credit support, soil testing support and other technology-based services and thus to improve the production and productivity of crops and to motivate the farmers. It acts as a technology and information disseminating centers with facilitating role in field visits.

- A mobile farm clinic may be established to provide solution to the field problems equipped with audio visual and online support.
- Each ASC should have trained working groups and they should be given with training in usage and repair of machines and other equipments, plant protection activities etc.
- ASCs can also be involved in agricultural practices like land preparation of padasekharams, plant protection measures, harvesting, fallow land cultivation, preparation of land for school gardens, preparation of grow bags for terrace cultivation etc.
- Bio pharmacy and nurseries can also be started so that plant protection measures and planting materials are made available for the farmers. Bio fertilizers and bio pesticides can be made available in the bio pharmacy.
- Awareness programme may be conducted to farmers and other beneficiaries about the services available in ASC, and the practices followed in there and its benefit in crop production.
- Effective communication may be provided to farmers regarding other facilities such as Bio pharmacy, soil testing facility, organic manure unit etc. available in ASC and its important in productivity improvement.
- Farmers may also be made aware through ASC about the latest scientific agricultural practices available.

24.1.7 Weekly Markets for Agriculture produces

Weekly markets are proposed at important junctions for the farmers to sell their goods directly at affordable price. The main aim to suggest these markets is to make availability of

local goods to the public without the intermingling of mediators. Locally cultivated vegetables, fruits etc. can be sold here.

24.1.8 Labour bank

Some of the major problems faced by agriculture sector is subdivision of agriculture land, non-availability of agricultural labours, machineries and noncooperation among different government agencies. For making solutions to these problems, a labour bank can be formulated at ward level to undertake the agricultural activities. The details of the agriculture labours may be kept in a register in the Municipality and Grama Panchayats. The agriculture labourers may be supplied from the labour bank to the cultivators based on demand. This programme can be implemented jointly by Krishibhavans, and the Municipality.

24.2 Animal Husbandry

24.2.1 Promote Integrated Duck Farming

The Kayal banks of Alappuzha are suitable for duck farming. Integrated Duck Farming may be promoted by those who are residing near backwaters. People who are interested in duck farming may be identified by conducting surveys by the Animal Husbandry Department and project reports prepared for scientific duck farming. The ducklings may be given to the beneficiaries selected through agriculture and ancillary development center.

- Rice – Fish – Duck integrated practice or duck cum fish farming can be promoted in homesteads near backwater.




Figure 24-5: Integrated Duck Farming Practices.

- Group activity in duck farming can be promoted among woman or SHGs by providing financial assistance to them.
- Promote marketing and branding for duckery based products.
- Financial assistance should be given for infrastructure development such as packaging and processing units and cold storages.

- Duck farmers should be educated with good production practices which can control duck diseases and also should practice bio security.

24.2.2 Promote Fodder Cultivation

Fodder cultivation has become an immediate necessity for promoting dairy development activities and to support the development of livestock sector. Assistance from the Dairy Development Department should be ensured.

- Small scale fodder cultivation at individual level is to be promoted in all the possible homesteads.
- Promote the production and conservation of fodder in farmer fields and diary cooperatives, commercial and massive fodder production in barren lands and waste lands.
- For reasonably large-scale fodder cultivation, plantations can be established along the natural drains by individuals or dairy units.



Figure 24-6: Fodder Cultivation

- Assistance should be given to farmers for mechanization of fodder cultivation and harvesting, irrigation facilities etc.
- Good quality seeds should be provided for farmers and promote dual purpose varieties of crops which has the potential of meeting fodder requirements in season and off - season.
- Encourage fodder production on commercial basis by bringing out farm mechanization to improve the productivity so as to reduce the cost of production in terms of labor, both human and bullock.
- To familiarize the cultivation of green fodder, commercial fodder production, cultivation of fodder in cultivable wasteland under irrigated condition, to get maximum yield by timely operations, constant timely interaction and persuasion to establish the crop should be given to farmers, in addition to the available amenities.
- Provide irrigation assistance for existing fodder plots having source of irrigation. Pump sets, storage tanks, connecting hose, sprinkler system, drip system etc. can be established. Assistance may be given for rain water harvesting also.

- Assistance should be given to women groups to take up fodder cultivation and marketing to the needy farmers.
- Better credit facilities at low interest rate have to be made available to the farmers.

24.2.3 Slaughter House

Proposal of revitalization of abandoned slaughter house near private bus stand. Modernization contains an effluent plant and subsidiary treatment facilities and also it would involve scientific slaughtering of animals, including facilities to bleed out the animals completely and coagulation of the blood to turn it into fish feed.



Figure 24-7 Modern Slaughter house



Figure 24-8 Effluent plant in Slaughter house

24.3 Fisheries

Alappuzha is one of the leading districts in inland fish production which holds promising future in Kerala. Insufficient availability of good quality fish seeds has been identified as a major problem. To increase the production of good quality fish seeds, it is required to strengthen the existing hatcheries, nurseries, fish farms and construct new units to the existing infrastructure.

24.3.1 Promote the value addition of marine products.

Value addition means "Any additional activity that in one way or another changes the nature of a product, thus adding to its value at the time of sale". Fish processing can generate a lot of byproducts that maximizes the economic potential of a community. The fish processing byproducts can be turned into food, fish meal, fertilizer, pharmaceutical and other marketable products. Value addition makes the fish more visible and acceptable to all for the following reasons:

- Ready to cook and ready to eat fishery products.
- Increases the value.

- More returns generated from the same quantity of fish.
- More convenient products for consumers.
- Minimum issues of waste disposal for consumers in urban areas.
- More quantity and variety from a given quantity of fish.
- Utilization of unconventional fish varieties.
- Attracting more consumers towards fish consumption.
- Products for those who are afraid of thorns / bones in fish.
- Products for those who don't like fish smell/flavour but appreciates its nutritive value.
- Increases the bulk of the product – eg: Batter and Bread crumbs - in turn reducing cost.



Figure 24-9: Various fish products

- Value addition can be achieved by:
  - ✓ Improved infrastructure facilities on – landing centres/fisheries harbours, water, ice, storage, drainage, transportation etc.
  - ✓ More primary processing centres – for fish dressing, value addition etc.
  - ✓ Changing the mindset of stakeholders through awareness creation – inculcating the necessity /importance of proper handling/preservation, hygiene, product development, product presentation etc.
  - ✓ Training programs, Awareness campaign, Group interactions, Special Drives, Exhibitions/ Fairs, Posters, Pamphlets, Brochures etc. can also be prepared.
- Utilization of low cost fish either from fresh water or marine water as a raw material for making different types of value added products which are equally good from nutritional point of view can be a potential option for fisherwomen, women self-help groups and unemployed youth. Women self-help groups are the potential users of the value-added fish product technologies.

24.3.2 Promote "Oru Nellum Oru Meenum" (One paddy one fish) Programme

This project aims the rotation of fish culture with paddy culture; implemented by the department of fisheries. The programme aims at sustainable aquaculture through rotation of rice or fish farming. Rice farming with fish culture is a type of duo – culture fish farming system in which rice is the sole enterprise and fishes are taken to initiate additional for extra income.

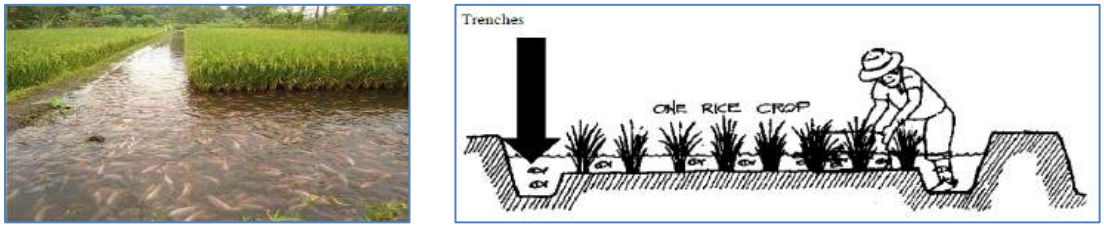


Figure 24-10: One paddy One fish farming

In addition to padasekharams, derelict areas where paddy cultivation is not practiced now can also be developed and will become suitable for paddy cultivation. Production of herbivorous fishes like Grass carp that relish on aquatic foliage will facilitate biological control of weeds – a boon to paddy cultivators.

24.3.3 Promote Aquaculture

Aquaculture plays an important role in the development of fisheries sector. The waterlogged areas including unutilized paddy fields can be brought into fish/prawn culture farms. Aquaculture can be an important driver of local development, providing employment and incomes, and contributing to the social cohesion of the area. It can also contribute to raising the skill levels of the local community. Aquaculture can also be a source of additional revenue for other local businesses. It increases the area's attractiveness, helping to boost tourism

This project can be commissioned with the help of Central Institute of Brackish Water Aquaculture and the Kerala Fisheries Department for multi-species hatchery in the Eastern side of Alappuzha Town areas and which are expected to give a big boost to aquaculture in the State. The agency will provide scientific and technical support to the government for developing captive breeding and seed production technology for the commercially important brackish water fish varieties like Anabus, Asian sea bass, Milk fish, and Pearl Spot.

Raising awareness among the local community and building trust

- Build linkages between aquaculture producers and the local community, so as to raise awareness and trust in aquaculture.

- Support skill development among the local inhabitants, and help to strengthen business linkages within the area, for example by organizing business-to-business events.
- Support networking between producers willing to develop similar initiatives to exchange knowledge and experience;

Promotional activities to convince consumers to buy local aquaculture products

- Fish/shellfish festivals and fairs, with attractions such as tasting sessions, angling competitions, etc.
- Cookery books with recipes or cooking lessons showing how local fish can be prepared (this can be particularly important for some, especially freshwater fish species which have a reputation of being difficult to cook).
- Activities organized jointly with local schools and youth organizations to promote fish consumption and healthy lifestyles.
- Working with local canteens in schools, kindergartens, hospitals, prisons etc. to encourage them to serve locally sourced fish.





Figure 24-11 Images showing Brackish Water Aquaculture

24.3.4 Improving fish landing center

Fish landing centers are very much important for supplying fresh harvested fish to the different fish markets which helps to improve the livelihoods of fishers and fishing communities. Construction of new fish landing centres and improving the facilities and capacity of the existing fish landing center by providing modern and hygienic facilities for the fishermen and fish traders and facilities for berthing, landing,



auctioning, cold storage, freezer storage and transport, which is located at the immediate vicinity of the South municipal boundary. To enhance the facilities, feeder roads from the sea coast to main roads should be constructed or repaired along with facilities such as electricity supply, sufficient water supply, sufficient ice supply, drainage system, storage facility, net mending centre and office room should be provided.

24.4 Industry

Municipality should take necessary actions to promote the development of industries in the town since the industrial development is in a slow pace now. To develop Alappuzha as an economically vibrant town, focus is given for traditional coir based industrial development.

24.4.1 Modernization of Coir Industry

Kerala being the home state of Coir Industry with traditional skill for the production of quality export oriented, value added, coir products provide employment to large number of artisans. Alappuzha is pioneer for coir and coir products earlier and is now in a declining stage. Modernization of coir industry can accelerate the economic growth of the local community as well as the town.

i Modernization of Production Process

- Modernization of production processes should start from extraction of fiber from husk to manufacturing of value-added products. This helps in achieving higher productivity, enhanced earnings, reduction of drudgery in operations and evolving eco-friendly production processes.

ii Development of Machinery and Equipment's

- Promote the design and development of innovative and modern machinery (for spinning coir yarn, extraction of coir fiber, weaving coir products etc.) to achieve higher productivity, cost effectiveness and improvement in quality.

iii Product Development & Diversification

- Promote product diversification (Coir Bags, Coir Geo Textiles etc.) by blending coir with other natural fibers.

iv Development of Environment Friendly Technologies

- Promote the development of appropriate technologies for the promotion of eco-friendly production processes.




Figure 24-12: Coir bags & Coir Geotextiles

v Technology Transfer, Incubation, Testing & Service Facilities

- Provide trainings on spinning of thin yarn, weaving of different variety of fabrics, winding of bobbin, cops etc.
- Establishment of market for coir fiber. Strengthening of market and marketing facility in and around the town is proposed.
- Municipality may extend support to the existing entrepreneurs and encourage new entrepreneurs to start units for manufacturing value added coir products by using the locally available coir fiber of coir units. Ensure the quality of coir products by adopting strict quality control measures.

vi Women Empowerment Through Value Addition of Coir Products

- Provide financial assistance to woman artisans in coir producing regions. Conversion of coir fibre into yarn on motorized ratts in households provides scope for large scale employment, improvement in productivity and quality of coir fiber, better working conditions and higher – income which ultimately leads to the improvement of standard of living of woman artisans.



- Improve value addition and access to technology and information.

vii Promotion of the sale of Coir and Coir products

- Enhancement of sale of coir products through various marketing outlets of coir Board's Showrooms and Sale Depots. Co-operative Societies, Public Sector Enterprises etc.
- Popularize coir and coir products by way of organizing exhibitions, carrying out publicity propaganda through audio & visual media, organisation of sales campaign, bringing out brochures, pamphlets, erection of hoardings etc.

24.4.2 Promote Handicraft Industries



Handicraft enterprises can be promoted as a family oriented economic activity. It helps them to earn and sustain themselves and can be established with less amount of capital. It is proposed to promote the handicraft industries within the town; using the available raw materials such as coconut shells, wood, clay, coir, palm leaves etc. Promotion of handicraft industries should be done with the help of apex agencies such as Kerala State Handicrafts Apex Co-operative society (SURABHI), Handicraft Development Corporation (HDCK), And Kerala Artisans Development Corporation (KADCO).

i Social Interventions

- Develop clusters or Self-Help Groups for specializing production of a particular handicraft.
- Provide identity cards to the artisans.

ii Technological Interventions

- Promote the development and new innovations in various handcrafted products.
- Promote the development of new production technologies and supply modern tools.
- Conduct design & technical development workshops on new technologies and diversified handcrafted products.



Figure 24-13: Various Handicraft Products

- Conduct skill development / Training programmes/ Seminars/ Symposiums for handicraft artisans.
- Ensure the availability of raw materials for developing handicraft products.

iii Marketing Interventions

- Promote the exporting and online marketing of these products.
- Craft Bazaars / Melas may be planned at various locations.
- Provide publicity through print and electronic mode and brand building campaigns.

iv Infrastructure Related Interventions

- Establish Common Facility Centre for Handicraft Industries to supply tools/ equipment's to make standardised products and other service facilities.
- Establish resource center for major crafts.
- Create raw materials bank and E- Kiosks.

24.4.3 Proposal for Common Facility Center

In ward number 11 an area of 0.058sq.km is demarcated as a special zone for development of common facility center for the agro industrial sector, so as to promote the development of various agro based products. They are supposed to provide machineries required for agriculture or for any other industrial units. Storage facilities, marketing facilities, effluent treatment facilities etc are to be provided.

- Creation of tangible "assets" like Testing Facility, Design Centre, Production Centre, Effluent Treatment Plant, Training Centre, R&D Centre, Raw Material Bank/Sales Depot, Product Display Centre, Information Centre, any other need based facility.
- The constructions in this zone should be flood resilient.
- A retention area is also proposed in this special zone to retain the flood water since the proposed area falls in the medium flood prone zone.

24.4.4 Proposal for Skill Development & Training Center

Skill Development and Training centre is proposed at the best accessible area for the upliftment of youth as well as educated and uneducated unemployed peoples coming in all age groups without any gender bias. The approach of this programme mainly covers two aspects, one for youth / teenagers aiming to develop them by proper career guidance and trainings as per their interest with the help of Government schemes like Kaushal Kendra, ASAP etc. The other one emphasis on skill development and training for all age group including uneducated peoples, which can be work out in ward level or street level.

- **Kaushal Kendras** can be set up with the support of Kerala Academy for Skills Excellence(KASE) as part of employment enhancement programme. Kaushal Kendras are community skill parks focused on rural youth with world-class training facilities for Language Lab, Digital Library, Assessment and Counselling Centre, and Multi Skill Centre with video conferencing facility for skill training in various sectors. The language lab will impart functional english skills for different levels, from students to workers.
- The Assessment and career guidance cell of kaushal kendra will help each person to identify their right aptitude. The assessment is done with the help of an online scientific aptitude tool and based on the results generated and by taking into account the socio - economic background of the candidate, career guidance is provided by qualified personnel.
- Multi Skill Centres provide round-the-year placement linked practical training. Multi Skill Centres are being set up as skill training hubs focused on rural population where the students receive hands-on training in various technical and vocational skills which are designed to meet industrial requirements for employment in India and abroad.





Figure 24-14 Conceptual images for Skill Development and Training Centre

- Develop ward level or street level skill development and training programme, which incorporates all peoples from all age groups including educated and uneducated without any gender discrimination. This program can also be act like developing a small scale HH industry which ultimately affects the financial strengthening and economic development of the rural peoples. Some guidelines that have to be follow is given below.
  - ✓ Identification of interested peoples with the help of ward councillors with respect to the activity nodes or streets which is suitable for development of HH industry.
  - ✓ Registration of the members with the help of ULB.

- ✓ Giving guidance programmes and identify the area of interest of group.
- ✓ Giving on site skill development and training programs with respect to the area of interest.

- Innovative training programs like manufacturing of plastic bottle bricks, solar panel assembling units, LED bulb assembling units can also be incorporated in training programme.

24.5 Tourism

Alappuzha has great potential in tourism sector, for the efficient utilisation of the available tourism potentials within the planning area, several development proposals are suggested.

Alappuzha, popularly known as the 'Venice of the East' is endowed with a system of canals, beautiful water fronts and lagoons. On the Western side, the port, the 387-meter-long kadalpalam, the light house on the opposite side, the artistic work of the old buildings on the canal side etc. which are the remains of the earlier splendour of Alappuzha town in the economic, industrial and commercial fields. But now the available resources are not actually tapped in a better way for the development of tourism. If these areas are properly planned and developed, tourists flow to Alappuzha will be much increased and a corresponding impact in the economic activities can be expected. Thus, Alappuzha can improve its importance in the tourist map of India. Keeping in view of the above facts, an integrated tourism development project is to be prepared for the town incorporating the following proposals. Below given are some recommendations to improve the facilities in tourism sector.

24.5.1 Improvement of existing facilities

- Planned development in beaches to be promoted based on detailed study considering the environmental changes, including the changes in beach character. Explore the possibilities of beach sports and delineate specific beach stretches for the same. Beach tourism to include local stakeholders. Incentives and awards for hotels and resorts in the beach area for cleanliness.
- Identify areas in CRZ zones which are able to open for tourism development, promote PPP model of environment friendly development in these areas.
- Responsible tourism to be initiated at all levels. Priority can be given to safety and security of tourists. Daily performing centers across the year, which includes art,

culinary, cultural events etc. Tourism department to act as the pivotal agency to manage all activities regarding tourism in the state. PPP models to be encouraged.

- Along with PPP models, promote training programmes by local body for guidance, servers and part time job opportunities for the local youngsters can boost the responsible tourism and local employability.
- Develop and promote public See-Kuttanad boat service for the domestic as well as foreign tourists.

  1. Cheaper than other tourist boat service with same infrastructure facilities and accessibilities to the tourist destinations.
  2. Provide more service at proper timings which can access good scenic beauty, ethnic cuisine, etc.
  3. Trainings should be given to boat conductors and cleaners in such a way to guide the tourists and give some incentive for the guidance with respect to the tourist's arrival and uses of the service.

- Infrastructure development of tourist areas especially in beach area, house boat terminal. Bleak scenario of basic amenities has to be taken as a serious matter, as it effects in health and hygiene of the locals and tourists and also the environment. Following are the basic amenities that need to be provided in all major tourist destinations.

  - ✓ Lounge
  - ✓ Cafeteria
  - ✓ Parking Facilities
  - ✓ Rubbish Bins
  - ✓ Visitor Information Centers
  - ✓ Telecommunications
  - ✓ Park Benches
  - ✓ Roads
  - ✓ Pedestrian Pathways
  - ✓ Drinking Water
  - ✓ Toilet Blocks/ Comfort Stations
  - ✓ Signage

- Public amenities should be ideally located and should be noticeable. It is important to keep the amenities and its premises well-maintained and clean. Public awareness programs may be organized to understand about the importance of their responsibility in keeping the city clean and maintain hygienic surroundings.

24.5.2 Proposals for new facilities

- Adopt Unique Access System (UAS) for tourism sector. UAS is a single-entry operating mechanism for tourists operated by a committee that consist of selected members from both private and government stakeholders in tourism sector. Advantages of this UAS system are: it will provide data on the tourist arrival and the facilities availed by tourists during their visit. This will help in planning and improving the facilities to be provided for the tourists and help to check whether the spot exceeds the carrying capacity. It will also help in bringing forth a standardized and affordable rate based on tourism facilities, it reduces corruption by the interference of intermediary agents in this sector, it also makes sure, the safety and hospitality of the tourist is well served.
- International standard budget accommodation facilities like Bed and Breakfast (BB), dorms need to be promoted.
- Provide sufficient tourism information centers.
- Develop self-signage showing tourism destination and walkways throughout the main tourism areas and roads.

24.5.3 Tourism Circuits

- Promote heritage tourism incorporating all heritage buildings and developing heritage walk. The detailed description of heritage walk is mentioned in heritage proposal. The location of heritage buildings is shown in Figure 24-15 and the list of buildings is given in Table 14-1 .



Figure 24-15 Location of Heritage Buildings

- Develop small tourism circuit connecting new local tourist areas, cycle paths, and farm tourism activities.
- Develop kayaking and rowing centre near Chungam area. Promote rowing path through Vadai canal, commercial canal, west and east link canals to make a closed circuit.



- Proposal for a cable car connecting the places Ponjikara, DTPC office, Dock Chira.
- Backwater tourism aactivities are concentrated around the Vattakkayal, Punnamada lake and Pallathuruthy river. To promote the tourism activities in these areas, riverside development along the Pallathuruthy river is also proposed.

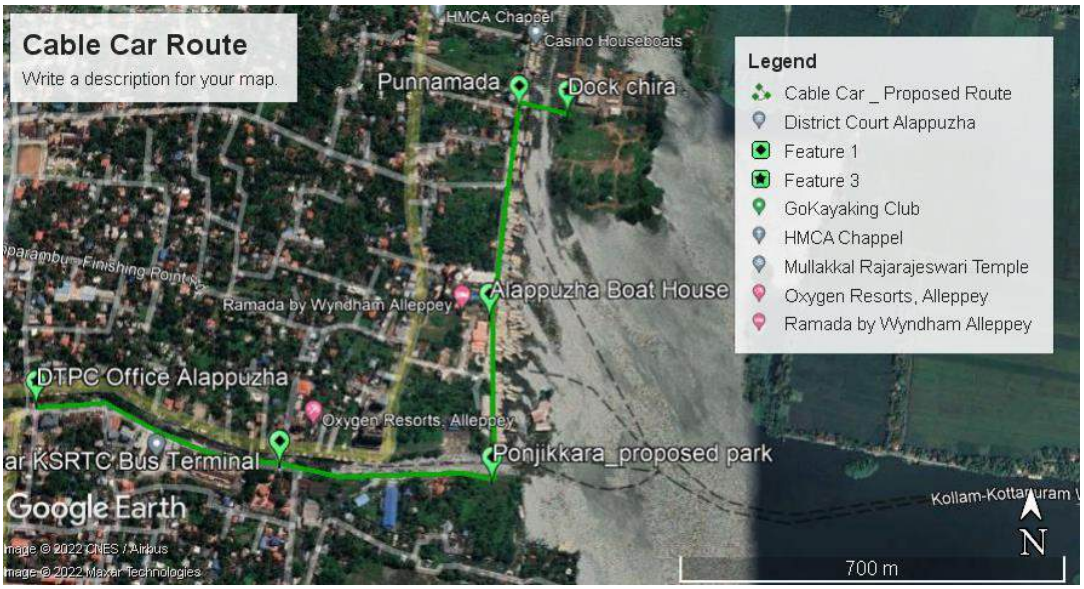


Figure 24-16: Location map of cable car destinations

24.5.4 Linking tourism spots through boat cruise and heritage walk

Different tourism spots in between the major tourism destination backwater tourism and beach tourism can be connected through heritage walk and boat cruise through the canals that run through the town center. Boat landings are provided at intervals to provide easy access to different tourism spots inland and town. Boat has to be designed keeping in mind the special features of local boat design. Tourists will rather cruise slowly through the canals (Commercial canal, Vada canal and Link canals connecting them) seeing heritage structures and sights along the banks, slowing down to take



Figure 24-17: Slow moving cruise for tourists

photographs, stopping here and there to get on land for some time to see heritage buildings or so. Guided tours can be conducted for exploring these tourism spots. Self-guided heritage walk can also be attempted by providing proper signages, brochures, audio narratives etc. Town square can be used as a tourism information and facility center with provision of multi storied parking facilities.

24.5.5 Health Tourism

Promote medical tourism like Ayurveda, Kalari chigilsa, Naturopathy could be an attractive tourism option especially for foreigners. Promote and imply such lifestyle options that can boost immunity and relative stress which are need of the century. Specific research materials could be developed in this line with the aid and approval of all medical practices and could be propagated through medical tourism.

24.5.6 Cultural Tourism

Promote and develop seasonal events like Mullakal chirapp, Kidangamparambu festival, beach festival, Latheen church festivals etc. by integrating with tourism calendar and incorporate domestic as well as international tourists by promoting local crafts, foods, street walks, games, exhibitions etc.

24.5.7 Farm tourism

Along with promoting tourism, 'Farm Tourism' helps to maintain the balance of the nature by giving importance to the natural resources and environment friendly. Usually farm tourism involves:



1. Accommodation
2. Farm visit
3. Farm shops
4. Guided walks in farms
5. Farm activities

Farm tourism makes people rejuvenate themselves through healthy walk in the serene ambience of nature and treat the taste buds by following a healthy diet. These farm houses are also a best spot for shopping natural products. Some among them also provides organic seeds to explore the farmer in tourist. Getting closer to nature is a way to be away from majority of the lifestyle diseases. Experience this directly with the help of farm tourism.

State Tourism department recently has launched "Green Farms Kerala", which aims to revamp agricultural land in the area to tourism destinations. Along with tourism, this will help the local farmers to have financial stability.

Farm tourism helps the tourists to be part of day-to-day agricultural activity. They can also buy products from there along with enjoying the local cuisines. The additional income from this can be utilized for the improvement of agriculture and farming.

Some benefits from farm tourism are:

1. A get together on a farm will be some of the most precious moments in your life
2. It involves group work
3. An opportunity to meet new people
4. Get closer to nature

24.5.8 Culinary Tourism

- Tea café - "Chayakkada" concept have to develop in the main activity nodes of town as well as tourism centres. While emphasising locally sourced and natural building materials, the shops must be constructed in a classic style.
- Develop and promote ethnic foods of settlement like, Konkani, Gujrathi, and even local traditional type foods through developing food areas and small shops or cafeterias adjacent to settlements. This proposal can be worked out with the help of KTDC, Municipality and various stakeholders incorporating the members from the settlements. This joint venture can be purely owned by the respective settlements and the coordination and management has to be controlled by the concerned government authority.





24.5.9 Water Sports Tourism

Promote water sports tourism for domestic as well as international tourists. This project can be worked out by incorporating with government bodies like SAI and KTDC.

Water Sports includes Kayaking, Surfing, Rafting, Catamaram sailing, Bamboo rafting etc. have to located by identifying suitable potential areas with the help of officials and stakeholders. Inorder to utilize the underwater equipment conveniently, skilled personal trainers must be available to assist, guide and let the tourist to know how to use it technically. Observe the guidelines that have been created for risk reduction, operating instructions, SOPs, guides and instructers, equipment inspection and maintenance, emergencies and rescue techniques and trading with assistance from the relavant authorities.





24.5.10 Development of Nehru Trophy area and surrounding

At present the Western side of the Punnamada kayal, where the Nehru Trophy boat race is conducted every year is lying open. During the time of the boat race, temporary pavilions are constructed for the V.I.P.'s, judges and spectators. Every year, money is wasted needlessly on building these adhoc pavilion. Hence it is proposed to acquire 0.6 Hectares of land from the Western side of the Punnamada kayal and construct permanent galleries, pavilion, office etc.

The proposed 18m wide road running along the Western side of this area will improve the accessibility and development of this area. The land between this road and the Punnamadakkayal is proposed to be developed for Tourism. Internal roads, land for commerciall use, fishing, open air theatre and other necessities are provided for in this part of the DTP project for the Nehru Trophy West area.

Besides, on the Eastern Bank of the Punnamada lake, a tourist resort is proposed in an area of 24 hectares. This is an island in the vicinity of the Nehru Trophy Area which is an ideal location for tourist center. Detailed lay out plan is to be prepared for the area with necessary provisions for tourist cottages, roads, yoga centers, health clubs and other tourist attractions like fishing, boating etc.

24.5.11 Promote Accessible Tourism

- Accessible tourism is about providing access to tourism for people from all walks of life and all kinds of backgrounds- provision for disabled people makes up just one fragment of this. Accessible tourism provides opportunities for all types of people to take part in tourism activities. People's needs vary considerably- while one person may have a physical disability, another person may be financially disadvantaged or may not have access to the technology required to organize their trip. By ensuring accessible tourism, destinations are enhancing their business prospects by attracting a wider range of tourists than they may otherwise achieve.

  Accessible tourism involves a collaborative process among all stakeholders in tourism including governments, international agencies, tour-operators and tourists themselves. There are many things to consider when planning for accessible tourism, such as accessing information, travel arrangements to the destination, local transportation, accommodation, shopping, and hospitality.



Figure 24-18 Image showing Accessible Tourism



Figure 24-19 Image showing Accessible Tourism (Disabled)

24.5.12 Promote Aqua Tourism

The aqua tourism is an upcoming avenue for resource generation. Alappuzha, being the hub of backwaters, lakes and wetlands has the great opportunity to use these resources for aqua tourism. With the growth of the "experience economy", many visitors want to take part in something memorable, out of the ordinary. Such visits can offer tourists a more easily accessible experience than going out to sea in a fishing boat. Visits to fish farms can also provide an opportunity to tell the owner's personal story of how they developed the business, and to provide facilities for tasting the products. Thus, an aquaculture producer with good communications skills can become a "tourist attraction". Learning how to clean and fillet a fish can also be a memorable experience.

Fishers can be employed in various sectors of aqua tourism like boating, managing parking lots, transporting visitors from city by non-polluting vehicles like e-rickshaws, establishing eateries, input and service providers for angling etc.

i Angling on fish farms

- It offers tours to the public, who have the possibility of catching their own fish, which can be cooked on the spot.

ii Stairway to Heaven/ Viewing Platforms/Aquatic Homestays/ Erumadams

- A viewing platform/stairway to heaven can be built, which enables visitors to have a bird's-eye view on the picturesque fish lakes and the surrounding backwaters.
- Homestays can be integrated with fisheries for recreation.



iii Promotional Aspects

- Preparation of promotion material on locally farmed fish (brochures, calendars, packaging, recipe book), the organization of events etc.
- Develop local brands to encourage local business.

iv Upskilling of Aquaculture Producers

- To get benefit from aqua tourism to the local economy, fish farmers, or members of their families, must be able to present their work and their products in a way that appeals visitors. Necessary skills should be acquired by them.
- Communication skills (including knowledge of foreign languages, where relevant).
- Business management and marketing skills, to ensure the viability of any new enterprises.
- Other necessary skills, such as health and safety, veterinary, or hygiene regulations, which might be relevant for such activities as taking tourists on a boat or direct sale of fish from the farm, and environmental legislation that can have an impact on the planned activities.

v Promoting Local Tourism Activities

- Set up a consortium to market local products, and develop eco-museums.
- Set up a local agency to coordinate and promote fisheries-related tourism.
- On-site visits to aquaculture farms linked to currently popular activities (e.g. sport fishing).
- Organization of interactive games and thematic routes around the farms.
- Conduct Angling festival and special workshops on angling tips regularly to attract tourists.
- Promote outdoor pursuits such as cycling, horse riding and kayaking, and a playground for children.

24.6 Heritage

The policy in heritage sector is to conserve the built and natural heritage, preserve and showcase the rich cultural heritage, and optimally utilise this potential to enhance the vibrancy and tourism potential of the area. The specific proposals are detailed below.

24.6.1 Restoration and Upgradation of Heritage Buildings

Despite their general good condition, the historic buildings and archaeological structures of Alappuzha are vulnerable to inappropriate or inadequate maintenance. Instead of being done proactively, or as preventative maintenance, the majority of conservation work is done reactively, or as problems arise. So proactive conservation techniques should be adopted for the conservation of heritage structures.

Effective conservation of heritage resources not only aids in preserving and safe guarding the resources, but also in stimulating local economies, and in fetching about a sense of identity, pride and belonging to residents. Conservation comprises all actions to care for cultural heritage sites such as: maintenance, restoration, reconstruction, and their adaptation for subsequent functions different from the initial ones.

- **Heritage Zoning**

Art & Heritage Commission is responsible for the regulation of the developmental activities within the zoned heritage area. They should issue permission for any type of development activity such as new development, redevelopment, additions, alterations, repairs etc. in the zoned area as per the zoning regulations. Possible interventions for conserving the

identified heritage structures can be done by this Committee. Listing , grading and conservation of these structures can also be done by the Committee.

- **Development Controls**

Development guidelines should be issued by the heritage committee to assign architectural controls in the site.

- Regulations on type of buildings and its roofs considering the character of the area and styles of traditional Kerala architecture.
- Regulations to parking and street vending to avoid image obsolescence in major heritage areas.
- Height of new constructions in plots abutting the canal bank roads.
- Individual architectural elements like roof forms and fenestration must work to complement existing local models without striving to replicate historic detailing.
- Projecting cornices, moulded architectural details around lintel, window surrounds etc. are desirable.
- Detailing shall only be an inspiration from the past, exact duplication is not the idea.
- Additions to the heritage structures should respond to their significant architectural character
- New buildings should adopt the scale, massing and setbacks of the existing buildings in the area.
- Use of modern materials like ACP on front façade should be strictly prohibited.
- Signage should complement the historic character of the building and should be limited in extent so as not to dominate the facade.

- **Incentives for conservation**

Ownership of heritage buildings in the study area lies in many different hands. There are many privately owned structures in the region. Most of the responsible parties are not experts in conservation. Individual properties should be managed, maintained and repaired for the conservation of heritage structures. This can cause a burden on the owners if proper incentives for the conservation is not provided. So incentives like TDR, loans with minimum interest rates, tax rebates, aid in kind labour and materials, free consultancies for conservation etc. can be provided.

24.6.2 Streetscape Upgradation

The street elevations should be altered to re-create the traditional look of the streets. Major typical architectural elements taken from the heritage buildings within the study area can be used to provide an architectural character to the area. This will provide an identity and character to the area which inturn increase interest to the visitors.



Figure 24-20: Traditional look of street

Height of new constructions along the canals should be as per the zoning regulations. Additions to the heritage structures should respond to their significant architectural character. New buildings should adopt the scale, massing and setbacks of the existing dwellings in the area. Use of modern materials like ACP on front façade should be strictly prohibited. Street infrastructures like street lights, signage, waste bins, advertisements etc. should complement the historic character of the building and should be limited in extent so as not to dominate the facade.

Relevant landscaping and installations like street lights, Signage, waste bins, advertisements etc. shall be planned for the area. In case of unused buildings, proper adaptive reuse meeting the requirements of the potential proposals could be planned. The whole area could be envisaged as a setting that would take the tourist to the olden times presenting the one of the most important chapters of history to the people.

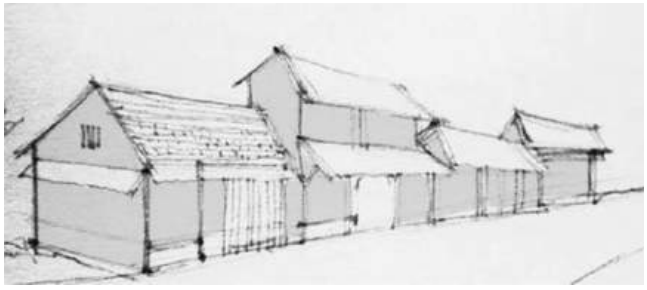


Figure 24-21 Continuous Street Façade to be maintained

24.6.3 Adaptive Reuse of heritage structures

Disused or damaged buildings, structures and sites deteriorate quicker than those in use and do not contribute to the local economy. All disused or damaged historic structures should be identified, and all efforts put into securing their repair and reuse. Adaptive reuse of abandoned structures into restaurants, cafes, home stays, tourist facilities etc. can be applied.

It increases the heritage value thereby preserving the heritage character. It also enhances the economy of the town by putting into effective use of otherwise abandoned structures. Adaptive reuse of the following heritage structures are suggested and this can be carried out in consultation with the Muziris Heritage Project Limited by obtaining approval from the art and heritage commission..

- **Gujarati Cultural Centre**

A Gujarati cultural centre is proposed to be provided in the existing Gujarati School. This will help to provide an insight to the Gujarati culture in Alappuzha. Cultural exhibitions like documentaries, photography exhibitions can be conducted there. Space for cultural performances, visitors' amenities like cafes, information kiosk, art & crafts centre, souvenir shop etc will also be provided in the centre.

- **Port Museum and Maritime Signalling Museum**

Existing port office complex will be revived as Port museum to depict the entire history of Alappuzha town with respect to the port. The exhibits at the museum will take the visitor through the experiences of the town and its people during the ups and downs of Alappuzha's past. Visual and interactive displays will be provided to get an idea about the equipment used, import and export goods, significant personalities in the development, life of citizens in that period etc. Old signal station in the port office can be converted into a maritime signaling museum, which will showcase the rich maritimem signaling heritage.

- **Coir Museum**

Kerala State Coir Corporation Ltd building will be reused as Coir Museum to show how coir evolved through the ages and the history of the coir industry in Alappuzha. The museum content will cover the historical and modern uses of coir. It also allows visitors to understand the various process involved in the production of coir products. The evolution of Alappuzha's coir industry ie from manual means of production to modern, mechanized processes and equipment will be depicted using graphics, audio visuals and other mediums. Equipment used in the process will also be exhibited.

- **Umbrella Museum**

This will offer a comprehensive view on the umbrella industry and displays of technological improvements made to umbrellas. This give an insight to the contributions of local, Alappuzha based umbrella manufacturers.

- **Performing Arts Centre**

A Performing Arts Centre is proposed in the abandoned rice godowns in Chungam area. This will provide a space for performing the cultural art forms. This will help in transmitting the intangible cultural heritage. The intangible heritage helps the visitor gain a deeper understanding about the place and the culture.

- **Gandhi Museum**

Old Madhura company can be developed into Gandhi Museum which will depict the Gandhiji's five visit to Kerala. It also focuses the political leaders, social activities and notable personalities of the region who were inspired by the Gandhian philosophies.

- **Education Museum**

Leo XIII school can be conserved into an education museum which represents the educational heritage of Alappuzha.

24.6.4 Conservation of Ethnic Settlements

This welcomes various ethnic groups back into the town there by constituting the cultural diversity of Alappuzha. In the study area three ethnic settlements were identified namely Brahmin settlement near Mullackal Temple, Gujarati Settlement near West link canal and Konkani settlement near Konkani Temple. Heritage buildings in these settlements will be preserved and protected. Traditional style foot paths to the street from road connecting the street to town roads will be set up. Information counters and shops which supply ethnic foods and articles are encouraged to get an experience of their unique culture.

24.6.5 Heritage Walk

Heritage walks have become an innovative source of learning opportunity for society and for preserving heritage, simultaneously. Heritage walks can drive shared value among various stakeholders. They have not only been promoted as recreation activities or for exploring cities and their rich heritage but also as a tool for old city revival and heritage management. The proposal is to create a self-guided heritage walk in the streets of Alappuzha. Narratives will be created for the pedestrian travelers through interpretive signage on the streets.

Outdoor display panels will be given on the streets, heritage buildings, houses of famous personalities of Alappuzha etc. Way finding facilities will be provided for ease of navigation. Old photographs can be put up on building walls to show the building in its old

context. Digital applications can be designed to provide audio tours of streets. Brochures for various types of tours like cycling tour, heritage walks, hop-on hop-off boat rides, museum circuits etc. can be provided at all museums.

Street furniture will be provided at regular intervals. Public art can be commissioned to impart character to some areas. Guided tours can be planned for children with activities like traditional street games (Kuriakose, 2018).

Components of the Memory Lane Walk

- **Display Panels**

The display panels will be placed on the road sides and near buildings of significance. The panels will provide Information about street or structure. The information will comprise of text about the subject, old photographs, building layouts, diagrams etc.



Figure 24-22: Display Panels



Figure 24-23: Way Findings

- **Way finding**

Various way finding aids will be provided in the streets to aid navigation and identification in the streets.

- **Memories on Walls**

Walls can be used as a surface for display. Old photographs of the streets or the buildings can be put on walls.

- **Digital Experience**

The visitors can navigate the Memory Lane Walk through multiple digital aids like audio guides and downloadable navigation applications. Digital applications can be developed to let the visitor plan routes and tailor their own experience.



Figure 24-24: Wall Dispalys

- **Street Furniture and Public Art**

Street furniture will be provided at regular intervals for the pedestrians to pause and rest. Local artists and students can be commissioned to produce public art following a certain theme.





Figure 24-25: Street furniture & Public art



Figure 24-26: Signages

- **Signage**

Different types of signage will be provided in the entire project area. It will give directions, mark important landmarks and provide instructions.

- **Tours for Children**

Special tours can be organised for school children. Activities like street games, map games, cycling etc. can be planned.







Figure 24-27: Special Tours for Kids

24.6.6 Public Awareness & Participation

Active involvement by the general public must form part of policies for the protection of the heritage. The rights and interests of the host community and property owners over their own land should be respected. They should be involved in establishing goals, strategies, policies and guidelines for the identification, conservation and management of their heritage resources and cultural practices. Increasing awareness through heritage fairs, festivals, heritage walk and heritage awards can increase people's participation. Introduction of local guides like auto rickshaw and taxi drivers will help in generating a responsibility among the locals to preserve their heritage.

24.7 Trade & Commerce

24.7.1 Proposal for Street Vendors Zone

Street vendors are an integral component of urban economy around the world. They are essential to the social and economic life of a city since they are distributors of reasonably priced goods and services also offer constumers quick and accessible shopping options. Street vending as an occupation has existed for hundreds of years and is considered a cornerstone of many cities' historical and cultural heritage. Street vendors may have fixed stalls such as kiosks, semi-fixed stalls like folding tables. They may operate from crates, collapsible stands, or wheeled pushcarts that are moved and stored overnight.

- The details of street vendors are to be recorded and they are to be provided with identity cards.
- Basic facilities for drinking water and sanitation are to be provided in those areas where the numbers of female workers are more.
- Facilities to provide for vendors include provisions for solid waste disposal, public toilets to maintain cleanliness, aesthetic design of mobile stalls and push carts, provisions for electricity and drinking water and providing protective covers for protecting themselves as well as their properties from heat, rain, dust etc.

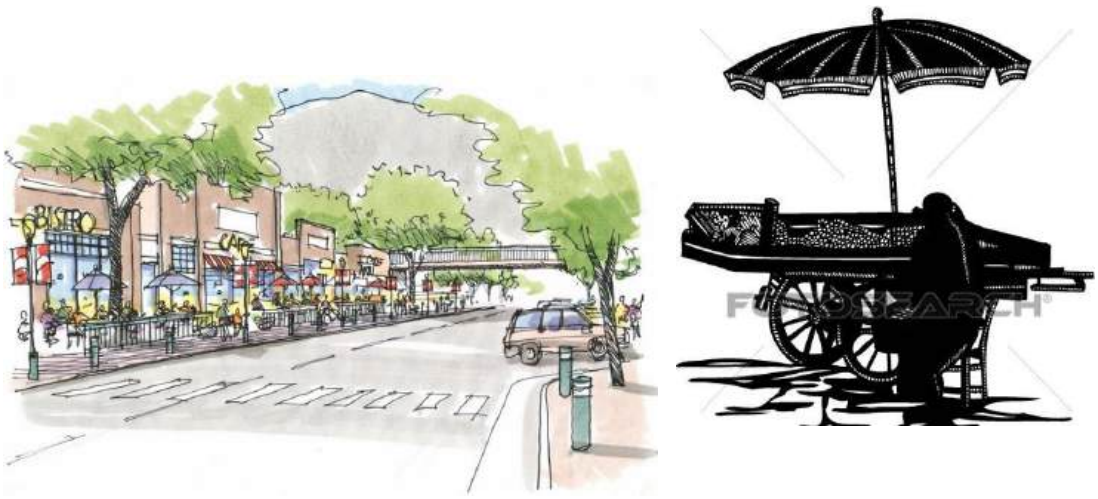


Figure 24-28 Conceptual images of Street venders

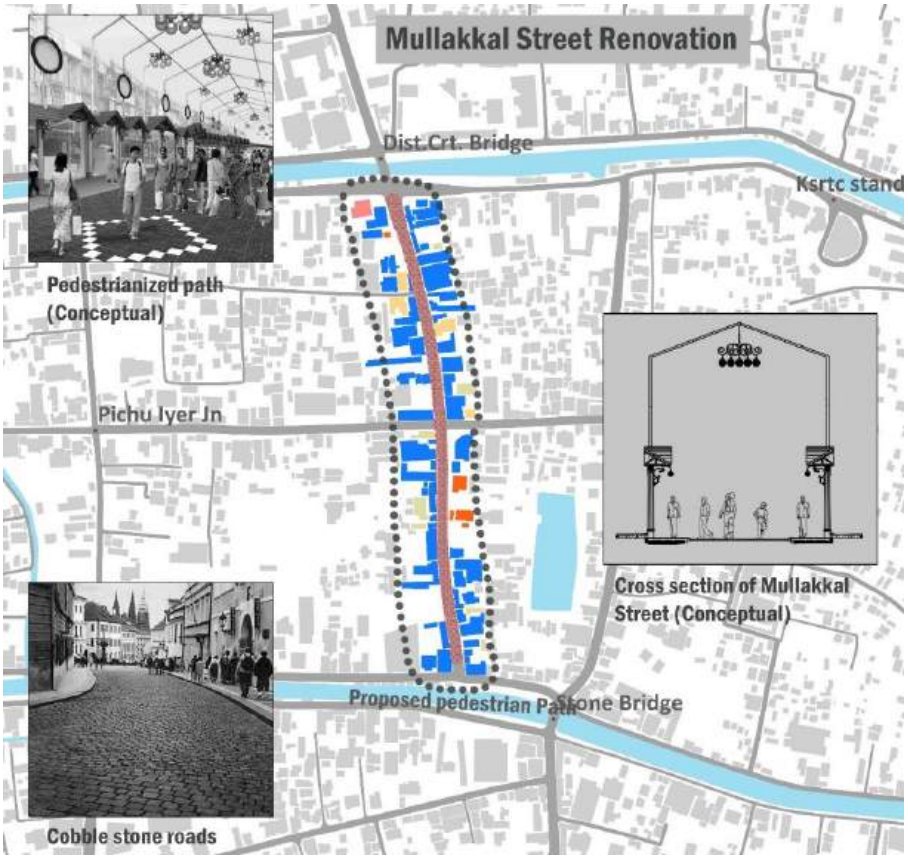
24.7.2 Renovation of Mullakal Street

Renovate Mullakal street considering pedestrian prioritization measures like scheduled pedestrianization along the street together with one-way vehicular traffic dy giving

due consideration to the resident population. by keeping the architectural harmony of street. The total length of street to be renovate is around 580 meters and the components which have to include in the project are cobble stone carriage way, granite foot path, underground cables for electricity, fire hydrant valves, fire brigades, drain and duct work etc. proper necessary infrastructure and beautification elements have also to be considered while renovation. Proper timing for the entry of goods vehicles and other facilitators have to be designed with respect to the DPR study report.

A detailed feasibility study of the proposal and DPR of the area have to be worked out with the help of all stakeholders and concerned government authorities. All this is possible if all stakeholders show a sense of ownership and develop an emotional connect with the place. The conceptual image of the delineated area and of the street renovation are presented below.

The concept of pedestrianisation of streets can also be adopted for market streets like Dhara Ismail Market (Vazhicheri) and Pulayanvazhi market areas. (one of the successful case study of the concept is at SM Street, Calicut). Proposal for the development of encroached area for street vendors in mentioned in transportation sector.



24.8 Water Supply

24.8.1 Strengthening of Distribution line

- Strengthening of distribution lines by laying new networks and connecting the existing distribution lines.
- Replacing old and inefficient distribution lines with the help of government schemes like AMRUT.
- Ensure the quality check in public water, RO plants etc. by proper monetarization of concerned departments like Health department, PCB, and KWA.

24.8.2 Ground Recharging and Enforcement of Rain Water Harvesting

- Ground water recharging is the primary method through which water enters an aquifer. This process usually occurs in the zone below plant roots and is often expressed as a flux to the water table surface. To improve the ground water levels, the runoff water needed to be reduced. For that planting of trees needs to be promoted.
- Rain water harvesting can be defined as activity of direct collection of rain water and its storage aimed at harvesting and conserving surface and ground water for most efficient utilization of rainwater towards best use for the humanity. By considering the increased water demand within the town area, measures should be taken for recharge of ground water as a futuristic approach. A policy level approach is required to promote the rain water as a massive movement. All the open wells and ponds in the Municipality may be recharged through point recharging by injection of roof top rain water directly into the well.
- On a long term basis, watershed management interventions such as water pits, water bunds, stone bunds, vegetative embankments etc. shall be adopted in order to increase the water table.
- Measures should be taken to minimize the causes of ground water contamination and hence reduce the pollutions.

24.8.3 Storm Water Pumping Stations

Alappuzha is surrounded by waterbodies and probability for causing flood is also high and it necessitates large, reliable pumping systems capable of handling large volumes of water. Stormwater pump stations helps to protect areas by pumping away large volumes of water, thereby preventing the occurrence of flood.

24.9 Sanitation

24.9.1 Drainage

Total revamping and beautification of the canal networks considering the order of canal system needs to be worked out closely. It is proposed to improve the canals by widening, side protections work and deepening. Instead of using conventional methods of cleaning the canals, it is proposed to clean the main canals by proper scientific learning incorporating the study of soil structure, property of water and its flow, environmental characters etc.

- A detailed drainage Master Plan should prepare for the exhaustive study of entire area.
- Drain mapping should be conduct for identifying all drain networks, so that gaps in the existing system can be identified.
- Proper networking of drains has to be developed in such a way that the drain out water from all water logged areas especially occurring in heavy rainy times.
- Road repair or development projects must have mandatory drains or side pitching for storm water discharge.
- Public comfort stations should be insisted in all public buildings especially in bus stands, commercial complexes, community halls etc.
- Waste disposal to canals should be strictly prohibited.

24.9.2 Sewerage

It is proposed to provide decentralised septage treatment for Alappuzha Municipal area. Apart from the existing ongoing projects, it is proposed to extend the number of septage treatment plant and particularly provide STPs at Government Hospitals, all existing schools and public building having large coverage area.

Proposal for Mobile Septage Treatment Units:

Mobile septage units are very useful for pre monsoon cleaning in areas having water logging problems, this unit can be used for not only HHs but also other buildings like hotels, home stays etc.

Special mobile septage treatment units have to be proposed for house boats, which are inevitable for the health and hygiene of the peoples as well as the protection of the environment.

Some suggestions for septage management in Municipal area are:

- Preparation of Faecal Sludge Management Plan (FSTP) for Alappuzha municipal area aimed at the proper functioning of sewerage system and management has to be taken up in consideration.
- Ensure 100% coverage of scientific septic tanks for HHs as well as other buildings and converting the existing unscientific septic tanks like pit latrines to scientific treatment methods.
- Site specific Faecal Sludge Management Systems approach can be used while planning, implementation and operation of STPs especially in decentralized methods.
- Cluster level of Faecal Sludge Management (FSM) approach can also consider in case of clustered houses like slums and colonies.
- Formation of government authorized committee consists of various authorities and stake holders by local body in Municipal level for the entire coordination and management of STPs. Management includes access, collection, conveyance, treatment and disposal of the septage treatment plants and more over operation and maintenance of the system.
- Stringent action to be taken for those who are allowing outfall of septage into canals or drains by proper enforcement mechanisms.
- IEC (Information Education and Communication) programs have to be conducted in Public areas. And also signage showing IEC should be provide in public areas emphasising on proper knowledge about the "unlikeness in drainage and sewerage" and "My waste is my responsibility".

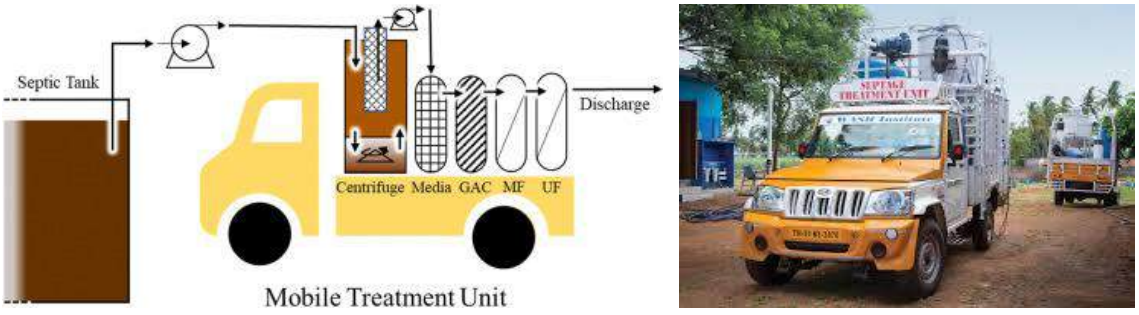


Figure 24-29 Proposal for Mobile Septage treatment units

24.9.3 Solid Waste Management

The existing decentralized waste management model is running very healthy. But as there is lack of coverage of HHs, it is proposed to strengthen the present system by providing additional Thumboormuzhi model aerobic bins.

- The first and foremost importance for waste management has to be given for promoting, practicing and entertaining in reduction of waste at source level itself.
- Promoting 3R's- Reduce, Reuse, and Recycle.
- Proposed to strengthen the present collection system with additional labours, vehicles and other facilities.
- Promote HH level waste management systems like biogas, bio bins etc.



Figure 24-30 Biogas plant and Bio bin

- Proposed to establish Material Recover Facility(MRF) and non-biodegradable processing centres.
- Initiate action to improve public participation, awareness and monitoring mechanism.
  - ✓ Formulate bye-laws to introduce user charges, to chart out citizens' duties to impart fines for unhealthy dumping practices.
  - ✓ Engage local inhabitants for monitoring of SWM activities at the local level.
  - ✓ Conduct awareness campaign against the unhealthy practices of disposal of solid waste and to make door to door collection.
- Hotels and restaurants should provide their own waste management systems and if there is space constrain in their premises, they are responsible to use the nearby municipal waste management system like aerobic bin composting units.
- Formation of authorized hotel waste management association for monitoring and controlling of waste management. They should ensure the properness of waste management of institutions under their control.
- Develop strict enforcement of observing and marking mechanism (Microchip based Smart card) in aerobic units for the daily waste which has been disposing of by the hotels and other institutions. That should be monitored under a team lead by any concerned authority or local body. A calculation of waste that would have been generating by the

hotels should be found out with respect to the size of hotels, and an online attendance mechanism for the hotels for opening and closing time should develop, which would connect to the nearby waste disposing centre with an attendance/ marking mechanism in an online portal. If there any fraudism or any kind of waste dumping or littering have noticed by the concerned they can take action against them by cutting their license.

- Promote and follow green protocol in schools, functions, corporate buildings, public buildings, tourism areas including house boats and other recreational areas.





Figure 24-31 Promotion of Green protocol

24.10 Energy

24.10.1 Provision of Solar Panels

- Promotion of non-conventional sources of energy like solar panels by giving tax reduction and subsidies and other benefits to the public. Awareness programs needs to be conducted so that people will get an idea about future energy crisis.
- Another technique which can be adopted for promoting solar energy usage is installation of solar panels on roads and foot paths. Thus energy produced can be utilized for street lighting and for supplying power to commercial enterprises adjacent to these roads.
- Promote waste to energy concept- It is a method which converts waste to electricity by using suitable techniques. One of the best method widely used is controlled combustion method, by which waste is burned at a very high temperature. The steam thus produced will be used to work the turbines to produce electricity. The electricity produced at the plant can be sold to the Kerala State Electricity Board at the rates fixed by the Electricity Regulatory Commission. This project can be done with the help of Kerala State Industrial Development Corporation (KSIDC). Promoting installation of solar panels over roof tops of public buildings, schools and other institutions.




Figure 24-32 Solar panel over Roof tops and used for public street light

24.10.2 Floating Solar Panel

Solar power is one of the best options to derive its renewable energy. Floating solar panels are a source of clean, renewable electricity. The use of renewable energy technologies helps decrease the emissions of greenhouse gas emissions and other pollutants into the atmosphere, leaving a positive impact on the natural environment as well as human health. Floating solar is still a new way of approaching solar power compared to the land-based panels we're used to, but it appears to have a lot of potential in areas where land for solar farms is scarce or there is simply an abundance of water. Floating solar panels are typically moored on calmer bodies of water, such as ponds, lakes or reservoirs. Two floating solar projects has been commissioned at Kerala are the22 – MW plant, part of the 92-MW floating solar power project being set up by the NTPC at its Kayamkulam unit.



24.10.3 Street Lighting

Street lighting or street lamp is a raised source of light that is often mounted on a lamp column or pole either on the side of the road or within the median, or suspended over a wire above the road to provide illumination, lighting should always provide at signalized intersections and roundabouts. In order to have safer, comfortable, more convenient, efficient movement of vehicles and pedestrians at night time, street lighting or highway lighting is required along the road.





LED street lighting is one of the most efficient lighting solutions. The long lifespan of over 50,000 hours makes LED street lighting extremely useful. The solar outdoor light integrates with its favourite LED lights to produce the most sustainable, efficient, and eco-friendly outdoor light solution.

24.11 Recreational Facilities & Civic Amenities

24.11.1 Beautification of canal banks and converting the area to a recreational space

Beautification of canals & walkway along the entire stretch gives accessibility and connectivity of canal side. Canal side should be a place where not only tourists come to relax and enjoy themselves but local families come out in the evenings to sit and chat and watch their children play. Small play areas for children can be provided near to seating facility for adults.

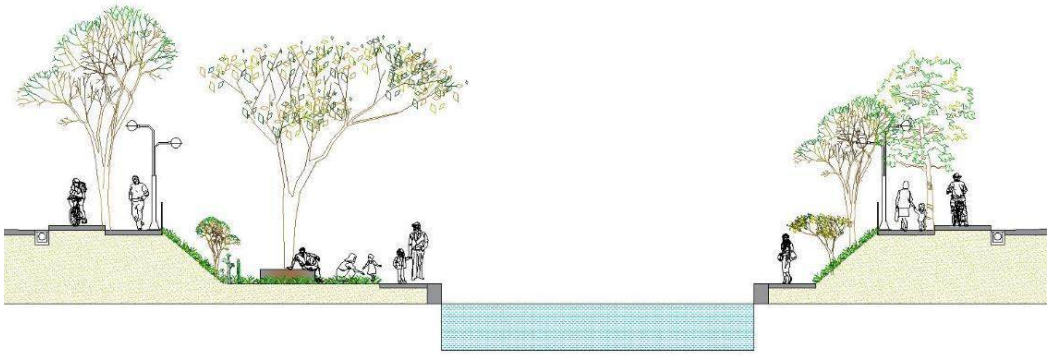


Figure 24-33: Typical section of Canal Bank

Pedestrian bridges across the canals should be reconstructed as a design element and should facilitate viewing platform along with it to experience the beauty of canals. Provide cycle track and pedestrian path alongside the canals.



Figure 24-34 Pedestrian bridge with viewing platform

24.11.2 Conservation of existing parks and open spaces

All existing parks and open spaces are to be conserved and only its maintenance and supporting facilities shall be allowed in those areas. Upgradation of these existing facilities and its renovation is permissible.

24.11.3 Beach Beautification

It is proposed to develop proper infrastructure facilities at beach. Develop a proper plan for the beach area and the area occupied under flyover with proper planning and drawings under the supervision of ULB and NHAI etc. Develop temporary cafeterias, street vending, other recreation spaces, parking and other facilities. The detailed study, planning and drawings of this zone has to be workout. Developments may include proper maintenance of toilets, proper management of beach fest and other events, proper management of open stage and nearby park etc.





24.11.4 Revival of Raja Keshavadas Swimming Pool

Raja Keshavadas swimming pool is located near to the Alappuzha lighthouse. Developing a swimming training centre for the public as well as the students in the same area, which can be good opportunity to develop their skills as well as self-protection while flood times. This project can be worked out with the help of Kerala State Sports Councils and ULB.



Figure 24-35 Swimming training



Figure 24-36 Raja Keshavadas swimming pool

24.11.5 Upgaradation of Public Libraries

- Upgradation and standardization of existing public libraries including facilities like digital library, access to published papers and journals, etc.
- Develop district library to a Unified Data Bank Centre(UDBC). UDBC act as a unified data bank centre with accessibility of all secondary data of the district. The detailed feasibility study of the project has to be conduct in the lights of concerned authorities.

24.11.6 Development of Town Square

- Renovation of the existing town square is proposed to develop this area into a well maintained recreational area within the heart of the town.
- Considering the locational characteristics, facilities which attract tourists may be provided.

24.11.7 Upgradation of EMS Stadium & SAI Sports Centre

- Upgradation of EMS stadium and premises to a well-planned recreation centre incorporating open gym, cycle and pedestrian path, turf ground etc. by incorporating sports council and other line departments.
- Upgradation of SAI sports centre by improving infrastructure facilities and extending number of intakes of yearly students who come for training.

24.12 Education

According to the planning standards the education facilities are adequate for the town. Infrastructure facilities are to be improved.

24.12.1 Smart Class Rooms

The smart classes are a modernized method of education which provides quality education to students by helping them in better concept formation, concept elaboration, improvement in reading skills and academic achievement. Computer and internet has become part of day to day life. The smart learning approach provides learners of all ages and walks of life with a framework and a host of Smart Thinking Tools that motivate higher levels of understanding. Through the process learners activate and build background knowledge, process information, transform their learning into a product that shows what they know, and reflect on their learning.

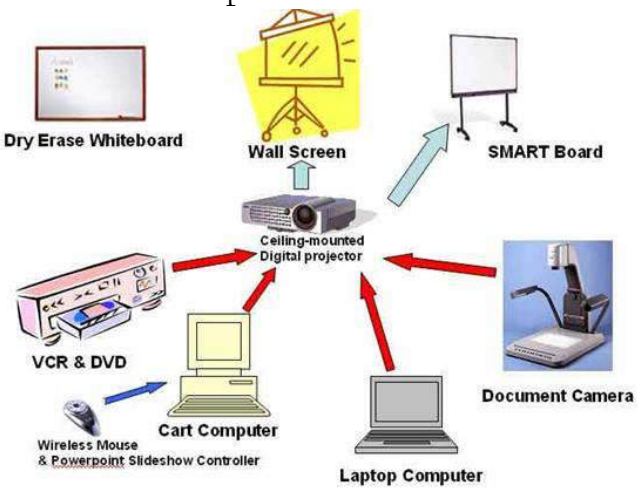


Figure 24-37: Components of Smart Class Rooms

24.12.2 E library / Digital Library

The internet has become deeply embedded into every aspect of our private and public lives. In the academy as well, the internet and the growing cyber-infrastructure that carries information to us and facilitates scholarly work has become an essential fixture in the lives of students. The pure power that online databases provide for quickly locating



Figure 24-38: E - Library

facts about virtually any person, place, or thing, or the possibilities that cyber technology holds for bringing together massive geospatial information, which would otherwise be largely inaccessible. This enhances the importance of a digital library in every educational institution. To deliver the massive digital geospatial information along with the pleasant atmosphere that our ordinary book filled libraries give an e-library has to be established in every educational institution.

- A digital library is a collection of documents – such as magazine articles, book, papers, images, sound files and videos – organized in an electronic form and available on the internet or on a digital support. It maintains a database as the collection of e-materials and provides services in digital form.
- Digital libraries give access to multiple contents with a potentially infinite number of resources and selections at hand.
- Online libraries help the scientific **society** since they act as a reservoir for the storage of important research data, information and findings.
- The digital storage of books and, above all, audios, solve the problem of deterioration.



24.12.3 Electrical Incinerators for Girls Toilets

To improve the sanitary conditions in schools, all schools should have hygienic toilets and there should be provisions for electrical incinerators. With increase in institutions like schools, anganwadies, health centres etc. disposal of waste is becoming a serious problem. Both non- degradable and bio- degradable wastes can prove hazardous for health, if proper complete disposal is not done. In schools especially, disposal of sanitary cloth and sanitary napkins in girls' toilets is a big problem. It affects proper functioning of toilets when disposed in the toilets and serious health problems if thrown out in garbage dumps or in the open. There is thus an imminent need to address this important sanitary waste disposal effectively especially in terms of developing cost effective and simple technology for composite waste disposal for schools.



Figure 24-39: Electrical Incinerator

24.12.4 Special Coaching for Economically Backward Students

- To improve the educational background of the students, who is from economically backward categories special coaching should be provided from the schools itself.
- The empowerment of the weaker sections has been a priority area of concern for the government since independence. A number of plans and programs are being implemented for assisting the weaker sections so as to enhance their skills and capabilities for ensuring rapid economic development and integration in the national mainstream.
- Utilization of Vidya Samunnathi Scheme of Kerala State Welfare Corporation for Forward Communities Ltd. Under this scheme, the students of economically backward forward communities will get educational scholarships and competitive assistance for their studies. Financial assistance will be provided to economically backward students from forward communities who are undergoing training for various competitive exams.



24.13 Health

According to the planning standards, health facilities in the town are seen to be adequate. Infrastructure facilities are to be upgraded. Various other suggestions are:

- Mosquito eradication programme shall be strengthened and periodical monitoring shall be made.
- Hotel sanitation and food safety should be ensured, periodical inspection by Health department in hotels and other food serving hubs should be promoted and strengthen.
- Facility to provide essential medicine at low price to economically weaker sections.

24.13.1 Proposal for Contagious Disease Monitoring & Prevention Center

It is proposed to set up a contagious disease monitoring and prevention center at the Virology Institute located at the General Hospital, Alappuzha; to prevent disease, disability, and death caused by a wide range of infectious diseases.

24.13.2 Mobile Clinic

The mobile clinics offer flexible and viable options for providing outreach services to populations and communities where government health facilities do not exist, are not functional or in the areas where public transportation is inaccessible. As the clinics are

deployed and move around within a specific area, vulnerable and often displaced communities, elderly people and people who are bed ridden will be able to receive access to life-saving health services. Mobile unit shall travel on a regular schedule, providing screenings and treatment for people at risk of diabetes and other chronic health conditions. The mobile clinics provide diagnosis, treatment, immunization, early diseases detection, control and response services, to ensure adequate follow up of patients with specific medical needs, referral of critical cases to advanced care, and detection of possible outbreaks of diseases. Since most of the houses are near to water bodies, boats can also be used as a transportation mode for the mobile unit. Each mobile clinic shall be accompanied by a medical team and pharmaceutical supplies to cover a range of essential health services for children, women and older people.

24.14 Social Welfare

24.14.1 Implementation of Vayomitram Project

Kerala Social Security Mission is implementing the Vayomithram project which provides health care and support to elderly above the age of 65 years residing at Corporation/Municipal Areas in the state. The main objective of the scheme is to provide free health care to the old age people.



- Vayomithram provides medicines free of cost by conducting mobile clinics in ward basis in the area. There are no economic criteria for availing the service. Each mobile unit comprises of Medical Officer, Staff Nurse and JPHN.
- It provides palliative care for the bed ridden patients in the project area. Trained nurses and JPHN's are available for the service.
- Vayomithram coordinators provide help desk service to the needy old age in the area. The old age can avail the help from the vayomithram office.
- Counselling service to the old age with the consultation of Medical Officers in the project.
- Special medical camps are conducted in project area for aged.
- Special entertainment programmes like Sallapam, Snehayathra were conducted mainly for the destitute in old age home and vayomithram beneficiaries

- Sponsorship programmes are conducted with the help of NGOs, Institutions in the area.
- Conduct old age day programme, elderly abuse awareness day programme etc.
- Involvement in social issues related to old age in the area. (Rehabilitation etc.)
- Other services include Awareness Programs, Health Classes, Interactive Sessions etc.

24.14.2 Implementation of Pakalveedu / Geriatric Care Facilities

Local governments are the most important agency for geriatric care. Pakalveedu facilities should be established in two or three wards of the Municipality with the help of Social Justice Department.

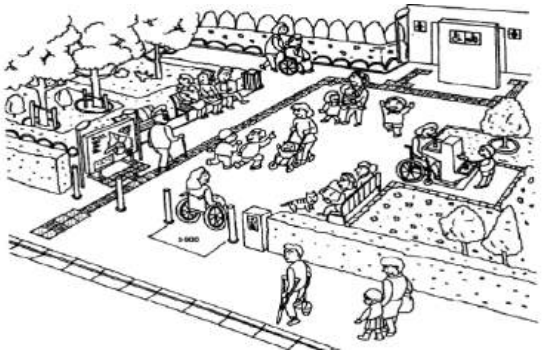
- It should function under the supervision of Kudumbashree or voluntary workers.
- There should be facilities not only for entertainment and relaxation but also for food and treatment.
- Those ailing elderly persons who are dwelling in houses can be protected through palliative networks. Implement Snehitha Calling Bell Scheme and Kudumbashree workers should visit their homes once in a week. Under the aegis of Kudumbashree, Elder's meets and 'melas' should be conducted in all CDSs. Geriatric councils consisting of pensioner's organizations, Kudumbashree, palliative / health workers should be established.



- Create geriatric friendly environments in hospitals.

24.14.3 Proposal for an old age home

It is proposed to setup an old age home to improve the quality of life of senior citizens by providing basic amenities like shelter, food, medical care and entertainment opportunities. It should provide health care, education, legal and psycho-social support and services, reaching elderly population and their care givers. Old age homes should be provided with;



- Security measures (CCTV, terrace and Outdoors); isolation rooms.
- Adequate privacy & personal space.
- Rooms- ventilated, adequate space, anti-slippery flooring, provision of storage, night lighting, alarm bells.
- Senior- friendly facility design- with grab bars, skid-free flooring, elevator, wheelchair friendly doorways and hallways, natural lighting.
- Bathrooms- provision for intercom facilities, separate for males and females; kerb ramps; anti-slippery tiles and railings for hand support.
- Hygiene and maintenance.
- Ambience (Barrier Free Environment) – site planning (walks and paths); sensory stimulation; landscaping.
- Other facilities such as library, guest room, recreational hall, gardening, dining hall, public address system, mini gymnasium/ occupational therapy room, rooms for counselor, social worker etc. should be provided.

The centre would provide a basket of services for the meaningful engagement of elders in the proposed centre; such as:

- Day care services managed by a trained community nurse/ social worker for the elderly population of both sex.
- Organize routine medical check-up, health camps, physiotherapy, meditation, counselling, age specific life skills, linking with social security schemes and recreation activities etc.
- A memory clinic can be attached and made functional in the centre.
- Create smart space with in the centre to connect the elderly with their relatives.
- Support and help with social activities in order to improve the social environment and living conditions.
- There should be facilities for learning and entrepreneurial activities focussing on their menial employment, productivity and wellness.



The following institutional mechanisms are to be followed:

- Organize training programs for the Panchayath/ Municipality staff, elected representatives front line workers, and community volunteers.
- Create income and employment generation activities, share information by publishing newsletters, hold social gatherings such as "Meet the Veterans" programs, organize interfaces with youth and celebrations.

24.14.4 Improve the Facilities for Differently Abled Persons

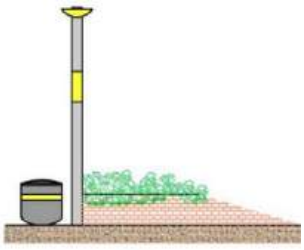
Differently abled is often described in terms of lack of normal functioning of physical, mental or psychological processes. It is also defined as learning difficulties or difficulties in adjusting socially, which interfaces with a person's normal growth and development. Differently-abled persons need special arrangements in the environment for their mobility and independent functioning. It is necessary to address the accessibility related issues and to ensure that future development should be disable friendly.



24.14.5 Facilities to be Provided in Outdoor & Indoor Spaces

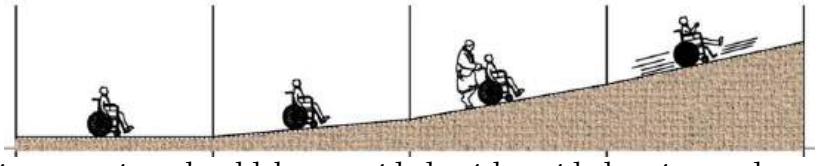
Outdoor spaces should be planned to ensure that differently abled person have access to use the facilities that are in place.

- Provide signages which is wall mounted, overhung, and free standing. It is important to use internationally accepted signage for clarity and ease of understanding.
- Street furniture's should be made accessible and designated for differently abled persons with clear signage. Fixed benches at parks should be checked for conformity and modified wherever necessary.
- The lamp posts, planting tubs, and garbage bins should be easily identified.

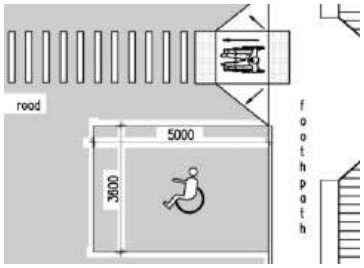


- Footpaths must be safe and accessible for all users, particularly for differently abled people. Existing footpaths should be provided with upstand wall railings depending on the site conditions. Footpaths should be repaired and made free of potholes and loose flooring materials.
- Steps associated on a footpath should accommodate level differences to help differently abled persons so as to overcome obstacles in transition of spaces.
- At least one toilet accessible with a wheelchair for one user in institutional buildings or one toilet for every hundred users, should be allocated.

- Create special facilities such as ramps, rails etc. Existing ramps should be checked for conformity and modified using permissible slopes, width, even surfaces, non-slip flooring material and good drainage.



- Pedestrian crossing should be provided with guided strips and proper signage to indicate its position. The road surface should be non-slip, well drained, and free of construction joint. Pedestrian crossings should be modified and made accessible with ramps connecting the footpath to the road level.



- Designated parking spaces should be allotted for differently abled persons with proper space consideration and signage.
- Parks and playgrounds should be easily accessible from the parking areas with proper gateway and footpath. Signage's and information board should be placed to easily locate the facilities. Existing parks can be redeveloped by providing ramps, signage's, drinking fountain and street furniture's.
- Living spaces should be designed and furnished for maximum comfort and ease of use.
- Public information/service counters, wherever provided, should be accessible and easily identifiable from a building entrance with assistive listening system.

24.14.6 Create Safe Public Spaces/Public Transportation for Women

To improve women's accessibility in public spaces; following recommendations are made:

24.14.7Create Safe & Walking Environments for Women

Since a greater proportion of women make walking trips, insufficient, unshaded and poorly maintained pedestrian infrastructure affects them to a greater degree than men. Pedestrian infrastructure should be designed as per IRC 103: 2012 Guidelines for Pedestrian Facilities, which proposes three zones - a dead zone, pedestrian zone and a multi-functional zone for footpaths along with a level of service approach for determining the width of footpaths.



Figure 24-40: An Active Street in Pune

24.14.8 Encourage Cycling among Women

- Continuous, consistently shaded and well-lit, smooth bicycle tracks are recommended on roads.
- Conduct programs to teach women how to repair and ride bicycles and create groups to increase women's confidence in riding bicycles by themselves at a later stage.

24.14.9 Make Public Transport Safe for Women

- Improve the experience of public transport through real time information on websites, phones, public transport stops, and vehicles and safety applications. Real time information must be combined with route maps, and destinations that are important to women such as public toilets, markets, schools etc.
- It is necessary to mandate for all taxis, including app-based service providers like Uber, Ola Cabs, Easy Cabs, Taxi for Sure etc., to display the vehicle number, driver's photo ID and license number both inside and outside the cab.
- Implement online bus tracking system through which passengers after a simple free registration with their email ID can easily track the current location and timing of the bus and expected arrival time at a particular bus stop so that one need not has to wait for hours for the bus.
- Intermediate public transport stands should be designed to provide sheltered, safe and well-lit waiting areas with signage and information on complaint and emergency helpline numbers.

24.14.10 Training on Women Safety and Gender Sensitivity

- Conduct campaign for improving women's safety and to create awareness on sexual harassment and violence against women in public transport.
- Conduct various activities such as exhibitions at bus stops, signature campaigns, talk shows with police and role plays in the buses. Record people's feedback on the same to act as a source of underlying information for later stages.
- Conduct gender sensitization sessions for drivers and conductors to encourage them to be stakeholders in the process of making transport safer for women.

24.14.11 Other Infrastructure Facilities for Women in Public Spaces

- Install CCTV cameras in public parking zones. Provide improved lighting and emergency bells in underground parking lots.
- Increase the number of toilets in female restrooms in subway stations, newly-built performance centers, stadia and parks.
- Install diaper-changing tables and improved lighting in public restrooms.
- Install paid phones on bus stops as holistic measure that helps to make bus service safer for women.

24.14.12 Hostel facility for Women and Men

- Proposal for hostel facility for women and men especially working persons.
- Provide accommodation on monthly as well as daily basis with enough standard infrastructure facilitiy on a reasonable rent.
- This project can be worked out with the help of PPP model.

24.15 Housing

24.15.1 Development project for houseless

- Provide flat or house for those who have no land and house, through life mission project under state government by ULB.
- Provide house for those who have land and also provide enough fund for renovation for the houses which are in bad condition through life mission of State government.
- Provide hostel facility for working men and women with affordable rent. This project can be worked out with partaking both private and government agencies together.



Figure 24-41 Conceptual drawing of flat in life mission and a report came in newspaper about the life project

24.15.2 Development of Colonies

The major suggestions to improve the existing facilities in colonies are follows:

- Connectivity and accessibility should be developed.
- Development of modern sanitation system.
- Parks, library, public well with pump system and open spaces should be provided as a part of colony beautification.

24.15.3 Reconstruction of Slum like substandard housing area (A pilot project)

Reconstruction of Chumgam colony, which consists of 8 HHs living in a congested row like houses at present. It can be reconstructed by pooling the existing house plots and designing by considering the physical aspects and also social, cultural and economic characteristics as well. This project can be done as a separate special project by the urban local body and funded completely by any of the schemes by government.



Figure 24-42 Conceptual image of reconstruction of HHs in Chumgam Colony

24.16 Environment

Environmental aspects such as ecologically sensitive lands like back waters, canals, paddy and low lying areas etc. are focused while framing suggestions and proposals in this sector. Apart from the aforementioned areas pollutions from noise, water, air etc. have also been considered.

24.16.1 Paddy Land/Low Lying Land

A portion of Municipal area comes under Ramsar site (Vembanad lake), so intense consideration has to be given for the protection and conservation of the wet lands. Strictly

follow the guidelines for implementing wetlands (Conservation and Management) Rule, 2017 by Ministry of Environment, Forest and Climate change, Government of India.

The existing paddy lands identified as per the Kerala Paddy and Wetland Act needs to be fully conserved. In areas where the character of paddy lands has been changed by filling up, and in other low-lying lands, controlled development needs to be permitted.

24.16.2 Coastal land

Protect and conserve costal regulation zone (CRZ) area as per the CRZ rule, 2011 by department of Environment, Forest and Wildlife and the amendments came after the rule published which supplement the rule. Municipal area comes under CRZ zone II area. Suggest suitable location or projects to relocate the peoples who come under very critical areas in CRZ zones. Detailed study and proposals should be conduct regarding the most vulnerable peoples come under in this zone especially in future for rehabilitation.

Projects to construct sea walls along the coasts with heavy erosion need to be framed. Feasibility of construction of sea walls or such other infrastructure needs to be primarily assessed after studies by experts. Rehabilitation of people living in these areas needs to be carried out taking into account whether their economic activity depends on the sea.

24.16.3 Canals and Waterbodies

The town canals in Alappuzha have been silted up and filled with water hyacinth, garbage, plastic, branches of trees etc. The silt deposit resulted stagnation of water and prevents normal flow of water through the canals. This in turn has resulted in flooding and can give rise to epidemics. Cleaning and desilting the canals in Alappuzha town generates hygienic condition among public and decreases infectious diseases and ensure healthy environment. Some of the suggestions and recommendations are given below.

- Canals and water bodies are rejuvenated and utilized for recreational and agricultural purpose. Canal sides can be converted into parks as well as pedestrian and cycling tracks if there is enough width, if the width is limited, canal sides can protect by laying geotextiles and grass lawn plantation, small bamboo plantation etc.
- Stringent action to be taken against those who are encroaching the canal sides and water bodies.
- A clear demarcation of lakes, pond and canals with the help of geodatabase have to be publish in a public domain so that peoples can understand the encroachment and

development activities. Also develop an authorized task force for the maintenance and operation. This will help to ensure peoples participation in maintaining canals and waterbodies.

- Adopt green protocol in tourism areas, functions etc. where waste generation is maximum which causes the degradation of canals and environment.
- Strict control and monitoring against waste disposal to canal should be ensured.
- Promote desilting and protecting the canal bed by gravel laying, which can improve the infiltration rate of ground water and maintenance of canals. Canals need their gravel and bed material to maintain their natural equilibrium and vital aquatic life.
- Provide screens at the exit points of sub canals and small merging canals to prevent and filter solid waste materials to entering into main canals.
- Provide gabions for the protection of canal banks.

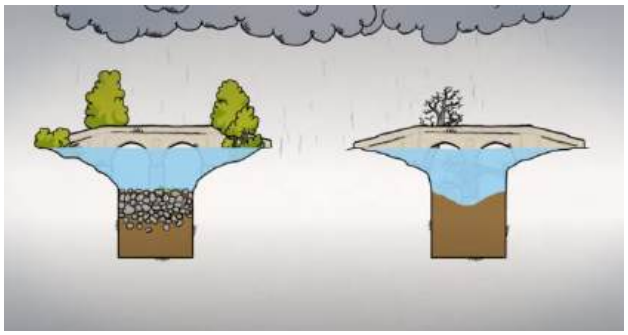


Figure 24-43 Desilting and protecting the canal bed by gravel laying



Figure 24-44 Gabions at the canal banks

- A detailed study and proposals to be workout on tackling the waste coming from sub canals apart from main canals. Since most of the waste including liquid and solid wastes in sub canals are from HHs outfalls, which are the main sources of waste accumulation in main canals. So a detailed study on waste management and sustainable environment friendly solutions to tackle the current issues have to develop.
- Develop a concept called Canal Bank Building Beautification Right(CBBBR). The concept portrays that canal beautification and maintenance are carried out by the buildings adjoining to the respective small stretches of canals. The selection and entrusting process have to be done by the ULB. The rights are giving as only in tenancy manner which can be completely perceives and coordinates by the officials of Municipality. The beautification should include mainly by adopting green concept and sustainability principles. It is also suggested to include signage and that space can also be utilized for showing advertisement boards of the particular buildings that get

endorse for the CBBBR. The sign boards and advertisement boards must be in standardized manner, which shall be guided by the concerned authority in the ULB.

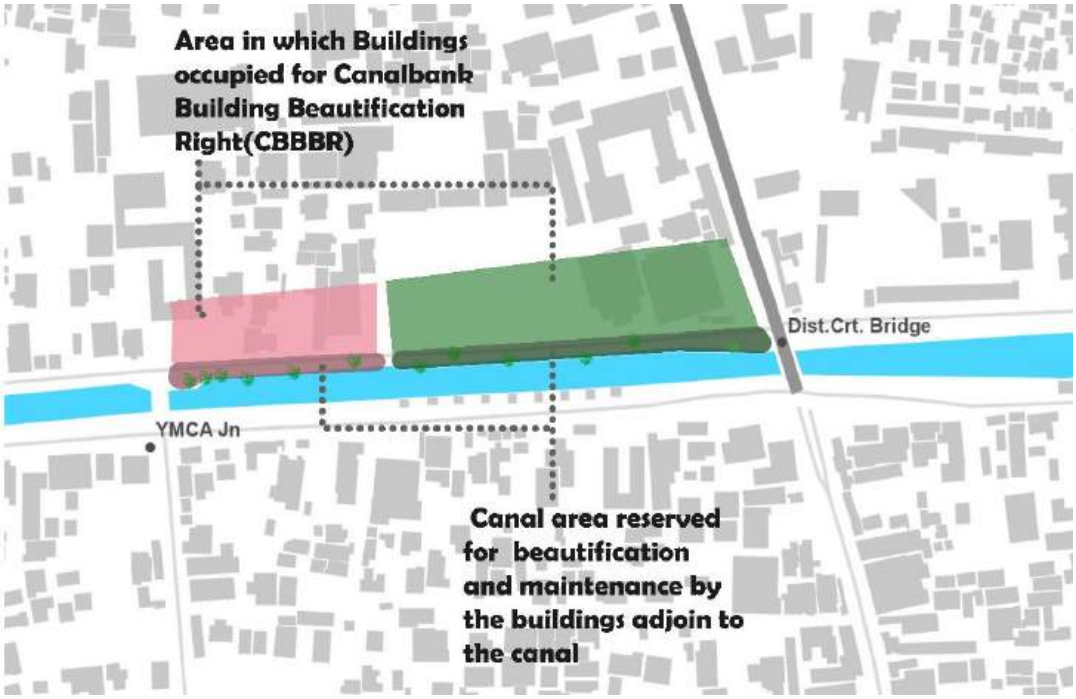


Figure 24-45: conceptual representation of CBBBR and canal banks

- CCTV surveillance can be provided in critical areas. Strict actions are to be taken against those who dump waste into canals and drains.
- IEC programmes, trainings and public awareness programme should be conduct for the betterment of attitude and education of peoples.

24.16.4 Environment Conservation Methods

- Existing marshy or waterlogged areas and Paddy lands are proposed as conservation zone. Also existing green areas are proposed to be conserved.
- Identify and conserves sacred groves/kavu within the Municipality which has possessed by public as well as private ownership by planting medicinal plants. (Kavu conservation area near Thathampally named "Kunnummelparambu Kavu" is a good model for the similar conservation project.
- Miyawaki Forest- developing Miyawaki forest in open lands of municipal area, which helps in expanding the green cover. This method is a good option where land and space are the major constraint. This project can be work out with the help of K-DISC (Kerala Development and Innovation Strategic Council), ULB and other departments. Growth monitoring and maintenance of the plants can be done with the help of Haritha karma

sena and can be included in AUEGS (Ayyankali Urban Employment Guarantee Scheme). Suitable locations have to identify with the help of concerned authorities.

According to afforest (service provider for creating natural, wild, maintenance free, native forests) Miyawaki technique includes a six-step process that are soil survey, native species & biomass survey, sapling preparation, prepare soil & mound plantation with community and maintenance & growth monitoring. An image of success story of transformation to forest by one year is given below.



Figure 24-46 The 750 square metre Miyawaki forest at Barapullah site.

24.16.5 Air pollution

- Promote construction of green spaces along the roadsides and junctions by planting trees and shrubs. This can reduce the air pollution as well as increase the percentage of the green space.
- Promote NMTs by walking and bicycling which reduces the usage of motorised traffic and related pollutions.
- Usage of staff vehicle needs to be promoted in private and government officials.
- Mobile application has to be introduced to promote vehicle sharing – car pooling, shared cabs which is more economic and environment friendly.
- An air quality map of the city can be generated and published to create a general awareness.

24.16.6 Noise pollution

- Strict noise standards for new vehicles have to be ensured such that any new vehicle purchased should obey with the prescribed noise standards.

- Provision of proper screening during construction in high density residential areas is also to be ensured.
- Setup a mobile noise assessment unit along busy roads and highways.
- Strict action to be taken for those who make noise pollution from unnecessary announcements and loud speakers from temples, mosques, and other religious institutions.
- Resurfacing of road surface with low noise materials can be considered.
- Establish buffer zones on both sides of road if possible.
- A noise mapping system to public has to be generate regarding the noise level analysis. This citizen making can be done with the help of any mobile application, this can be applicable if the noise level exceeds the prescribed limits.

24.17 Projects Identified

The proposals for various sectors described in the above sections are listed out as follows:

24.17.1 Traffic & Transportation

- Widening of existing road networks / proposal for new roads
- Improvement of existing roads and bridges
- Junction/intersection Improvement
- Proposals by PWD
- Traffic management & oneway regulation
- Parking management and suggestions for parking zone
- Identification and development of encroached areas
- Eey auto
- Proposal for dedicated bicycle lanes
- Provisions for bus bays and bus shelter
- Improvement of pedestrian facilities
- Pedestrian prioritizatioin at Mullakkal street
- Foot overbridge across NH
- Foot overbridge across national water way
- Implement the project for Mobility Hub
- Road overbridge at Mangalam railway crossing
- Improvement of water Transport
- Re-establish Canal Navigation

24.17.2 Disaster Management

- Formation of emergency response team and working group at Local Self Government Level
- Identification of potential shelter or relief camps or multi-purpose rescue shelters
- Improvement of infrastructure in identified relief camps
- Identification of safe parking zone, Livestock shelter and mass gathering venues
- Identification of possible evacuation routes and construction of all-weather roads
- Restoration of streams and channels
- Interventions to Vembanad Lake, Thottappally spillway and Thanneermukkam bund
- Adoption of sponge city strategies in development (urban park and wetland park)
- Facility scale strategies at Aryad school (Miyawaki/Pachathuruthu groves, earthen berms, bioswale); EMS Stadium (Joggers park, earthen berm, rain gardens etc.); and SD College (Detention areas, Miyawaki, Bioswales etc.)
- Provision for flood water detention/retention areas
- Strategies for storm water management
- Coastal protection measures (conserving/restoring mangroves, shore protection using pine buffer strip, salinity protection measures, strict implementation of CRZ notification, Beach nourishment etc.)
- Protection and Compartmentalisation or clustering of paddy fields
- Adopt flood proofing measures for building construction
- Relocate people to safer zones
- Modification of critical infrastructure
- Implementing building codes and standards
- Hazard Zoning
- Campaigns and workshops for knowledge and awareness raising
- Insurance and risk transfer

24.17.3 Agriculture and Allied Sectors

- Create micro irrigation canals around the paddy fields
- Establish Rice mills and parboling units
- Establish Keragramams
- Develop a flower growing zones and flower growing clusters
- Establish Agro Service Centres
- Establish weekly markets for agricultural produces
- Supplying high yield variety seeds (Coconut/Paddy/ Flowers/Fruit/Vegetables etc.)

- Improvement of the fish landing centres
- Establish Labour Banks
- Conduct training programs to promote agriculture practices like paddy/ Coconut/ Floriculture / organic farming/ homestead or rooftop farming/ fodder cultivation/ integrated duck farming/ Aquaculture etc.
- Training programs for the value addition of coconut products/ Marine products/
- Capacity building programmes on eco-friendly crop protection technologies
- Skill development in production and marketing of value-added products
- Slaughter house

24.17.4 Industry

- Common Facility Centre
- Skill development & Training Centre
- Modernization of Coir industry
- Training programs to promote Handicraft Industries

24.17.5 Tourism

- Identify areas in CRZ zones which are able to open for tourism development, promote PPP model of environment friendly development in these areas
- Increase the number of Public see – Kuttanad Boat Service
- Adopt Unique Access System (UAS) for tourism sector
- Infrastructure development in tourist areas
- Develop Heritage Tourism Circuit
- Develop farm tourism and aqua tourism projects
- Cable car connecting the places Ponjikara, DTPC office, Dock Chira
- Link tourism spots through boat cruise and heritage walk
- Establish Tourism Information Centres
- Develop and promote Ethnic Food Settlements
- Develop Water Sports Tourism
- Development of Nehru Trophy area and surrounding
- Explore the possibilities of Aqua Tourism Sector
- Link Various tourism activities (Health Tourism; Cultural Tourism; Farm tourism; Culinary Tourism; Water Sports Tourism; Aqua Tourism)
- Public Awareness Programmes – clean city & Responsible Tourism

- Training programmes for the local youngsters to boost the responsible tourism activities and local employability

24.17.6 Heritage

- Restoration and upgradation of heritage buildings
- Upgradation of streetscape along canal banks
- Adaptive reuse of disused / damaged historic structures
- Conserve the ethnic settlements
- Develop Heritage Tourism Circuit/Heritage Walk
- Landscaping of Heritage area
- Heritage fairs/festivals/heritage awards
- Public Awareness Programmes – Heritage Conservation

24.17.7 Trade & Commerce

- Street Vendors Zone
- Renovation of Mullakkal Street- and other markets

24.17.8 Physical Infrastructure

- Strengthening of Distribution lines
- Promote rainwater harvesting methods and recharging of the open wells and ponds
- Water Kiosks and Storm Water Pumping Stations
- Prepare a detailed drainage Master Plan
- Establish mobile septage treatment units
- Sewage Treatment Plant
- Prepare a Faecal Sludge Management Plan (FSTP)
- Promote use of biogas or bio bins at household level and Formulate bye-laws to introduce user charges, to impart fines for unhealthy dumping practices
- Establish material recover facility (MRF) and non-biodegradable processing centres
- Installation of Solar Panels
- Floating Solar Panel
- Street lighting
- Conduct awareness campaign against the unhealthy practices of disposal of solid waste and to make door to door collection

24.17.9 Recreational facilities & Civic Amenities

- Beautification and conversion of canal banks to recreational space

- Beautification and infrastructure development at beach
- Revival of Raja Keshavadas swimming pool
- Development of Town square
- Upgradation of Public Libraries
- Upgradation of EMS Stadium & SAI Sports Centre
- Comfort Stations – Take a Break

24.17.10 Social Infrastructure

- Improve the Infrastructure facilities in schools (Smart Class rooms; E Library / Digital Library; Electrical incinerators for Girls Toilets etc.)
- Establish a Contagious Disease Monitoring & Prevention Centre
- Mobile clinic
- Implementation of Housing Projects (Life Mission)
- Improve the infrastructure facilities in colonies
- Establish projects to reconstruct Colonies

24.17.11 Social Welfare & Security

- Establish an old age home, Implementation of Vayomithram project; Pakalveedu or geriatric care facilities
- Improve the facilities for Differently Abled Persons
- Create Safe & Walking Environments and transportation for Women
- Improve the Infrastructure Facilities for women in Public Spaces
- Establish a working women's and men hostel and other accommodation facilities
- Training on women safety and gender Sensitivity

24.17.12 Environment

- Develop Environment conservation zone (ECZ)- Miyawaki Forest
- Conservation / Restoration of Mangroves
- Protection of sacred groves
- Development of green areas along road sides
- Rejuvenation of waterbodies

25 LAND USE PLAN

The land use plan for the town is prepared considering the spatial structure of the town, transportation network, land use characteristics, vulnerability of disaster-prone areas and projected demand for various sectors during the plan period. The existing land uses such as sandy beach, mangroves, waterbodies, paddy land and wetland and major public and semi-public areas, industrial use areas, park and open spaces, and Water bodies are retained in the proposed land use zoning. Flood is identified as the major hazard in the town. The flood prone region in the town is divided into four, based on the possible inundation level, and is categorized as very high flood prone zone, high flood prone zone, moderate flood prone zone and low flood prone zone. Thus, the entire town area is categorized into three as follows:

25.1 Areas open to limited human interventions

The areas that are to be conserved or protected with limited human interventions are included in this category. It includes existing water bodies, paddy, wetland, marshy areas mangroves, sandy beach, pine forest and very high flood prone zone which are likely to be inundated to a depth of more than 2.5m.

25.2 Areas with Regulated Human Intervention

High flood prone zone, moderate flood prone zone and low flood prone zone areas are included in this category. Regulated human interventions are permitted in this area with all future developments proposed to be flood resilient in nature.

25.3 Areas open to all human interventions

All other areas that are not included in the above two falls in this category.

25.4 Proposed Land Use Zones

The categories of land use proposed are:

1. Commercial use Zone
2. Residential use Zone
3. Mixed use Zone
4. Industrial use Zone
5. Public and Semi-public Use Zone
6. Traffic and Transportation Use Zone
7. Parks and open spaces Zone
8. Conservation zone

9. Mangroves
10. Pine buffer strip (Beach Oak/Kattadi)
11. Water bodies
12. Sandy Beach
13. Heritage Zone
14. Tourism Promotion Zone
15. Farm Tourism Promotion Zone
16. Green Areas Conservation Zone
17. Special Zones
    - Special Zone-A- Common Facility Center
    - Special Zone-B- Parking Zone
    - Special Zone-C- Urban Park
    - Special Zone-D- Wetland Park
    - Special Zone-E-Detention / Retention Basin
    - Special Zone-F-Multipurpose rescue shelter
    - Special Zone-G-Sewage Treatment plant
18. Flood Prone Zones
    - Very high flood prone zone (Inundation depth >2.5m)
    - High flood prone zone (Inundation depth between 1.5m and 2.5m)
    - Moderate flood prone zone (Inundation depth between 0.6m and 1.5m)
    - Low flood prone zone (Inundation depth<0.6m)

Table 25-1 Proposed Land Use Break up-Alappuzha

Land Use Category	Area in sq.km
Residential Use Zone	14.51
Industrial Use Zone	0.31
Public and Semipublic Use Zone	0.93
Traffic and Transportation Use Zone	2.42
Parks and Open spaces Zone	0.11
Conservation zone	7.57
Mangroves	0.04
Pine buffer strip (Beach Oak/Kattadi)	0.08
Water bodies	1.75
Sandy Beach	0.39
Mixed Use Zone	6.05
Commercial Use Zone	0.29
Tourism Promotion Zone	0.74

Green Areas Conservation Zone	0.14
Special Zone-A- Common Facility Center	0.06
Special Zone-B- Parking Zone	0.01
Special Zone-C- Urban Park	0.01
Special Zone-D- Wetland Park	0.12
Special Zone-E-Detention / Retention Basin	0.11
Special Zone-F-Multipurpose rescue shelter	0.02
Special Zone-G-Sewage Treatment plant	0.02
Total	35.68

25.4.1 Residential Use Zone

Residential area is scattered all around the Municipality. Existing residential areas and dry agriculture areas are proposed as residential use zone. As per URDPFI standard, 45% of the net area of the town shall be under residential use. For Alappuzha Town, proposed residential land use is 40.7% of the total land area and 56% of the developed area.

The projected population by the year 2041 is 1,80,000. As per URDPFI guidelines, average gross population density of developed land in medium town in plain area is 100-150 persons per hectare (pph). The requirement of developed land for accommodating 180,000 people is 14.40 sqkm considering density of population as 125pph. The net area available in the town is 26.09 sqkm. Hence available area is found sufficient for holding the projected population by the horizon period of 2041.

25.4.2 Industrial Use Zone

Industrial land use is only nominal in Alappuzha. Industrial sector is found as one of the key sectors for economic boosting up of the town. As per the concept of Development Plan for Alappuzha, industrial sector shall be promoted by promoting agro based industries especially coir and oil. Manufacture of umbrella is also an important livelihood of town. The existing industrial areas are included in this zone.

As per URDPFI guideline, the industrial land use requirement for medium town like Alappuzha is 8-10 % of developed area. The land area available is 0.29 sqkm which is 1.11 % of net area of the town. A common facility center is proposed as a special zone near Eastern paddy fields so as to act as a facilitation center for agro based industries. Non-nuisance type of small industries is visualized in all urban land use areas based on general development control regulations.

25.4.3 Public & Semi Public Use Zone

The present public/ semipublic use is 0.89% of net area and is sufficient. As per concept of District Urbanization Report, the town has to serve nearby local bodies and higher order facilities should be provided here to meet the demands. Majority of Govt/Semi Govt offices, major hospitals etc. are situated in the central area of the town. Priority is to be given for accommodating additional facilities like buildings, equipments, infrastructure etc. for hospitals, schools etc. The existing public and semi public institutions are included in this zone. Also, the construction of public and semi public institutions are allowed along major roads as per the zoning regulations of other land uses.

25.4.4 Traffic & Transportation Use Zone

An area of 2.42 sqkm is under traffic and transportation which is 9.81 % of net area. In this sector widening of existing roads and additional facilities required are proposed. In transport, the proposed Eastern bypass will decongest the traffic at the town centre. The existing areas which are used for traffic related activities are included in this zone.

If higher order facilities are provided in the town, then dependency of adjacent local bodies towards here shall increase. Hence regional connectivity shall be strengthened. As per development concept, proper connectivity between different activity zones shall be ensured for proper integration. Road widening proposals, parking facility, cycle track, pedestrian facilities, junction improvement etc. form part of the transportation proposals. Detailed Traffic and Transportation plan is given chapter 22.

25.4.5 Parks & Open Spaces Zone

At present, park and open space occupy 0.11 sq.km of land. This is not sufficient when compared with URDPFI standards. But large extent of water bodies and sandy beach compensates the need of park and open space. Recreational need of the Municipality shall be fulfilled through allied activities of tourism sector.

25.4.6 Conservation zone

Alappuzha is unique in the nature of paddy fields. The Kuttanadan paddy fields are situated below Mean Sea Level. Nearly 7.53 sqkm of Kuttanadan paddy fields are available in the town which constitute 21.13% of the total land area. 0.70 sqkm of paddy/wetland field is also available in the town area. Conservation and proper utilization of paddy fields are necessary while considering the vulnerability to flooding in this area and also for maintaining a strong economic base for the community.

Vast extent of cultivated paddy is available in Alappuzha. Paddy cultivation shall be promoted through strong interference of local bodies. The pressure on paddy /low lying land for conversion to urban uses is excessive. Hence conservation of paddy/ low lying shall be enforced in order to maintain a clean environment. The existing paddy areas and other low lying areas are included under Conservation zone. The uses permitted in this zone are in accordance with the provisions in the Kerala Conservation of Paddy land and Wet Land Act, and other wetland conservation acts relevant for the area. Also, constructions or developments in paddy/ wetland area should be limited in very high and high flood prone zones within the Municipality so as to conserve the area.

25.4.7 Mangroves

An area of 0.04sqkm is demarcated as mangroves. These are areas where mangroves exist or there is a possibility of planting/restoring them. This zone envisaged to reduce the effects of sea level rise by protecting existing mangroves and their restoration.

25.4.8 Pine buffer strip (Beach Oak/ Kattadi)

The areas demarcated as pine buffer strip are envisaged as alleviating measure for coastal erosion and storm surges that are recurring in the very active Lakshadweep Sea coast. It is envisaged that existing pine buffer strip which constitute an area of 0.08sqkm is conserved and the activity be continued along the coastal line that are not protected with sea wall construction.

25.4.9 Water Bodies

Alappuzha is blessed with canals and backwaters which constitute an area of 1.73 sq.km. All existing waterbodies like lake, river, ponds, canals, drains etc. are included in this zone.

25.4.10 Sandy Beach

The existing sandy beach located towards the Western end of the town is to be conserved so as to protect the coastal area from the effects of sea.

25.4.11 Mixed Use Zone

The central town area around the commercial zone is proposed for mixed use development. The National Highway bypass which passes through the Western part of the town meets at the Northern and Southern boundary of the town with other roads. Intense development is envisaged at these areas. Eastern bypass which meets State Highway-40 at

North and State Highway-11 at South has also some impact. An area of 6.06 sqkm is proposed as mixed zone in order to cater the development potential of the area.

25.4.12 Commercial Use Zone

Commercial land use covers an area of 0.29 sqkm. As per standards, a town like Alappuzha needs 3-4% of net area to be commercial. According to the development concept, the central area of the town with vibrant commercial activities are identified and proposed as commercial use zone.

25.4.13 Green Areas Conservation Zone

Some existing green areas in the town are proposed to be conserved and marked as Green areas conservation zone, so as to protect the the surrounding environment and to prevent pollution.

25.4.14 Heritage Zone

To preserve the rich heritage of the town and to align the new developments in tune with the heritage character of the area, Land to a depth of 20m from the outer edge of the streets on both sides of the canals (Vadai Canal, Commercial Canal and the two link canals connecting them), proposed as Heritage zone. It is proposed that the Façade of any building in land depth in these streets but falls outside the heritage zone shown in proposed land use map shall be harmony with the architectural character of the heritage zone.

25.4.15 Tourism Promotion Zone

It is proposed to boost the economy of the town through developments in the tourism sector. Tourism activity is mainly concentrated near Vembanad lake on the Eastern belt of the town and beach towards the Beach side. Tourism promotion zone is proposed in these areas in order to enhance tourism activities. An area of 0.90 sqkm is earmarked for this purpose.

25.4.16 Farm Tourism Promotion Zone

The Eastern area of the town have vast area of Paddy fields, which is under cultivation. Farm tourism promotion zone is proposed nearer to these paddy fields to promote tourism activities related to paddy fields so as to enhance the local economy.

25.4.17 Special Zones

Special zones include the areas demarcated for specific uses or projects. No other activity unless otherwise specified should be permitted in such areas. If the project is not

materialized within a period of 7 years from the date of sanctioning of the plan; the area shall be deemed as part of immediate surrounding zone and constructions shall thereafter be allowed with the concurrence of the Town Planner.

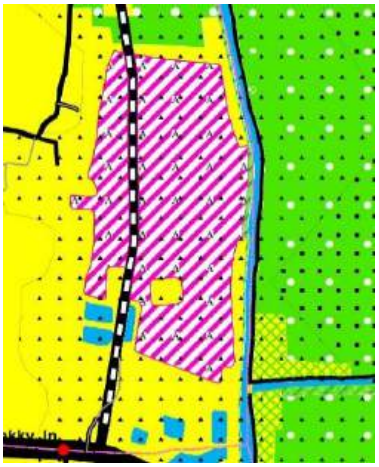


Figure 25-2: Common Facility Center

Special Zone -A- Common Facility Center

An area of 0.06sqkm of land near pallathuruthy river is demarcated for Common Facility Center (CFC) in the proposed land use map. Since this area is located in the flood prone zones of the town, flood adaptive constructions shall be adopted. If the project is not materialized within 7 years, it shall be deemed as conservation zone.

Special Zone-B- Parking Zone

Parking area has been demarcated in the proposed Land Use Map at the following locations. (i) 0.28 acre of land near venetia resort, opposite to KSRTC bus stand and North of

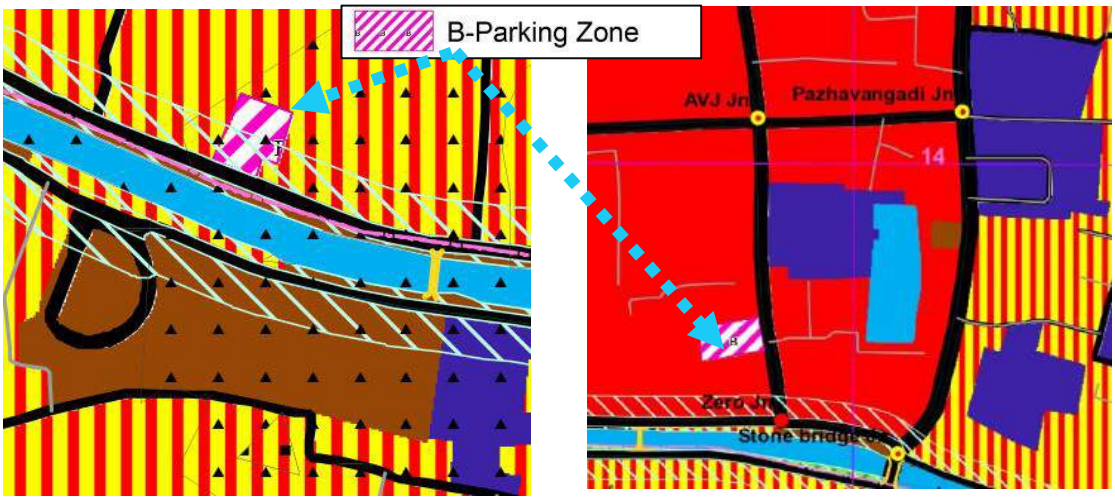


Figure 25-1: Proposed Special Zone B – Parking Zone

Commercial Canal (ii) 0.50-acre land located at a distance of 100m from Mullakkal temple towards Northern side.

Special Zone -C- Urban Park

Area has been demarcated for an urban park near Ponjikkara Subrahmanya Temple and the Punnamda Lake. Urban Park is proposed as a flood adaptive landscape that can be used as a recreational space for the local community.

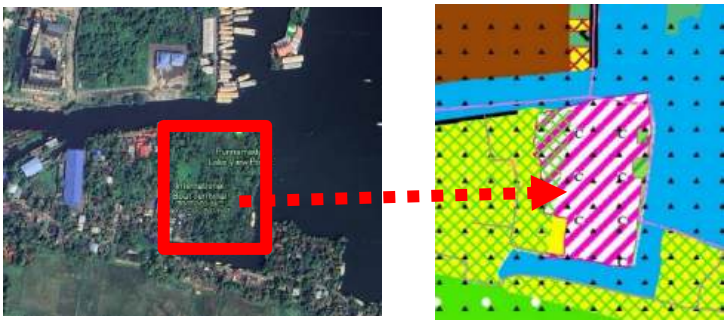


Figure 25-3: Proposed Special Zone C- Urban Park

Special Zone-D- Wetland Park

Wetland Park is proposed towards the Southern part of the Municipality near Changanasserry road. This area is also proposed as a flood adaptive landscape that can be used as a recreational space for the local community. Since the area is wetland, no built forms are encouraged. If the project is not materialized within 7 years, it shall be deemed as conservation zone.



Figure 25-4: Proposed Special Zone D- Wetland Park

Special Zone-E-Detention / Retention Basin

Detention or Retention basins are areas which are temporarily used to store excess rain water during heavy rainy season. The areas marked as detention/retention basins in the proposed land use map are envisaged as flood control basins which can be developed into a constructed wetland. No built development is permitted in this zone. If the project is not materialized within 7 years, it shall be deemed as conservation zone.

Special Zone-F-Multipurpose rescue shelter

The multi-purpose relief shelter is envisaged to act as rescue and relief shelter during hazards, nodal point for providing trainings and capacity building for citizens and response teams, providing vocational training for alternate livelihoods etc.



Figure 25-5: Proposed Special Zone F-Multi Purpose Rescue Shelter

Special Zone-G-Sewage Treatment plant

Sewage treatment plant is proposed at the locations shown in the proposed land use map in wards 21, 39 and 44.

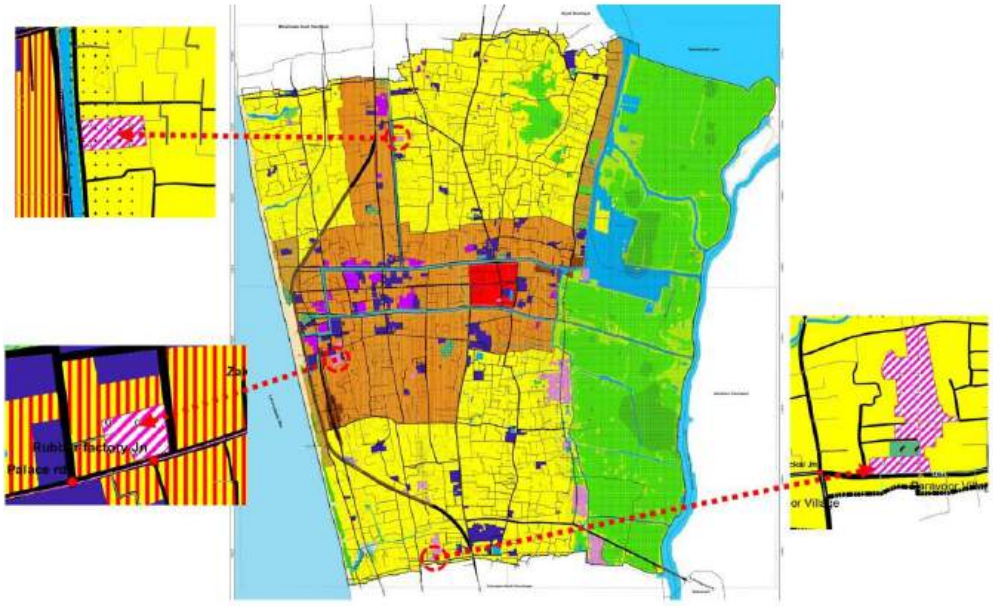


Figure 25-6: Proposed Special Zone G – Sewage Treatment Plant

25.4.18 Flood Prone Zones

Very high flood prone zone

Very High flood prone zones are areas with inundation depth greater than 2.5m. It covers an area of 0.93sqkm. These areas are zoned as regions with limited human interventions.

No new developments are allowed here. Permitted and Restricted activities in these areas are explained in Zoning Regulations.

High flood prone zone

The high flood prone zones are areas with inundation depth above 1.5 m and up to 2.5m. It covers an area of 7.04sqkm. These areas are zoned as regions with restricted human interventions. New developments with area limits are allowed here. Permitted and Restricted activities in these areas are explained in Zoning Regulations.

Moderate flood prone zone

These are areas expected to have an inundation level above 60cm and below 1.5m. It covers an area of 5.10sqkm. This area comes under regulated human intervention. Permitted and Restricted activities in these areas are described in Zoning Regulations.

Low flood prone zone

These are areas expected to have an inundation level below 60cm. It covers an area of 1.10sqkm These areas also come under regulated human intervention. Permitted and Restricted activities in these areas are detailed in Zoning Regulations.

The activities which are permissible in different use zones are explained in the zoning regulations. Figure 25-7 shows the proposed land use map.

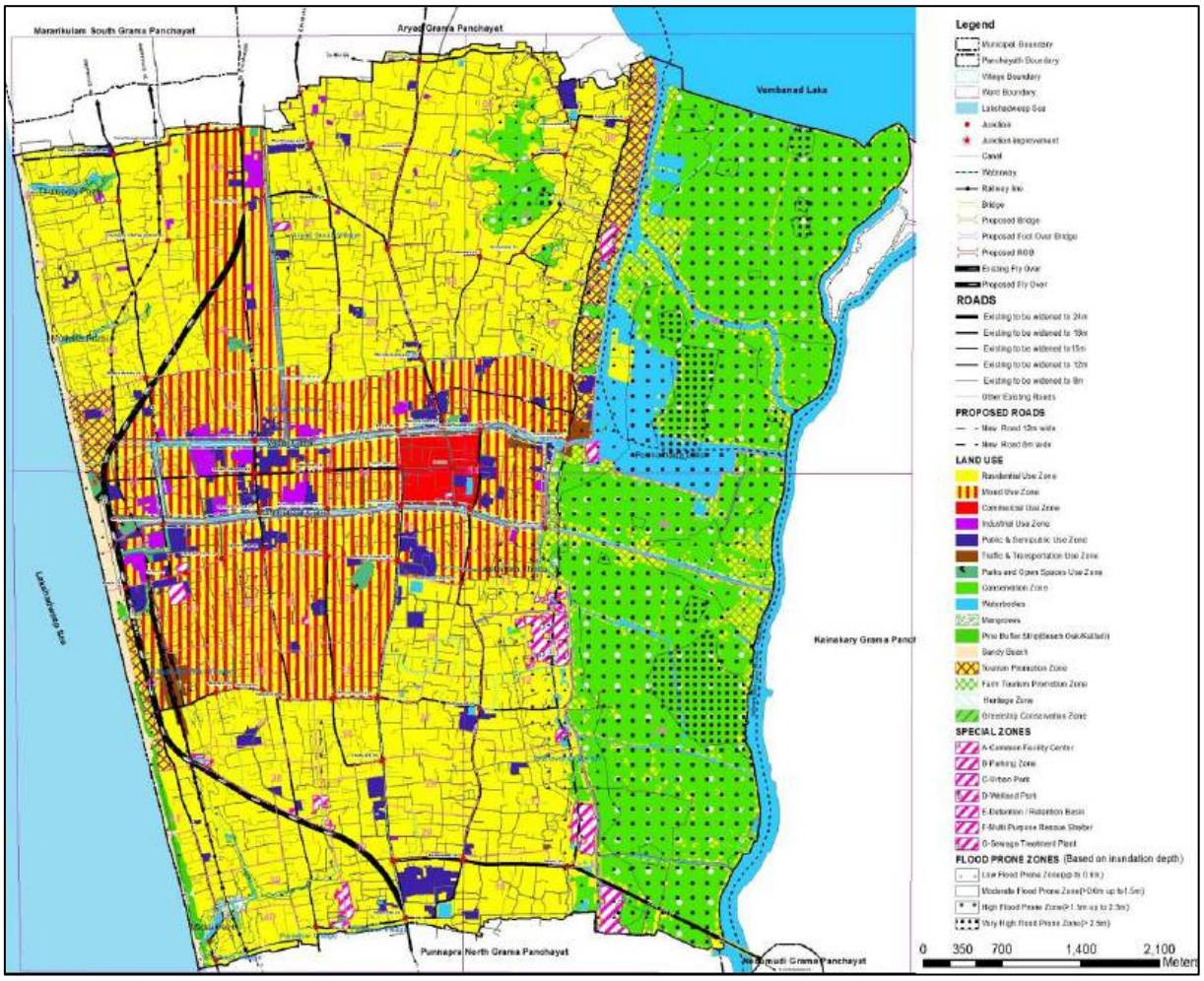


Figure 25-7 Proposed land Use Map

PART IV
PRIORITY PROJECTS, PHASING
&
FINANCIAL PLANNING

26 PRIORITY PROJECTS, ACTION PLAN & PHASING

The projects to be considered on a priority basis in various sectors have been identified and prioritized in this chapter with due regard to their significance in the socio-economic development of the town considering its importance and urgency. The action plan to execute the projects, its scheduling or phasing along with agencies involved, funding and resource mobilization also suggested.

Even though the vision aims at the development of tourism sector, the projects in all other sectors shall be integrated to achieve the desired goals in every aspect. In addition to this, priority shall be given to insist flood resilient measures in every projects so as to adapt to the hazards and the effects of climate change that may happen in future. The components or elements described here are suggestions, and any suitable or essential components required can also be included in the project during the stage of preparation of DPR or during implementation stage. The fiscal requirement calculated for each project is by rough estimate only, and the actual amount shall be calculated while preparing DPR (Detailed Project Report) during implementation stage. Land demarcated for special zone may be acquired or arranged by Land pooling method, or through PPP.

26.1 Development of Town Square

26.1.1 Location & Ownership details

Town square is located towards the Eastern side of SH40 nearer to District Court junction and along the Northern side of Vadai Canal. KSRTC bus stand and Boat jetty are located within a distance of 500m. (Figure 26-1). The area is demarcated as Park and Open Spaces Use Zone in the proposed land use map. It covers an area of approximate 90 ares in resurvey number 25 of Mullakkal village. This is located in Mullakkal ward and property is owned by Alappuzha Municipality.

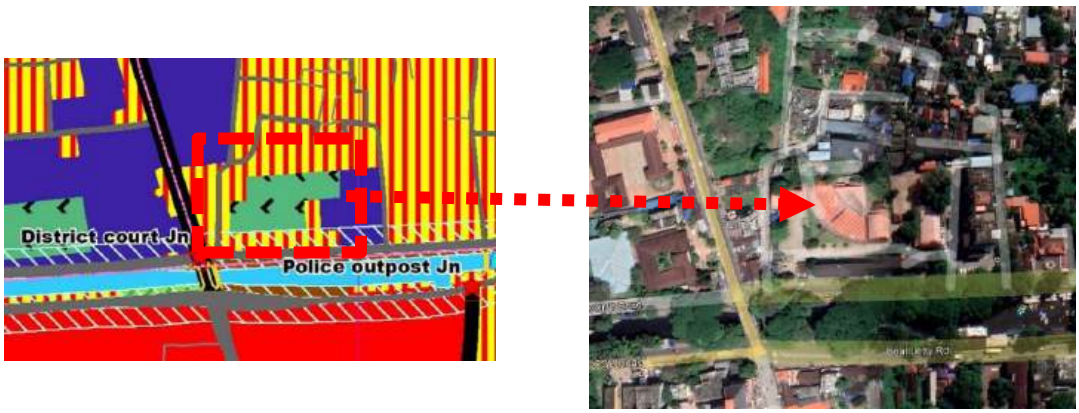


Figure 26-1: Location of Town square

26.1.2 Project Brief

The project envisages the development of the town square premises, where there is some public building persists. The development includes a multi-level car parking area in the available vacant area, Amenities & information center, Revamping of the existing basketball court and Floral Park around the buildings and Amphitheatre. (Figure 26-2).



Figure 26-2: Proposed development in Townsquare

It is proposed to construct a multilevel parking area to accommodate around 50 number of vehicles. This parking area may be utilized by the tourists and pay and parking scheme can be adopted by the Municipality which will also help to generate revenue. The location and the proposed view of the multilevel parking area is shown in Figure 26-3.





Figure 26-3: Existing & Proposed view of multi-level parking area

The proposed Amenities & information center comprises a mini theatre with a seating capacity of about 50 numbers, which may portrait the historic and heritage culture of Alleppey town, with a show time limited to 30 minutes. It should also display the tourism destinations within the town and route maps so as to help the tourists in identifying them. Also, a habitation area including rooms, toilets and food court has to be arranged in a modernized way. The proposed and expected view of Amenities & information center is shown in Figure 26-4.





Figure 26-4: Proposed location and expected view of Amenities and Information Centre

Floral Park has to be setup around Amphitheatre, Kerala lalithkala academy and near Amenities & information center to get a good ambience to the property which is situated on the heart of the town Figure 26-5.



Figure 26-5: Proposed location of floral area

Existing basketball court maintained by district sports council, to be renovated as indoor court with viewing stages for arranging district/state wise tournaments. A lot of students and other sports related persons have been depending up on this facility. The proposed location and expected view of revamped court is shown in Figure 26-6 .





Figure 26-6: Present and proposed view of basketball court



Figure 26-7: Expected view of Town square after development

26.1.3 Need for the Project

Since the economic development of the town is concentrated on tourism development, facilities which attracts tourists has to be provided. The availability of specified parking areas in the town is very less. Vehicles are parked along the side of the major roads and it creates vehicular and pedestrian conflicts. The characteristics of the location necessitates a well maintained parking area. It will also generate revenue to the Municipality. The facilities at the information center may guide and attract the tourists to different tourism destinations within the town. We can show our courtesy to the visitors by giving proper accommodation facilities at the amenities. This area may become active through the revamping of the basketball court by engaging more tournaments.

26.1.4 Agencies, Funding, Approximate cost and Project Period

The project may be implemented by the Municipality or by any agency suggested by Municipality. The possibility of getting financial assistance for amenities and information center by KTDC and revamping of the basketball court by District Sports council may be explored. Multi-level car parking may be funded by the Municipality. The approximate cost for the project comes around 11.20 Cr. 75% of the work is expected to complete in the first phase followed by full completion in second phase.

Table 26-1: Approximate Cost – Development of Town square

Component	Quantity*	Cost*	Source
Multi-level car parking	50 no's	2.85 Cr	MLCP project at Putharikandam Maidan,Trivandrum
Amenities & information center and habitation	2400 sqm@ 25000/sqm	6.00 Cr	
Floral area	1000sqm@1500/Sq m	15.00 L	
Revamping of basketball court	1100 sqm @20000/sqm	2.20 Cr	
Approximate Cost of the project		**11.20 Cr**	

**All dimensions, quantities and cost calculations are approximate*

26.2 Wetland Park

26.2.1 Location and ownership details

The proposed location is a wetland site along the Western bank of Ambalappuzha Thodu which acts as a buffer zone for flood prone areas in the Eastern part of the Municipality. It is a low-lying area nearer to the stream, and may capture floodwater during inundation, or storm water/sullage water in dry periods. The site is located at latitude 9°29'12.86"N and

longitude 76°20'59.60"E in Pazhaveedu (ward number 12) and Palace (ward number 13) wards. It covers an area of 28.90 acres in Mullakkal Village and details of survey numbers are shown in Table 26-2. This property is under private ownership and is demarcated as a special zone in land use plan. Location of the proposed wetland park is shown in Figure 26-8.

Table 26-2: Details of location – Wetland Park

Ward Name & Ward Number	Resurvey Number (Block number)
Pazhaveedu (12)	40 - 46, 100, 118, 121 - 125, 129, 131, 133, 174, 175, 186 - 189, 191 - 193, 205,206,208 – 211 (145)
Palace (13)	14, 26 (149); 1, 7, 8, 9, 10, 11, 12, 17, 18, 20, 21, 23 (108); 31 (146)

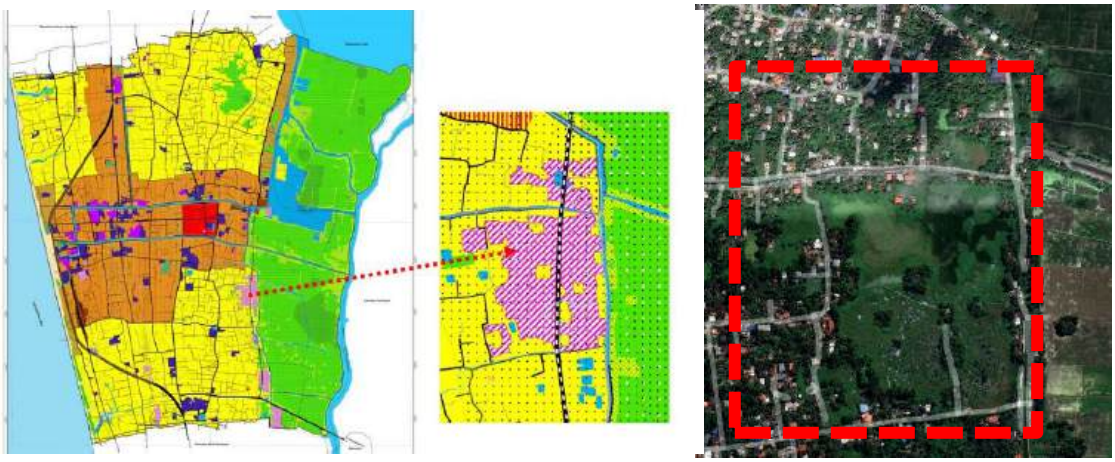


Figure 26-8: Map showing the location of proposed Wetland Park

26.2.2 Project brief

This project envisages to develop a wetland park by incorporating sponge interventions in design so as to act as a detention area for the surrounding flood prone areas. This project will become a model wetland regeneration project which uses natural filtration mechanism for storm water and grey water. This will also help to dispose of black water to be used for floriculture and cultivation of non-food produce. It includes the following components:

- Artificial wet land
- Nourished wet land
- Miyawaki forest.
- Joggers Park

- Filtration tanks

Conceptual image of the project is shown in Figure 26-9.

26.2.3 Need for the Project

This project is inevitable to conserve the existing wetland area as well as to reduce the effects of flooding in surrounding areas. Provision of land scape and architectural element for Joggers Park and promoting aqua culture for higher breed fishes will create revenue for the Municipality.

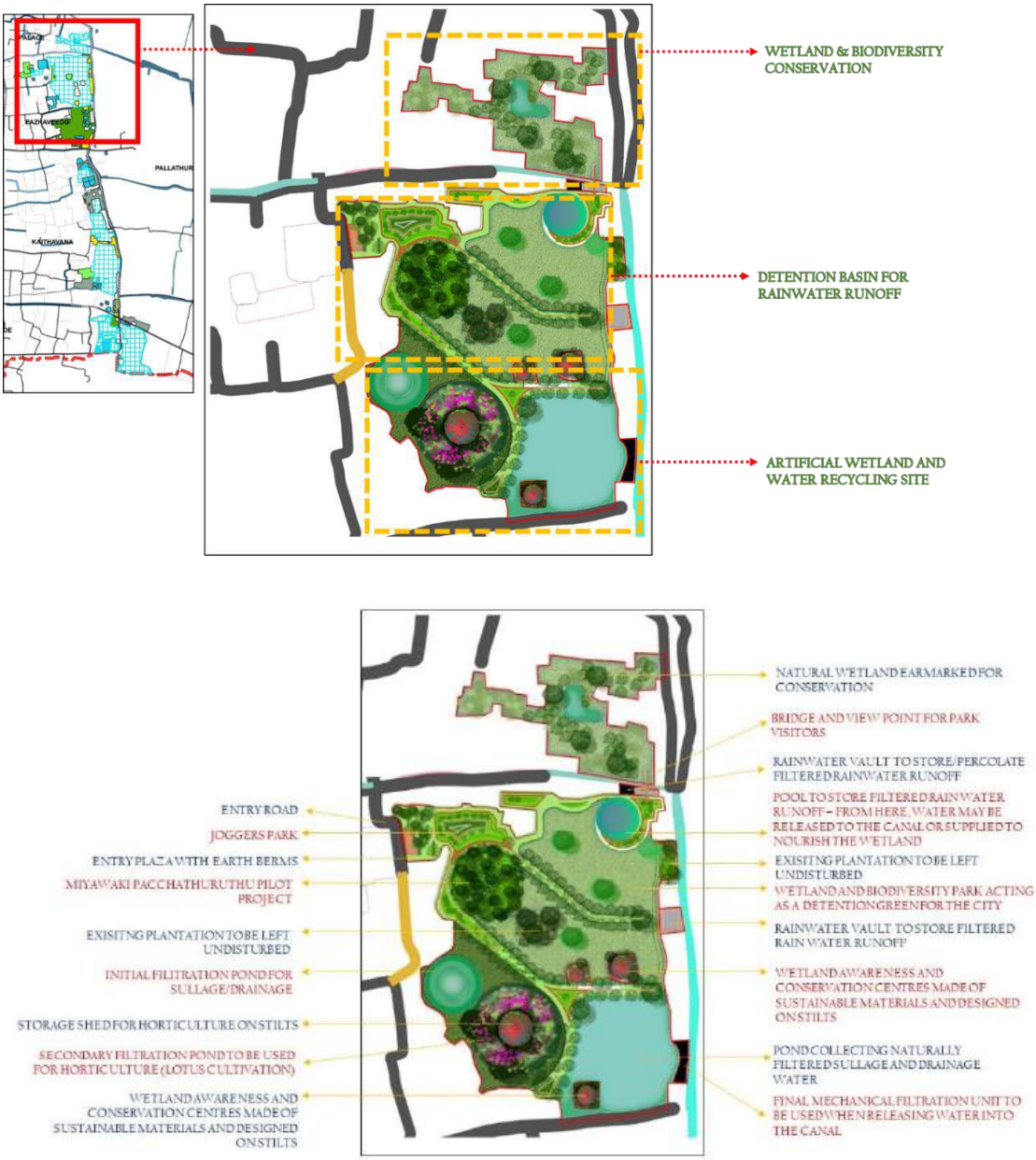


Figure 26-9: Conceptual image of the wetland park

26.2.4 Agencies, Funding, Approximate cost and Project period

This project may be implemented by Alappuzha Municipality or by any agency suggested by the Municipality. The possibility of getting financial assistance from agencies such as K-DISC (Kerala Development and Innovation Strategic Council) and Forest Department shall be explored. Growth monitoring and maintenance of the plants can be done with the help of Haritha karma sena and can be included in AUEGS (Ayyankali Urban Employment Guarantee Scheme). Approximate project cost for land development and infrastructure comes around 12.578 crores and land acquisition comes around 58.5 crores. Hence project costs around 71.08 crores. The project can be initiated in the first phase followed by 75% completion in the second and full completion in the third phase.

Table 26-3: Approximate Project Cost – Wetland Park

Component	Quantity*	Cost*	Source
Artificial Wet land	21929sqm @ 250/sqm	Rs 54.822L	Based on recently constructed artificial wetland project in South Delhi
Nourished Wet land	52840sqm @ 350/sqm	Rs 1.8494Cr	Biodiversity Park, New Delhi Based on wetland revival project project in Jakkur Lake, Bengaluru (subject to environmental studies of the area)
Miyawaki forest	6240sqm @ 3500/sqm	Rs 2.184Cr	Based on reports from crowdforesting.org, a CSR initiative of Invis
Joggers park	22181sqm @ 3588/sqm	Rs 7.958Cr	Based on Barrier-Free Jogger's Pak Garden under construction in Bandra West, Mumbai
Filtration tank	1083 sqm @ 360/sqm	Rs 3.898L	Based on AYALA's PNBS technology
Land acquisition cost for 28.90 acres	1170 are@ 500000/are	Rs 58.50Cr	
Approximate cost of the project		**71.07 Cr**	

**All dimensions, quantities and cost calculations are approximate*

26.3 Urban Park

26.3.1 Location and ownership details

This project is proposed in ward 8, nearer to Punnamada lake, at latitude 9°29'57.84"N longitude 76°21'9.10"E. It covers an area of 2.43 acres in Resurvey numbers 8/53, 55, 57, 58, 59, 60, 62, 65, 69, 72(block 97) of Mullakkal village. The area is demarcated as a Special Zone in Land use plan. Location of the proposed urban park is shown in Figure 26-10.

26.3.2 Project brief

A conceptual proposal was prepared for the site considering its prominent nature, and its proximity to the tourism circuit as shown in Figure 26-11. Since the site is ecologically sensitive, and accessible mainly via water, the decision was taken to provide a ferry point at the highest level of the site (4 m above MSL). The site slopes towards the Northwest into the water; at the lowest point, an artificial wetland has been proposed.

Considering the context of the site, it was decided to provide temporary exhibition areas and food stalls at the higher contours; additionally, viewing areas were created along the Northern and Western fringes of the site. From here, people could watch the boat races or enjoy the busy harbour. The viewing areas also buffer the site from flash floods; they act as a polder-and-dyke system to restrict water entry into the site, except along the artificial wetland.

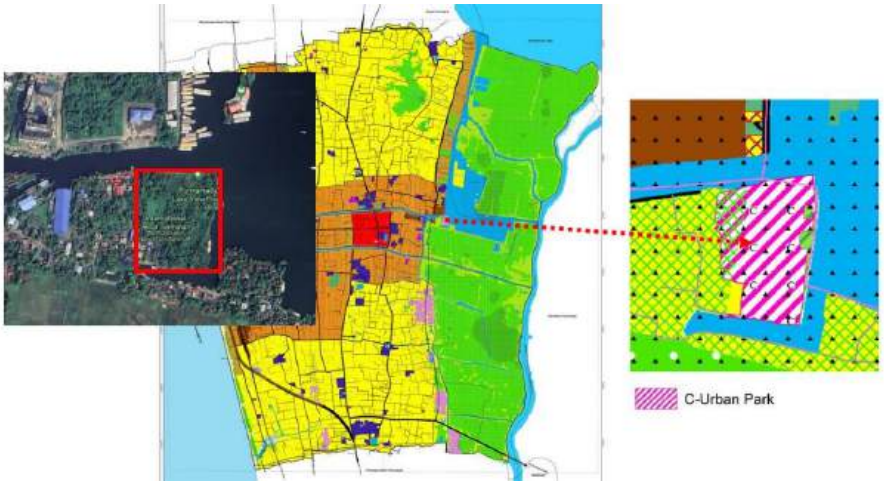


Figure 26-10: Location of proposed urban park



Figure 26-11: Conceptual view of the proposal for urban park

The components included in this project are: -

- Riverside Recreational Space
    - Terraced embankment, with flood adaptive landscape and viewing area.
    - Riprap embankment, floating viewing decks.
- Flood Resilient Cultural Pavilion

Designing a Pavilion with temporary exhibition spaces and can be used by people as a shelter during flood or rain.

- Flood resilient construction – Stilt structure
- Eco sensitive, lightweight materials that can with stand floods




Figure 26-12: Recreational space & Flood resilient cultural pavilions

- Open-Air Market & Food Stalls
    - Designing semi-permanent food stalls and open-air market stalls.





Figure 26-13: Open air markets & Food stalls

- Constructed Wetland
    - A constructed wetland is an organic wastewater treatment system that mimics and improves the effectiveness of the processes that help to purify water like naturally occurring wetlands.
    - Constructed wetlands are becoming increasingly popular as low-cost, energy-efficient, natural methods of treating sewage, industrial and agricultural pollutants, and storm water runoff while also providing various advantages.



Figure 26-14: Constructed wetland

26.3.3 Need for the Project

It is necessary to build an ecological, safe, and sustainable urban water circulation system to improve the overall level of water resources security, disaster prevention and mitigation capabilities. Since the site is ecologically sensitive, and accessible mainly via water, this area can be developed as a well-planned recreation space by adopting sponge city strategies.

26.3.4 Agencies, Funding, Approximate cost and Project period

This project may be implemented by Alappuzha Municipality or by any agency suggested by Municipality. The possibility of getting financial assistance from various departments such as PWD, KTDC, Irrigation Department and SWTD may be explored. Approximate project cost is 27.60 crores and the project can be initiated in the first phase followed by 75% completion in the second and full completion in the third phase.

Table 26-4: Approximate Project Cost – Urban Park

Component	Quantity*	Cost*	Source
Park entry	1527sqm @3588/sqm	Rs 54.78L	Based on Barrier-Free Jogger's Pak Garden under construction in Bandra West, Mumbai
Sunken pools 3 mtr depth with side protection	1231 sqm @1000/sqm	Rs 12.31 L	Based on MGNREGA 2015 estimates of a Farm Pond construction (at Rs. 152 per cu.m Rajasthan SOR, updated for 2022 standards to Rs. 215.85 per cu. m)
Commercial spaces	1047sqm @3588/sqm	Rs 37.56 L	Based on Barrier-Free Jogger's Pak Garden under
Play grounds	858 sqm @3588/sqm	Rs 30.78 L	
Cultural spaces	858 sqm @3588/sqm	Rs 30.78 L	

			construction in Bandra West, Mumbai
Wet land	1300 sqm@ 350/sqm	Rs 4.55 L	Based on recently constructed artificial wetland project in South Delhi Biodiversity Park, New Delhi
Boat Viewing	3020 sqm@ 65659/sqm	Rs 19.82Cr	Based on recently constructed viewing sea deck at Dadar Chowpatty, Dadar
Land acquisition cost for 2.43 acres/98.38 are	98.38 are@ 616000/are	Rs 6.06Cr	
Total		Rs 27.59	
Approximate Cost of the project		**27.60 Cr**	

**All dimensions, quantities and cost calculations are approximate*

26.4 Detention/Retention basins

26.4.1 Location and ownership details

Detention basins identified within the Municipality are demarcated as Special Zone in land use plan as shown in Figure 26-15 . The details of detention areas are shown in Table 26-5.

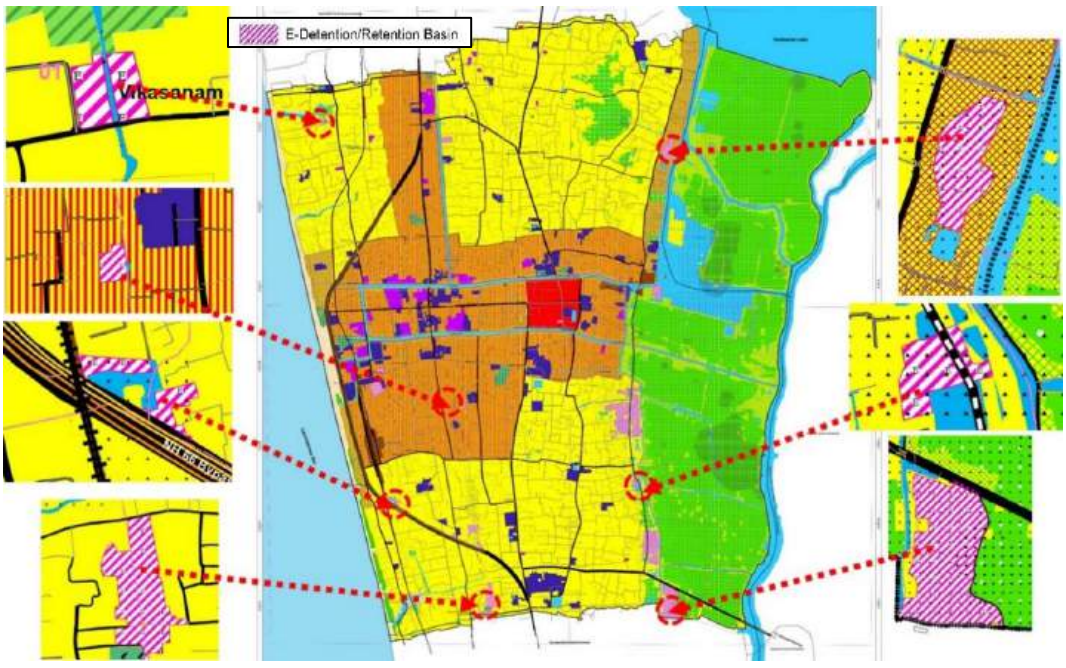


Figure 26-15: Map showing the locations of proposed Detention/ Retention Basin

Table 26-5: Details of Detention/ Retention Basins

Sl. No.	Ward Name and Number	Resurvey No (Block No) ,Village	Extent In Sq.Km
1	Kalarcode (10) & Pallathuruthy (9)	72(105);9,15,17(106); (Pazhaveedu)	0.060726
2	Eravukadu (30) & Gurumandiram (39)	118,142(187); 17,18,26,27(189); (Alappuzha West)	0.011152
3	Eravukadu (30) & Kuthirappanthi (38)	1(193); 19(153); 20(151); 1(193) (Alappuzha West)	0.003758
6	Kuthirappanthi (38)	7,8,9(152);20(151); (Alappuzha West)	0.004261
7	Kuthirappanthi (38) & Railway Station (42)	3,20,38,41,84(168); (Alappuzha West)	0.002302
8	Railway station(42)	61,66,67,68(125); 1,3(168); 71,72(169); (Alappuzha West)	0.001742
9	Pazhaveedu (12)	59(64); (Pazhaveedu)	0.003456
10	Pazhaveedu (12)	12,59,99(64) ; (Pazhaveedu)	0.001293
12	Karalakam (17)	28,42,43(163A); (Aryad South)	0.018408
Total Area			0.107098

26.4.2 Project brief

This project is proposed to create detention basins to collect the inundated water during flooding and these basins will retain some amount of water and allow this drain slowly to the restored channels to the river, thus reducing peak flow. These identified basins can be dug to a depth of 1m to increase the water storing capacity.

26.4.3 Need for the Project

During heavy seasonal raining, surface run off water creates flooding in low-lying areas. In order to resolve the condition, the existing wetlands or marshy lands and paddy lands may be used as detention basins so as to accommodate the excess water. This will create a water catchment shed, to collect maximum discharged surface run off water and the collected water may get infiltrated to the nearest water body or it can be treated for other industrial as well as commercial purposes. This will prevent the flooding of adjacent land or reduce the flooding in those watersheds.

26.4.4 Agencies, Funding, Approximate cost and Project period

This project may be implemented by Alappuzha Municipality or any agency suggested by Municipality. The possibility of getting financial assistance from Irrigation Department may be explored. Cost of construction for individual basins may vary according to ground specific conditions. Approximate project cost for construction work is Rs 4.80 crores and for land

acquisition is Rs 75.00 crore. Thus, the total financial implication comes around Rs 79.82 crores and the project can be initiated in the first phase followed by full completion in the second phase.

Table 26-6: Approximate Project Cost – Detention Basins

Component	Quantity*	Cost*
Detention basin area	0.1481 Sqkm@ Rs 32.50 crore/Sqkm	Rs 4.81L
Land acquisition cost	Rs 75.00 crore	Rs 75.00 crore
Approximate Cost of the project		**79.82 Crore**

**All dimensions, quantities and cost calculations are approximate*

26.5 Multi purpose Rescue shelter

26.5.1 Location and ownership details

A multi-purpose rescue shelter is proposed towards the Western side of the town nearer to the railway station. It is located at latitude 9°29'23.25"N and longitude 76°19'26.48"E in ward 43. It covers as area of 3.34 acres in Re survey no. 43/12 of block 104 of Alappuzha West village. It is demarcated as a special zone in the proposed land use map and the land is under private ownership. The location of the project is shown in Figure 26-16.

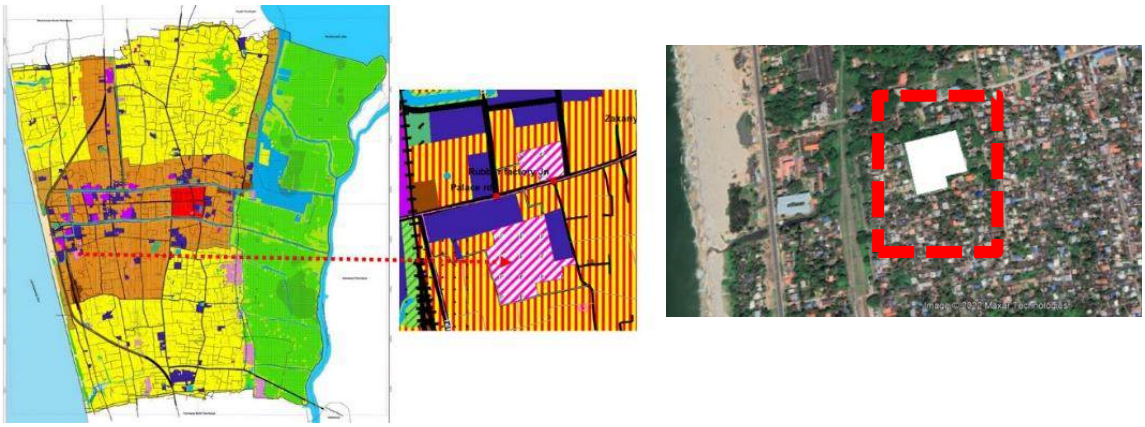


Figure 26-16: Location of proposed Multipurpose Rescue shelter

26.5.2 Project brief

This project aims to provide a permanent rescue shelter to accommodate the people during disasters. Features and facilities to be made available in the multi-purpose shelter are:

- Separate hall for men and women
- Separate toilets for men and women.
- One extra room to be used for sick/ labor room
- One store room
- Ramp of 1:12 slope for persons with disability

- Drinking water supply through submersible pump
- Internal electrical wiring done with 5 KVA generator set supplied for backup power supply.
- Black board for class room purposes
- All weather road connectivity to the shelter

26.5.3 Need for the Project

Coastal areas are expected to be affected by storm surges at any time. There should be a permanent rescue shelter to accommodate the people suffering from these disasters. This shelter can also be used during flooding. These open areas can also be used as space for the livestock or vehicular parking facility during non-flooding times.

26.5.4 Agencies, Funding, Approximate cost and Project period

This project may be implemented by Alappuzha Municipality or by any agency suggested by the Municipality. The possibility of getting financial assistance from agencies such as PWD (Buildings) and KSHB may be explored. Approximate project cost is Rs 34.72 crores and the project can be initiated in the first phase followed by full completion in the second phase.

Table 26-7: Approximate Project Cost – Multi purpose rescue shelter

Component	Quantity*	Cost*
Multi-purpose rescue shelter with plinth area (40 % of land area)	62400 Sqft@ Rs 3000 /sqft	Rs 18.72 Cr
Land acquisition cost	Rs 16.00 crore	Rs 16.00 Cr
Approximate Cost of the project		**34.72 Cr**

**All dimensions, quantities and cost calculations are approximate*

26.6 Foot overbridge across National Waterway

26.6.1 Location and ownership details

A foot over bridge is proposed towards the Eastern side of Alappuzha Municipality at Latitude 9°30'43.90"N, Longitude 76°21'14.10"E connecting Nehru Trophy Ward (Ward No. 5) and Karalakam Ward (Ward No. 17), across National Waterway-3 connecting Kottapuram - Kollam. One end of the foot over bridge is located in block number 163 A having resurvey number 54 and 43 of Aryad South Village. This area is demarcated as tourism promotion zone as well as flood prone zones in the proposed land use map. Other end of the foot over bridge is located in block number 66 having resurvey number 46 of Mullakkal village. This area is

demarcated as farm tourism promotion zone as well as flood prone zones in the proposed land use map. The location map is shown in Figure 26-17.



Figure 26-17: Location of proposed foot over bridge

26.6.2 Project Brief

A cable stayed foot over bridge connecting the inlands having two piers on either sides, with a width of 2.00 meter, length 65.00 meter and at a height of 7.00meter from National water way -3 level, without causing any hindrance to smooth movement of vessels. To reach the top of the bridge, stairs of 2.00 meter width having sufficient handrails at a height of 1.2mtr has to be provided., it is also proposed to give a viewing platform for the VIP and VVIP guests on behalf of Nehru trophy boat race. The model of 'Inchathotty' suspension foot over bridge done in Kothamangalam can be adopted here (Figure 26-18).



Figure 26-18: Inchathotty suspension bridge done in Kothamangalam

26.6.3 Need for the project

Transportation is the basic necessity of people. Nehru Trophy ward is isolated from the town as a lagoon and the only means of transportation is water ways i.e. through small vessels and boats crossing National Waterway 3. The absence of a proper connectivity to the main

land is a major problem that is faced by the people during causalities or other emergencies. Crossing the canals in small vessels is unsafe and have more chances of getting accidents caused by the movement of house boats and big vessels. Since Nehru Trophy ward is a flood prone area, the provision of a foot over bridge may help in easy evacuation during flooding.




Figure 26-19: Views at proposed location of Foot over bridge

26.6.4 Agencies, Funding, Approximate cost and Project Period

The project may be implemented by the Municipality or any agency suggested by Municipality. The possibility of getting financial assistance from agencies such as Kerala Tourism Development Corporation or Public Works Department may be explored. The approximate cost for foot over bridge is 2.75 Cr. Full completion of the project is expected in the first phase itself.

Table 26-8: Approximate Cost – Foot overbridge near Nehru Trophy Area

Component	Quantity*	Cost*	Source
Foot over bridge	65.00 mtr @4.20 L/mtr	2.73 Cr	Inchanthotti suspension bridge, Kothamangalam
Approximate Cost of the project		**2.75 Cr**	

**All dimensions, quantities and cost calculations are approximate*

26.7 Heritage Walk Project

26.7.1 Location details

The project proposes a heritage walk project interlinked with boat cruising through Vadai canal, commercial canal, and the two link canals. The locations identified for heritage walk is grouped into clusters and is sown in Figure 26-20. The following heritage structures are included in each clusters.

- Cluster I - **Commercial cluster** – Mullakkal temple and Mullakkal street
- Cluster II - **Coir cluster** –Aspin wall and co.; New model coir society and Kerala state coir corporation

- Cluster III- **Gujarati cluster** - Old Gujarati school, CSI Church, Jain temple & Bal Krishna haveli
- Cluster IV - **Beach cluster** - Muppalam heritage park, Lighthouse, Port Museum, Sea pier
- Cluster V - **Museum cluster** - Revi Karunakaran memorial museum, William goodacre coir factory



Figure 26-20: Map showing the locations of proposed heritage circuit

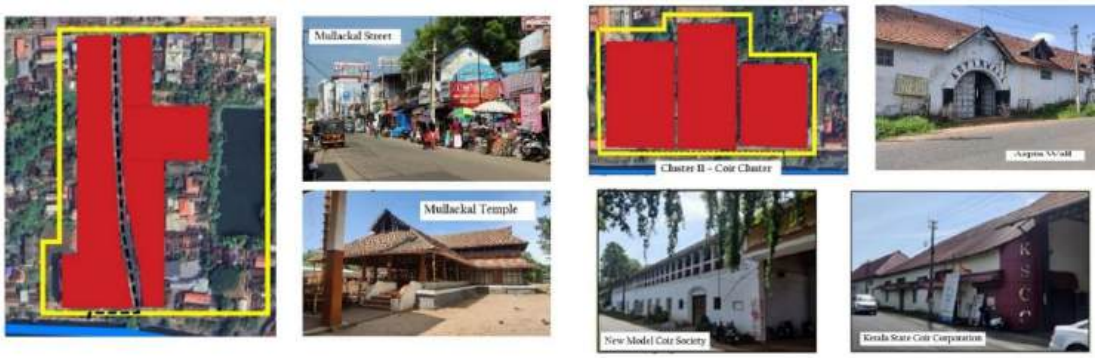


Figure 26-21: Buildings in clusters I & II



Figure 26-22: Buildings in clusters III

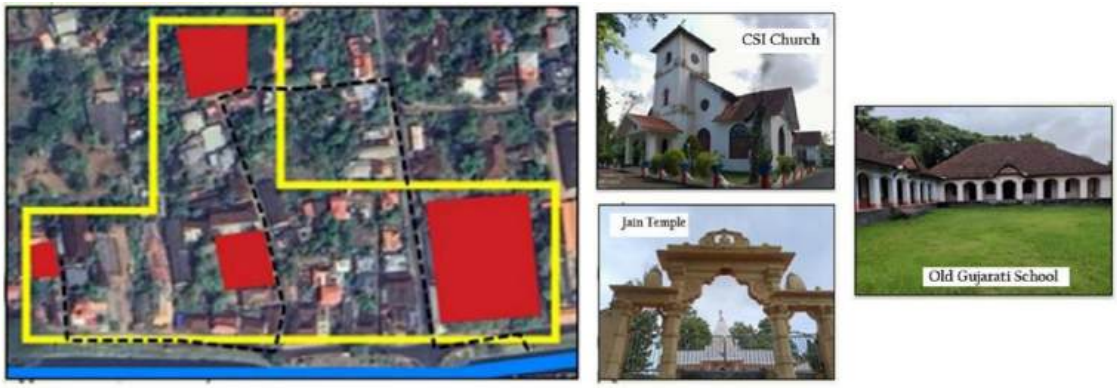


Figure 26-23 Buildings in clusters IV



Figure 26-24 Buildings in clusters V

26.7.2 Project Brief

This project aims to promote heritage tourism activities by linking the canal waterway and the heritage buildings which are abundant in the town. The project proposes a complete circuit of boat cruise through the canal, which is connected to various heritage clusters through heritage walk. Project can be managed in 5 clusters which consists of 15 locations/pause points. The circuit starts from the boat jetty and comprises of a full tour of the two main canals in boat covering a total distance of about 7.45km. There will be stops near to all the clusters for people to get off the boat and to have walk through these locations and come back to the boat to continue the journey. The circuit ends at the start point itself (boat jetty). The circuit will start at 4 pm and has a duration of about 3hrs 40 min. The timings may be fixed in such a way that the people can enjoy the sunset at the beach which is in the second last cluster and can continue their cruise from there. Different other heritage structures are present throughout the sides of the canal which the people can enjoy them by cruising in the boat. The following components are included in this project:

- Boats and landing centres
- Brochures showing the list of heritage sites
- Markings and sign boards
- Training for qualitative improvement to those persons interacting with tourists

- Water and food kiosk
- Street furniture's and art works

26.7.3 Need for the Project

To develop the town into a destination, the heritage attractions of the town are to be explored. For this, the heritage structures need to be conserved and should be open for the public to understand the heritage values of the town.

26.7.4 Agencies, Funding, Approximate cost and Project period

This project may be implemented by Kerala Tourism department or SWTD or by any agency suggested by the Municipality. The approximate cost for this project comes around Rs 1.40 Cr. A detailed study should be conducted to understand the feasibility of the project in the first phase, based on this, a pilot project may be implemented by choosing any of the suggested clusters or as per the detailed project report in the second phase and full completion of the project is expected in third phase.

Table 26-9: Approximate Project Cost: Heritage Walk Project

Component	Quantity*	Cost*
Boats and landing centres	LS	Rs 100.00L
Brochures Markings and sign boards	LS	Rs 5.00L
Training for qualitative improvement to those persons interacting with tourists	LS	Rs 10.00L
Water and food kiosk, Street furniture	LS	Rs 25.00L
Approximate Cost of the project		Rs 140.00L

**All dimensions, quantities and cost calculations are approximate*

26.8 Sewage Treatment Plant

26.8.1 Location and ownership details

Sewage treatment plant is proposed at three locations and is demarcated as special zone in the proposed land use map. The location of proposed sewage treatment plants are shown in Figure 26-25 and details of location, ownership were shown in Table 26-10.

Table 26-10: Details of proposed STPs

Location	Area in hectare	Ownership
1. Kommady, Sy no 2 ,Block no 74 , ward 21	0.243	Private land
2. Kalarcode, Sy no 143, Block no 187 , ward 39	0.300	Private land
3. Rubber factory junction, Sy no 8, Block no 97, ward 44	0.400	Private land

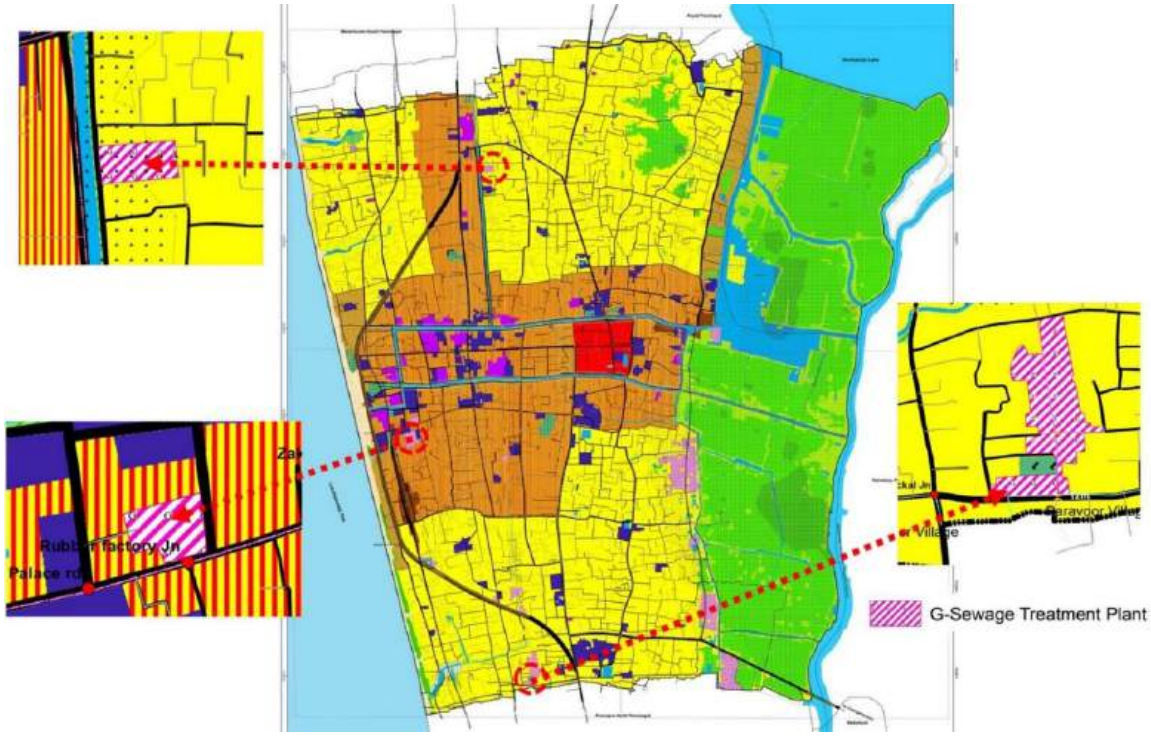


Figure 26-25: Locations of proposed STPs

26.8.2 Project Brief

This project aims to develop sewage treatment plants at specified locations so as to ensure proper sewage management within the town. It includes the following components:

- Assessment, analysis and Quantification of the present liquid waste management system, facilities and issues in the Town area
- Land acquisition, Implementation, operation and maintenance

26.8.3 Need for the Project

At present, sewage treatment facility is not available for the entire municipal area. The STP projects implementing under AMRUT mission projects of the Municipality at Chathanad colony, Shathabdimandiram near Civil Station and in premises of General Hospital are for institutional purposes only. Absence of a sewage treatment facility has contributed to the stagnation of wastewater, water pollution, spreading of waterborne and vector borne diseases. So, sewage treatment plants are to be provided for the entire municipal area.

26.8.4 Agencies, Funding, Approximate cost and Project period

The power and responsibilities of constructing sanitation facilities rests with Local Self Government Institutions. Municipality may purchase the land or get it sponsored, as the

selected sites are private owned land. Kerala Suchitwa Mission, Haritha Keralam Mission, Clean Kerala Company, Kerala Sustainable Urban Development Project (KSUDP), Kerala State Industrial Development Corporation Limited (KSIDC) or IMPACT Kerala may act as SPV for the project. SPV's can provide technical assistance and supervise the project. The operation and maintenance of the treatment plant may be done by the Municipality. Municipality can collect a fee from the sources for the plant's maintenance. Cost of construction for individual plants may vary according to ground specific conditions. Approximate project cost for the three plants including land acquisition is around 145 crores. STP-1 may be implemented as a pilot project in the first phase and STP-2 and STP-3 in the second and third phase.

26.9 Beautification of canal banks

26.9.1 Location and ownership details

The project is proposed along the the banks of Vadai canal, Commercial canal, East link canal and the West link canals as shown in Figure 26-26.

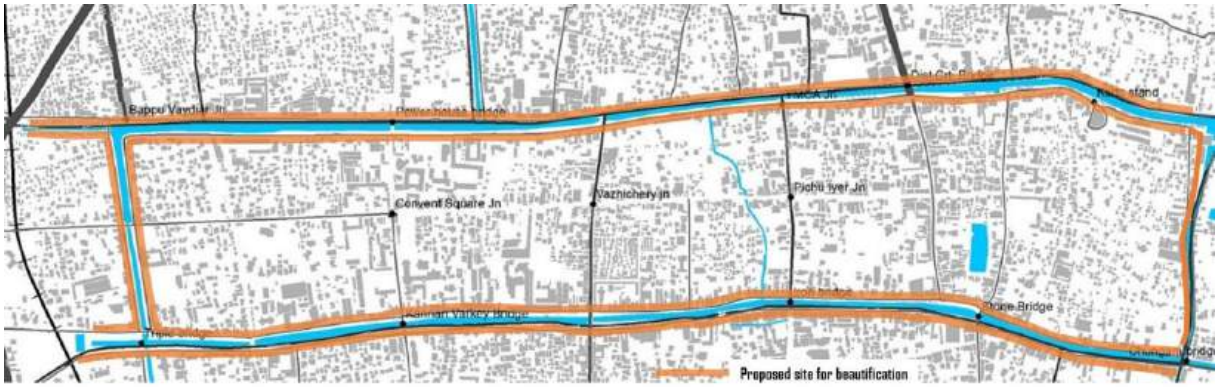


Figure 26-26: Location of proposed Canal Bank Beautification

26.9.2 Project Brief

The project components include foot paths and walkways, seating arrangements, green areas or landscaping, children's play area along the canal banks. Viewing platform is to be provided along the foot over bridges. Typical sketch is shown in Figure.

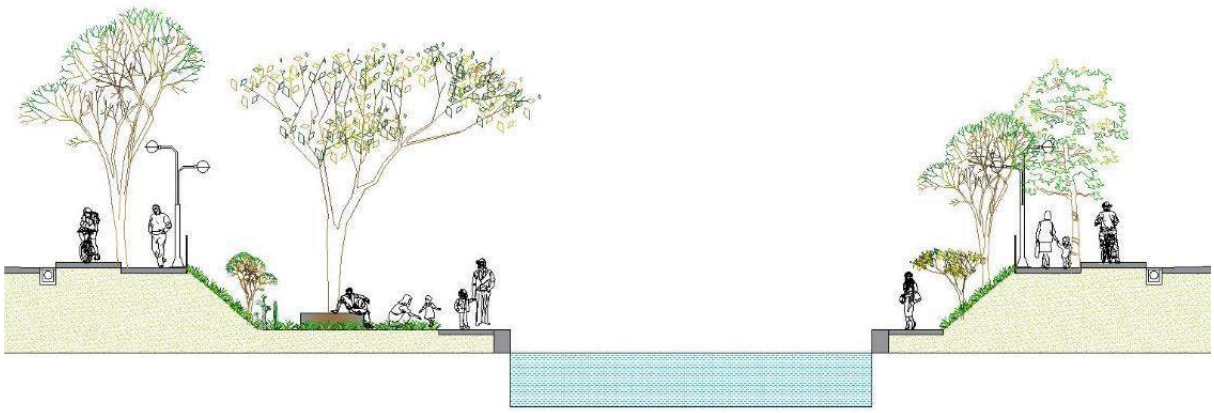


Figure 26-27: Typical section of proposed canal stretches after beautification

26.9.3 Need for the Project

The four canals are one of the major attractions of the town. These are not explored in such a way so as to portrait the character of the town. As Alappuzha is knowing as the Venice of the East, these canals should reflect the meaning of this name.

26.9.4 Agencies, Funding, Approximate cost and Project Period

The project may be executed through the Department of Tourism in consultation with the Muziris Heritage Project Limited or through any agency as suggested by the Municipality. The possibility of getting financial assistance from Kerala Infrastructure Investment Fund Board (KIIFB) may be explored. Approximate project cost is 50 crores and the project is expected to complete in 3 phases. 50% work completion in the first phase, 75% in the second phase and full completion in the third phase is expected.

Table 26-11: Approximate Project Cost – Beautification of Canal Banks

Component	Quantity*	Cost*	Source
Beautification of canal banks	7100 mtr @70000 /mtr	49.70 cr	Muziris Heritage Project Limited
Approximate Cost of the project		**50.00 Cr**	

**All dimensions, quantities and cost calculations are approximate*

26.10 Farm Tourism Project

26.10.1 Location and ownership details

This project may be located anywhere in the area demarcated as farm tourism promotion zone in the proposed land use map. The proposed farm tourism promotion zone is shown in Figure 26-28.

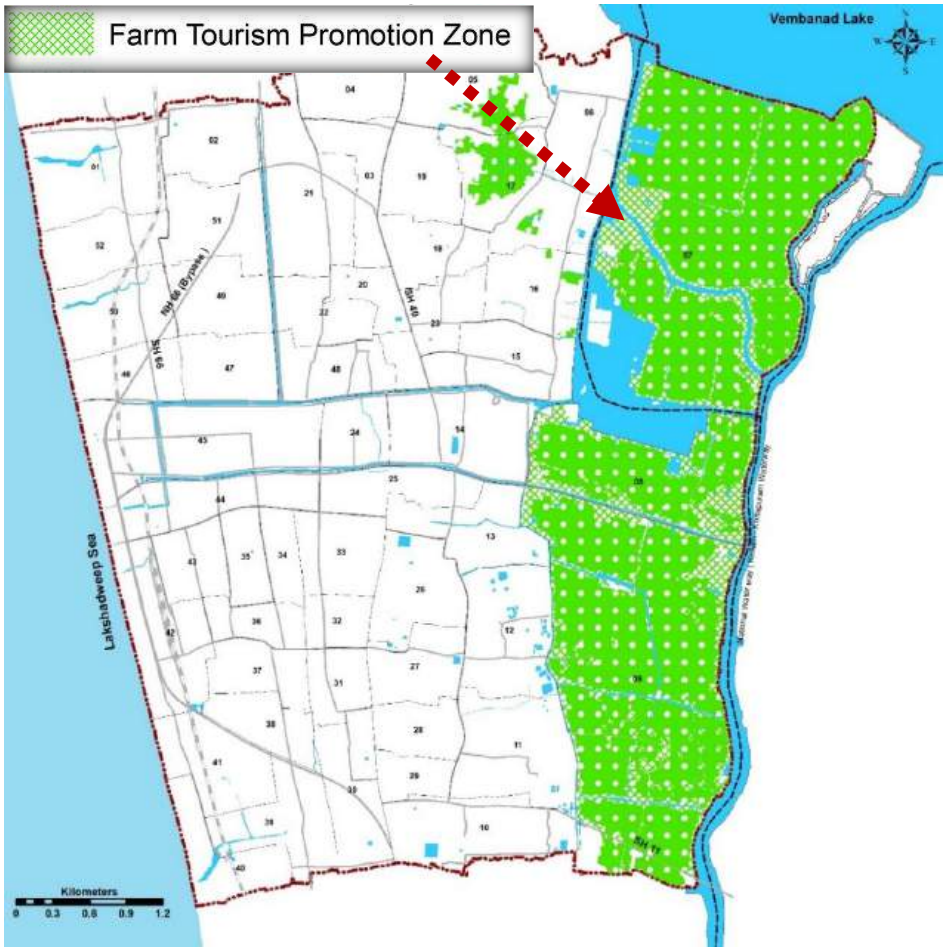


Figure 26-28: Map showing the paddy fields and proposed farm tourism promotion zone

26.10.2 Project Brief

The proposed intervention aims to promote farm tourism activities within the padasekharams of Alappuzha Municipality. Individual owners of paddy fields or padasekharasamitis can conduct farm tourism activities in their fields. Related infrastructure to promote the farm tourism activities can be developed by themselves or by the Municipality. The facilities that may be developed includes:

- Parking area and Development of entry area, Compound wall at the entry area
- Ticket counter, guardroom, gate, name boards etc.
- Stalls or shopping area, Restaurant/coffee shop/snack bar etc. outside or inside the farm
- Walkways, signage etc. within the farm, Toilet facilities inside and outside the farm
- Brochures, Tourist information centre, Communication centre etc.
- Development of new accommodation facilities exclusively for the tourists
- Training for qualitative improvement to those persons interacting with tourists

26.10.3 Need for the Project

Alappuzha Municipality have 7.46 sq.km land under paddy cultivation. Since the presence of backwaters and other destinations in the town attracts large number of tourists, there is tremendous potential for developing Farm Tourism in a big way without much additional investment. Land under paddy cultivation can be conserved to promote agriculture related activities in order to transfer the benefits of tourism directly to the farmers. It will revitalise the agriculture sector, opening up a new world of opportunity for farmers, while enhancing tourist arrivals.

26.10.4 Other Associated Issues to be Addressed

- Digital marketing platforms need to be promoted through online campaigns, interactive / social media and other modern and innovative technology spheres etc.
- Awareness about farm tourism and responsible tourism; capacity building of all the stakeholders and promotion of sustainable tourism practices are to be promoted.

26.10.5 Agencies, Funding, Approximate cost and Project period

Municipality or any agency suggested by Municipality may provide financial assistance to the individual owners or padasekharasamitis for the development of various infrastructure related to farm tourism activities. The possibility of getting financial assistance under the Green Farms Kerala project of Tourism department may be explored. Approximate project cost is 265.00 Lakhs and full completion of the project is expected in the third phase.

Table 26-12: Prospective agencies & their role

Agency	Role
Department of Tourism	Approval, Marketing and facilitating loans to farmers.
Kerala Institute of Tourism and Travel Studies (KITTS), Food Craft Institute, the Institute of Hotel Management and Catering Technology (IHMCT)	Training for qualitative improvement to those persons interacting with tourists

26.11 Aqua tourism project related to fish farms / Aqua tourism center

26.11.1 Location and ownership details

Aqua tourism project is proposed in Vembanad lake area within the Municipal boundary as shown in Figure 26-29.

26.11.2 Project Brief

The proposed intervention aims to promote aqua tourism activities to enhance the tourism potential and the economic base of the local economy. Components of Project are:

- Fish farms, Pedal Boating, angling and rowing facilities
- Ethnic food corners with fresh farm reared fishes
- Viewing platforms/ Aquatic homestays/ Erumadams with walkways
- Brochures/ Calendars/ Recipe books/Fish festival and fairs/Cookery books
- Facilities for sport fishing/ interactive games/Cooking lessons etc.
- Eco museums and Public Aquarium
- Promotion of local aquaculture products



Figure 26-29: Aqua tourism area

26.11.3 Need for the Project

Aqua tourism is an upcoming avenue for resource generation and also helps to promote backwater tourism activities. Aquaculture is an additional source of revenue for local businesses. Alappuzha, being the hub of backwaters, lakes and wetlands has the great opportunity to use these resources for aqua tourism. An aquaculture producer with good communications skills can become a "tourist attraction" and can be promoted as an upcoming avenue for resource generation.

26.11.4 Agencies, Funding, Approximate cost and Project period

Fish farms may be developed by the Department of Fisheries and Matsyafed or any agency suggested by Municipality. Possibility of developing tourism related infrastructure at the fish farm by the Department of Tourism may be explored. Schemes for developing local aqua culture, promotional activities for developing the aqua tourism at the fish farm etc. may be handled by the Municipality. Capacity building training may be imparted to the general public by the Municipality with the help of Central Institute of Brackish Water Aquaculture and the Department of Fisheries. Approximate project cost is Rs 6.00 crores and the full completion of the project is expected in the third phase.

26.12 Conservation / Restoration of Mangroves

26.12.1 Location and ownership details

The existing mangrove areas at Thumpoly Pozhi (Ward No: 01), Vadai Pozhi (Ward No: 42) and Ayyappan Pozhi (Ward No: 40) are proposed for mangrove conservation or restoration project. Location details are shown in Figure 26-30 and Table 26-13.

Table 26-13: Location details – Mangrove restoration

Location	Resurvey Number(Block Number)
Thumpoly Pozhi	Resurvey No. 132, 79, 76, 69,60, 54,53 (Block No. 2); 88,89,90 (Block No. 10) and part of Block No. 7
Ayyappan Pozhi	Resurvey No.3,4 (Block No. 101)
Vadai Pozhi	Resurvey No. 1,2,3,4,9 (Block No.182); Resurvey No. 2, 45,46,47 (Block No. 181); Resurvey No. 48,49,55 (Block No.176); Resurvey No. 40,41 (Block No.177); Resurvey No 42,44, 43, 46, 47, 48, 53,54 (Block No. 179) and Resurvey No 1 (180)

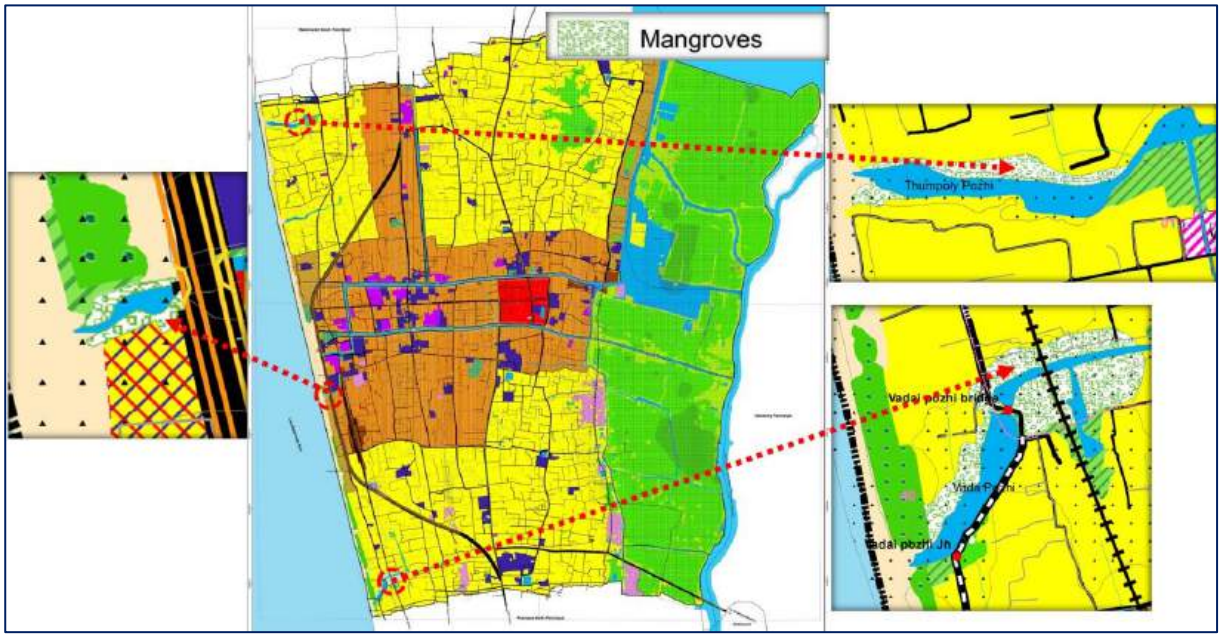


Figure 26-30: Locations identified for the protection of mangroves

26.12.2 Project Brief

This project aims to conserve the existing mangrove species and to restore mangroves at suitable locations, to protect the ecosystem as well as the coastal communities from the impacts of climate change. Components of the project includes Mangrove Nursery and Eco - tourism activities (Spot fishing, Kayaking and birdwatching tours).

26.12.3 Need for the Project

Mangroves are natural coastal defense which provide valuable protection for communities at risk from sea level rises and severe weather events caused by climate change. The mangrove forest waters provide local fishermen with a rich supply of fish, crabs and shellfish to sell for income. Mangrove forests also have potential to generate income for local inhabitants through sustainable tourism by providing rich environment for activities like spot fishing, Kayaking and birdwatching tours.

26.12.4 Responsible Agencies, funding and project period

This project may be implemented through community and government participation. A mangrove nursery can be established and community-based initiatives has been evolved to enhance public awareness and reduce threats to mangroves. Public awareness about the impact of climate change and its effect on coastal communities should be addressed during the implementation of this project. Alappuzha Municipality or any agency suggested by Municipality may provide financial assistance to individual for developing mangrove plantations near the pozhi area. Approximate project cost is 2.75 Cr and since it is a long-term goal, it should be included in the first phase followed by completion of the project is expected in the third phase.

26.13 Upgradation of EMS stadium

26.13.1 Location and ownership details

The EMS stadium is located towards the Western side NH 66 nearer to General Hospital Junction in ward number 33 at latitude 9°29'27.34"N longitude 76°20'10.32"E. The area is located in block no. 53 (Resurvey No. 81) and block no. 44(Resurvey No. 1,2,8,15,16,17,18,19,32,33,34,50) of Alappuzha West village. The property is owned by Alappuzha Municipality. The location is shown in Figure 26-31.

26.13.2 Project Brief

The proposal is to upgrade EMS stadium and premises to a well-planned recreation center by incorporating sponge city interventions. EMS Stadium is bounded by a canal on its Western boundary. This proved an apt place to locate sponge interventions. Project components includes Synthetic track upgradation for organizing games, roller skating tracks, Cycling Track, Turf Ground for football and viewing gallery revamping, cafeteria and Children's Park and Joggers Park at the vacant land near to the stadium. The jogger's park may be provided with earthen berms and rain gardens. Water collected from such areas can be

diverted into natural filtration bio swales, filtered, UV-treated and supplied to swimming pools located at the rear of the site. This water can then be reused for gardening, or released into the canal at a controlled rate. Conceptual image of the proposed development at EMS stadium is shown in Figure 26-32.

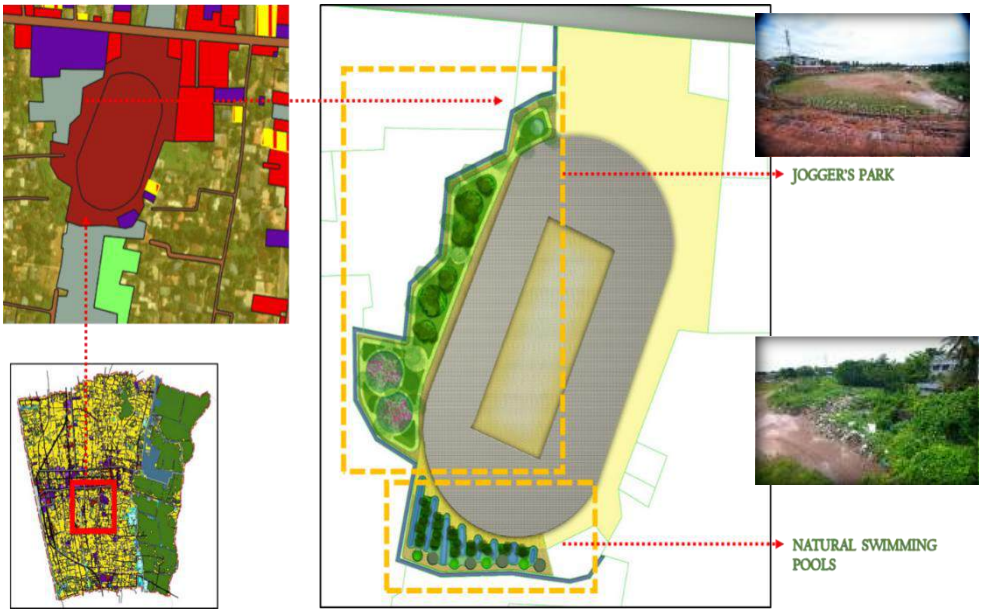


Figure 26-31: Location of EMS stadium and proposed developments



Figure 26-32: Conceptual image of the Proposed Development at EMS stadium

26.13.3 Need for the Project

Upgradation of EMS stadium is necessary to accommodate the growing needs so as to use it as a recreational space, since it is located within the CBD area of the town. Also, considering the characteristics of the location, incorporating suitable sponge interventions may help to mitigate urban flooding.

26.13.4 Agencies, Funding, Approximate cost and Project period

This project may be implemented by Alappuzha Municipality or by any agency suggested by Municipality. The possibility of getting financial assistance from District Sports Council may be explored. Approximate project cost is 10.407 crores and the project can be initiated in the first phase followed by full completion in the second phase.

Table 26-14: Approximate Cost – Upgradation of EMS Stadium

Component	Quantity*	Cost*	Source
Synthetic track of 8lane with turf and amenities for foot ball	400 mtr track	Rs 8.00 crore	Brennen college , Talassery
Joggers Park	450Sqm@ 3588/sqm	Rs 1614600.00	
Earthen berms and rain gardens	180 mtr @ 6500/mtr	Rs 1170000.00	Rutgers cooperative Extension Rain Garden
Swimming pools	1300 Sqm@ 1000/sqm	Rs 1300000.00	
Gallery renovation and upgradation	LS	Rs 2.00 Crore	
Approximate Cost of the project		**10.407 Cr**	

**All dimensions, quantities and cost calculations are approximate*

26.14 Installation of Solar Panels & Street lighting

26.14.1 Location details

This project proposes street lighting at all the major and minor roads within the Municipality, to ensure safer, comfortable, more convenient, efficient movement of vehicles and pedestrians at night time. It is also proposed to install solar panels on the sides of the bypass flyover bridge, overbridges and roof tops of public buildings and institutions and installation of solar panel street lights.

26.14.2 Project Brief

This project aims to promote an eco-friendly method of producing electricity. Emphasis should be given on energy conservation. Components of the project includes:

- Street lighting at all the major and minor roads
- Installation of solar panel street lights.

26.14.3 Need for the Project

Provision and maintenance of street lights is one of the obligatory functions of Urban local bodies and it is one of the sectors with major consumption of energy. Reducing the energy consumption by using energy efficient lights, expenditure towards energy charges may be reduced considerably. Using renewable energy will help to reduce greenhouse gas emissions. Properly maintained streetlights will ensure the safety and efficient movement of peoples at night.

26.14.4 Agencies, Funding, Approximate cost and Project period

This project may be implemented by any agency suggested by the Municipality. The possibility of getting financial assistance from Agency for New and Renewable Energy and Technology (ANERT) and PWD department may be explored. Approximate project cost is Rs 5 Cr. The project may be initiated in the first phase followed by full completion in the second phase.

Table 26-15: Approximate Project Cost – Installation of solar panels and street lighting

Component	Quantity*	Cost*
Installation of solar panels	1000KWA @40000 /KWA	4.00 Cr
Street lighting at major and minor roads	Approx. 1000 Led lights with posts@10000/POST	1.00 Cr
Approximate Cost of the project		**5.00 Cr**

**All dimensions, quantities and cost calculations are approximate*

26.15 Development of Infrastructure Facilities at Beach

26.15.1 Location details

The town is gifted with a beautiful coastline towards the West and is easily accessible through roads and railway. Festivals like Beach fest, Sand Art etc. are hosted here.



Figure 26-33: Present view at beach

26.15.2 Project Brief

This project aims to develop the facilities at the beach area, so as to have a good experience to the visitors and thereby increase the revenue for the Municipality. The following components are included in this project.

- Basic amenities like e-toilet facilities, potable drinking water arrangements, clock room, shower area, ticket counters, rest room for lifeguards, operators, security and a tourist information Centre etc.
- Cafeterias and open restaurants.
- Installation of CCTV cameras.
- Landscaping and provisions for amenities at Vijay Park.
- Revamping of the existing open stage in a modernized way with more architectural features with provisions of green room facility for ladies and gents with suitable amenities.
- Development of facilities for conducting water sports such as para sailing, jetskeiing, banana boat rides, beach volley ball etc.




Figure 26-34: Existing Open stage at Beach & Paring area under the flyover

26.15.3 Need for the Project

Even though the sandy beach in Alappuzha is a tourism destination which attracts tourists who visits the town for experiencing the journey along backwaters, the available facilities at beach are not satisfactory to accommodate the need of tourists. To improve this situation, modern and environment friendly infrastructure should be provided at beach area

26.15.4 Agencies, Funding, Approximate cost and Project period

The project may be implemented by any agency suggested by the Municipality. Proper maintenance of beach has to be ensured by timely removal of garbage and proper cleaning of public amenities which can be done through Kudumbasree. Approximate project cost is 1.5 crores and full completion is expected in the second phase.

Table 26-16: Approximate Project Cost – Development of Infrastructure at Beach

Component	Quantity*	Cost*
Basic amenities	LS	Rs 25.00 L
cafeterias and open restaurant	200sqm @17500/Sqm	Rs 35.00 L
CCTV cameras	LS	Rs 5.00 L
'Vijay Beach Park' renovation	1000sqm @1500/Sqm	Rs 15.00 L
Open stage revamping	LS	Rs 15.00 L
Water sports and beach sports Facilities to be arranged in PPP model	Jet skiing-10 no's Para sailing boats-4 no's banana boats-10 no's	Rs 30.00 L
PPP based bike/car/bi cycle rents facilities/parking facilities	LS	Rs 25.00 L
Approximate cost of the project		**Rs 150.00 Lakhs**

**All dimensions, quantities and cost calculations are approximate*

26.16 Improvement of Fish Landing Centres

26.16.1 Location details

The existing fish landing areas identified at three locations towards the Western side of the town as shown in Figure 26-35 are proposed to be developed as fish landing centers. The locations are:

- Available auction shed and vacant space nearer to Vadai pozhi
- Auction shed and vacant space towards the Western side of Vadackal – Beach Road at Kanjiramchira.
- Auction shed and vacant space available nearer to St. Antony's Chapel along the side of Thumboly – Kurushadi Road

26.16.2 Project Brief

This project aims to develop the facilities of the fish landing centers in modern and hygienic ways so as to improve the livelihoods of the fishers and fishing community. The following components are included in this project.

- Compound wall, internal roads & drains
- Covered landing Centre and fish auction hall
- Administrative building and net mending Centre
- Shops, canteen, restroom, cloak room, locker room
- Water supply and electrification
- Ice plant and chill room



Figure 26-35: Map showing the locations of existing fish landing areas

26.16.3 Need for the Project

Even though Alappuzha town have 8km long coastline, due to the unavailability of a notified fish landing centre, the fishermen have to depend the nearby landing centres outside the Municipality. So, it is essential to improve the existing facilities at the to solve the problem faced by fishermen. It will help to generate economy in the fisheries sector.

26.16.4 Agencies, Funding, Approximate cost and Project period

This project may be implemented by the Municipality and the possibility of getting financial assistance from Harbour Engineering Department or State Coastal Area Development Corporation (KSCADC) or NABARD may be explored. The approximate cost for this project comes around Rs 1.40 Cr. The project is proposed to be completed in the first phase itself.

26.17 Construction of outer bunds to paddy fields

26.17.1 Location details

The town is blessed with a large extent of Paddy fields towards the Eastern end; bordered by Pallathuruthy river, vembanad Lake and smaller canals. These paddy fields are grouped into 12 padasekharams and the location is shown in Figure 26-36 and area details are shown in Table 26-17 . These areas are located inside the flood prone zones of the Municipality. Very high flood prone zones are located in these areas and majority of the area comes under High flood prone zones.

26.17.2 Project Brief

This project aims to construct stronger outer bunds to paddy fields so as to provide safe environment for the cultivation in the paddy field without causing damages to the crops. It will help to protect the paddy land from submergence of flood water and draining of the stagnated water from the field during rainy season. It is proposed to construct stronger outer bunds and ring bunds for all padasekharams within the Municipality. Installation of storm water pumping stations at locations prone to flooding so as to collect the flood water and dispose it safely without causing any damage to the natural sources. Project components include:

- Raise the height of outer bunds around all Padashekarams above the flood mark or up to 1.6 meter by pile and slab.
- De-silting and deepening of natural water reservoir and drainage channels
- Construction and protection of all the flood protection embankments, ring bunds and other bunds
- Maintenance of storm water pumping stations, motor shed, motorthara, pipe culvert, ramp and spout.
- Construction of farm roads for the easy movement of machineries and crops





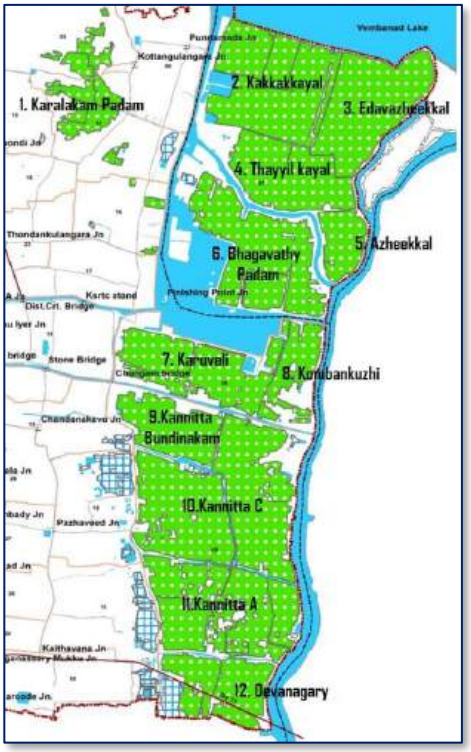


Figure 26-36: Map Showing the Locations of 12 Padasekharams within the Municipality

Table 26-17: Details of Padasekharams

Sl no	Name	Outer bund length in mtr	Area in Hectare
1	Karalakam	4670	26.00
2	Kannitta A	4270	93.60
3	Kannitta B	3140	33.60
4	Kannitta C	5960	132.16
5	Devassamkari	3735	43.60
6	Komban kuzhy	2220	44.62
7	Kakka kayal	4360	83.00
8	Karuvely	3260	36.00
9	Thayyil kayal	4050	73.35
10	Azheekkal	1970	21.50
11	Edavazhickal	3300	52.57
12	Bhagavathy padam	4750	77.60

Source: Irrigation Department

26.17.3 Need for the Project

Since the padasekharams are surrounded by numerous waterbodies, it will get flooded during rainy seasons and when tidal effects are experiencing at the lake. Since the outer bunds are not strong enough to withstand the tidal effects of flood water, it breaks and the crops get damaged. The construction of stronger outer bunds to these paddy fields by adopting the concept of compartmentalization may help to protect these padasekharams. It is also needed to install storm water pumping stations at locations to dispose the flood water quickly.

26.17.4 Agencies, Funding, Approximate cost and Project period

This project may be implemented by the Municipality or by any agency suggested by Municipality or by Irrigation Department. The approximate cost of construction is Rs 2.46 crores for Thayyil kayal Padasekhara as shown below. The same kind of construction may be adopted for other padasekharams also. In addition to this, storm water pumping stations shall be installed at suitable locations. 50% of the work completion is expected in first phase (includes thayyil, Edavazhikkal and Kakkakayal), 75% completion in the third phase and full completion in the fourth phase.

Table 26-18: Approximate Project Cost – Construction of outer bunds

Component	Cost*
Thayyil kayal with an Extent of 73.35 hectare and with outer bund length of 4050 mtr	
1. Repair and raising of retaining wall	102.50 L
2. Construction of pile and slab retaining wall	46.72 L
3. Construction of pipe culvert	3.57 L
4. Construction of motor shed	13.98 L

5. Construction of motorthara	70.92 L
6. Spout	5.72 L
7. Ramp	2.90 L
Total Cost	Rs 246.31 L
Approximate cost of the project	**Rs 2.463 Cr**

**All dimensions, quantities and cost calculations are approximate*

26.18 Pedestrian Facilities

26.18.1 Location details

The various components of this project are proposed at different locations as follows:

- Footpath along all the major and minor roads.
- Foot over bridge at Kalarcode and Kommady junctions across NH66 .
- Improvement of pedestrian facilities at locations where peak pedestrian volume is experiencing such as Thiruvambady Sri Krishna Swami Temple, along banks of Vadai & Commercial canal, near Puthenthoppu church, light house premises, SP office premises.

26.18.2 Project Brief

This project aims to improve the facilities for pedestrians available within the town. The components of the project include:

- Construction and maintenance of footpath along all the major and minor roads
- Guardrails, Seating arrangements, Waste bins, Drinking water kiosk and e-toilets
- Bollards where illegal vehicle encroachment is possible
- Road markings and Signage for easy navigation of pedestrians and other road users

26.18.3 Need for the Project

The walkability index of the Town is very low. Narrow width of the town roads, irregular parking management, vending areas along street sides etc. leads to heavy vehicular and pedestrian conflict within the town area. Pedestrian Networking is an important planning and policy tool for the development and promotion of walking as a mode of transport, recognizing that walking has a valuable role to play in creating a more effective and resilient transport system. It will help to provide seamless movement to all road users and persons with disabilities, children and the elderly.

26.18.4 Agencies, Funding, Approximate cost and Project period

This project may be implemented by the Municipality or by any agency suggested by the Municipality. The possibility of getting financial assistance from agencies such as NHAI, PWD, KSTP etc. may be explored. Actual cost of construction may vary based on the existing conditions in different locations. The approximate cost for the project is Rs.11 crores. Priority shall be given to major roads where large pedestrian volume is experienced. Full completion of the project is expected in the second phase.

Table 26-19: Approximate Project Cost – Pedestrian facilities

Component	Quantity*	Cost*
Foot over bridge at kalarcode and kommady (Ref: FOB at TVM, East Fort)	2 no @2.75 crores /No	Rs 5.50 Cr
Kerb stone ,Tactile tiles, Bollards, Guardrails	30000mtr @ 1800/mtr	Rs 5.40 Cr
Seating for pedestrian, Waste bins, Signages	LS	Rs 10.00L
Approximate Cost of the project		**Rs 11.00 Cr**

**All dimensions, quantities and cost calculations are approximate*

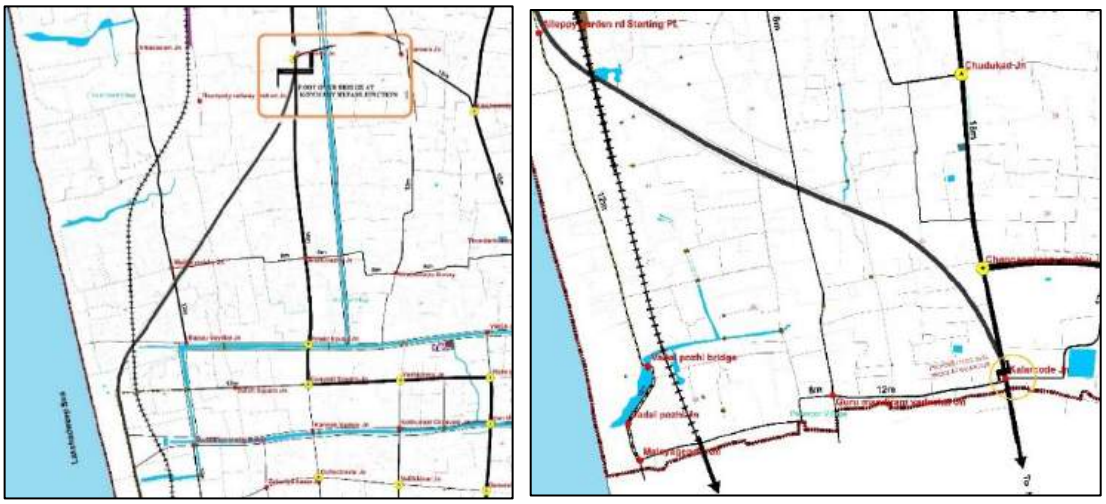


Figure 26-37: Proposed locations of Foot Over Bridges at Kommady & Kalarcode

26.19 Comfort Station - 'Take a Break'

26.19.1 Project Brief

This project aims to provide toilet and lavatory facilities for public use; to have a clean, and healthy communities. Construction and maintenance of sanitary complexes at suitable locations along the side of National and State Highways; near transport terminals; major tourist destinations like Mullakkal street, beach; premises of Govt.offices and institutions.

Every sanitary complex should be provided with separate wash closets for men, women and transgenders, urinal block, wash basins, sanitary napkin wending machines and destroyer etc.

26.19.2 Need for the Project

The overall purpose of good sanitation is to provide a healthy living environment for everyone. Several people lack access to sanitation while traveling long distances. Since Alappuzha is a busy tourist spot comfort stations are unavoidable part of public amenity.

26.19.3 Agencies, Funding, Approximate cost and Project period

This project may be implemented by the Municipality. The possibility of getting financial assistance from agencies such as District/ Block - Development fund, Suchitwa Kerala (Rural/Urban) Fund for Public Toilet Construction and Maintenance or MP & MLA Fund may be explored. The approximate cost for this project comes around Rs8.00 lakhs/ each. The project is proposed to take sanction and land relinguition in the first phase and partial completion of infrastructure. Full completion is expected in the second phase.

26.20 Road Over Bridge(ROB) at Mangalam Railway Crossing

26.20.1 Project brief

An over bridge is proposed to ease traffic congestion at the present railway level crossing in SH at the location shown in Figure 26-38.



Figure 26-38: Location of proposed ROB

26.20.2 Need for the Project

The present at grade level crossing in it results in traffic delay, frequent traffic jams and wastage of fuel whenever the trains pass through the crossing. It is reported that the railway crossing is closed for road traffic about 28 to 30 times in a day. The proposed ROB will improve

the smooth flow of vehicles and reduction in accidents due to haphazard movement of vehicles due to the level crossing.

26.20.3 Agencies, Funding, Approximate cost and Project period

This project may be implemented by Alappuzha Municipality with assistance from PWD-Roads and Bridges or Indian railways. The approximate cost of construction of ROB with composite structure and developments of approach road on either side comes around Rs 57.80 crores. Full completion of the project is expected in the second phase.

Table 26-20: Approximate Project Cost – Railway over bridge

Component	Quantity*	Cost*	Source
Road over bridge at Mangalam	400 mtr *10 mtr @ 6L /mtr	Rs 24.00 Cr	Construction of Guruvayur Rail Over bridge (ROB)
Land value for 24 are@140800/are		Rs 33.80 L	
Approximate Cost of the project		**57.80 Cr**	

**All dimensions, quantities and cost calculations are approximate*

26.21 Pedestrian Prioritization in Mullakkal street

26.21.1 Location details

Mullakkal street lies in the heart of the town between District Court bridge and zero junction for a stretch of 629 meter and a width of 12 meter. Mullakkal street is famous for its trade and commerce, has a vide connection with various roads, nearer to KSRTC bus stand and Boat Jetty. The location and the present view of the street is shown in Figure 26-39.



Figure 26-39: Location and Present view at Mullakkal Street

26.21.2 Project brief

The priority proposal is to implement pedestrian prioritization along the street by introducing measures like scheduled pedestrianization, along the street together with segregated one-way vehicular traffic with due consideration to the resident population. Renovation of street includes the following:

- Carriage way resurfacing and foot path pavement
- Cobble stone laying for pedestrian pathway
- Stepped pedestrian path
- Architectural street lights
- Underground cables for Electricity & Firefighting equipment's
- CCTV cameras
- Drainage
- Street vending areas
- Resting recliners
- Signages, dust bins and plant boxes and marking on roads
- Curb extension at District court bridge junction



Figure 26-40: Proposed view at Mullakkal Street

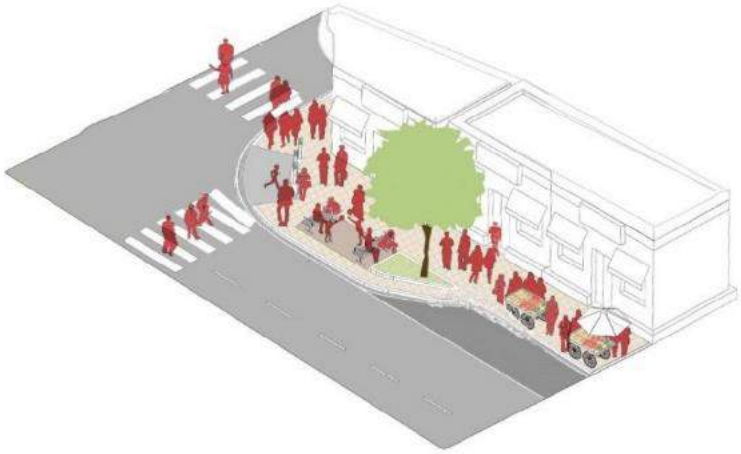


Figure 26-41: Proposed view at district court junction

26.21.3 Need for the project

At present, the streetscape of Mullakkal area is unattractive and heavy congestion is experiencing along the street due to unsegregated and criss crossed vehicle or pedestrian movement through the street. Pedestrianization is the only possible way to provide free movement inside the street. Sustainable and walkable streets provide a safe environment for its users which in turn helps pollution free environment.

26.21.4 Agencies, Funding, Approximate cost and Project period

This project may be implemented by Alappuzha Municipality. The possibility of getting financial assistance from PWD may considered The approximate cost of development and other allied works comes around Rs.2.00 crore. Approximate time required for the execution of the project is 5 years. The project is proposed to be completed in the first phase itself.

Table 26-21: Approximate Project Cost – Pedestrian prioritization in Mullakkal Street

Component	Quantity*	Cost*
Carriage way resurfacing and foot path pavement	3019 sqm @ 1300/sqm	Rs 39.24L
Cobble stone laying for pedestrian pathway 629*3	1887 sqm @ 2000/sqm	Rs 37.74L
Stepped pedestrian path (629* 1.8*2)	2264 sqm @ 1000/sqm	Rs 22.64L
Architectural street lights (50 nos @13000/E) landscaping (200 sqm @1000/sqm)	LS	Rs 8.5L
Underground cables for Electricity & Firefighting equipment's ,CCTV camera 6 no's with support post etc	LS	Rs 50L
Drainage	629 mtr @ 3000/mtr	Rs 18.87L
Street vending areas	300 sqm @ 2000/sqm	Rs 6L
Resting recliners 3 seater (40 no @10000/E),bollards (250 no@1200/E)	LS	Rs 7L
Signages ,dust bins and plant boxes and marking on roads	LS	Rs 4 L
Approximate Cost of the project		**Rs 1.97 Cr**
	Say	**Rs 2.00 crores**

**All dimensions, quantities and cost calculations are approximate*

26.22 Phasing of Projects

Phasing of the identified projects has been done based on the following considerations:

- Priority needs, with developed areas receiving priority over future development area

- Inter and intra – service linkages viz. Tourism development shall be complimented by various other sectors such as heritage, waste management, sanitation, and infrastructure improvements etc.
- Size and duration of the requirements, including preparation and implementation period and project linked revenue implications.
- The time-span required for implementation of the project and the availability of the funds.

Since the development of every sector is interlinked prioritizing the priority sector was troublesome. So, there should be short term and long term projects that may be started during the initial stages of the horizon period of this Master Plan. Thus, the horizon year of the Master Plan is phased into 4 and the phasing is assigned to the projects based on the expected status of completion during phases and the above-mentioned factors. The phasing of the various projects is shown in Table 26-22.

Table 26-22: Phasing of Various Projects

Sl. No.	Project	Phasing			
		Preliminary activities/Land acquisition			
		25-50% work completion			
		50-75 % work completion			
		75-100 % work completion			
		5 year	10 year	15 year	20 year
1	Development of Town Square				
2	Wetland Park				
3	Urban Park				
4	Detention/Retention basins				
5	Multi-purpose Rescue shelter				
6	Foot over bridge across National Water Way				
7	Heritage Walk project				
8	Sewage Treatment Plant				
9	Beautification of canal banks				
10	Farm Tourism Project				
11	Aqua tourism project related to fish farms				
12	Conservation / restoration of mangroves				
13	Up gradation of EMS stadium				
14	Installation of Solar Panels & Street lighting				

Sl. No.	Project	Phasing			
			Preliminary activities/Land acquisition		
			25-50% work completion		
			50-75 % work completion		
			75-100 % work completion		
		5 year	10 year	15 year	20 year
15	Development of new infrastructure facilities at Beach				
16	Improvement of Fish Landing Centres				
17	Construction of outer bunds to paddy fields				
18	Pedestrian Facilities				
19	Comfort station-Take a break				
20	Road over bridge at Mangalam				
21	Pedestrian Prioritization in Mullakkal Street				

27 FINANCIAL RESOURCE PLANNING

The financial resource planning (rough cost estimate of the project) of the proposed projects included in the Master Plan for Alappuzha Town, which are to be implemented within the plan period of 20 years, is discussed in this chapter.

The initial building blocks of the Master Plan are the 'elements' required to sustain the town's growth; public utility, urban environment, economic and social development, land use and transportation, Municipal resources, urban governance and capital facilities. The projects in the plan were developed through a consultative process carried out between the Local Body Officials, Council Staff and Elected Officials, Public Interest Groups, Project Stakeholders and the local citizens.

The rough cost estimate for the capital investment of each project in various sectors is found out. Detailed financial analysis and cost estimation of each project is to be done during the implementation stage. Table 27-1 shows the approximate cost and phasing of the proposed projects in various sectors.

Table 27-1: Approximate cost of the projects

Project	Approximate Cost (in Lakhs)						Responsible Agency
	Land acquisition	Construction cost	Infrastructure Facilities	Maintenance / Reconstruction	Others	Total Cost	
Traffic & Transportation							
Total estimated budget for road widening (Approximate)						250.00 crores	
Foot over bridge near Nehru Trophy Area						275	Municipality
Parking Management Plan or Parking policy						50	Municipality
Pedestrian Facilities		400	50			450	Municipality
Cycle Track			150			150	Municipality
Rail Over Bridge at Mangalam	100	4700				4800	PWD/ Railway

Project	Approximate Cost (in Lakhs)						Responsible Agency
	Land acquisition	Construction cost	Infrastructure Facilities	Maintenance / Reconstruction	Others	Total Cost	
Junction Improvement		100				100	PWD/NHAI
Pedestrian prioritization in Mullakkal Street		100	200			300	Municipality
Disaster Management							
Urban Park	1500	2140				3640	Municipality
Wetland Park	6000	1250				7250	Municipality
Multipurpose Rescue shelter	1600	3080				4680	Municipality
Detention/Retention basins	7500	480				7980	Municipality
Improvement of infrastructure in identified relief camps					25	25	Municipality
Workshops/ Public awareness programmes - Risk Management in Changing Climate					10	10	Municipality
Conservation / restoration of mangroves					275	275	Municipality
Construction of outer bunds to paddy field – Thayyil Kayal		246				246	Municipality/ Irrigation
Tourism							
Beautification of canal banks						5000	Tourism
Improvement of existing infrastructure in tourist places				150		150	Tourism/ Municipality
Development of new infrastructure facilities in tourist places		500	50			550	
Public awareness programme – Clean city & Responsible Tourism					40	40	Municipality
Farm Tourism Project			200		60	260	Tourism/ Municipality
Aqua tourism project related to fish farms / Aqua tourism center						100	
Development of Tourism Circuits					10	10	

Project	Approximate Cost (in Lakhs)						Responsible Agency
	Land acquisition	Construction cost	Infrastructure Facilities	Maintenance / Reconstruction	Others	Total Cost	
Heritage							
Revival of Old Heritage Structures						5000	Tourism/ Muziris/ Municipality
Upgradation of streetscape along canal bank						5000	
Conservation of ethnic settlements & Promotion of cultural events						1000	
Heritage Walk						50	Municipality
Conduct heritage fairs/ festivals/ heritage awards						100	Municipality
Public awareness programmes on heritage conservation					10	10	Municipality
Recreational Facilities and Civic Amenities							
Development of Town Square		735				735	Municipality
Upgradation of EMS stadium		700	60			760	Municipality
Recreational Facilities and Civic Amenities in Beach			150			150	Municipality
Revival of Raja Kesavadas Swimming pool			500			500	Municipality
Upgradation of public libraries			50			50	Municipality
Comfort station		200				200	LSG/ Municipality
Agriculture & Allied Sectors							
Improvement of Fish Landing Centres		30	40			70	Municipality/ Harbour Eng.
Training programmes – Promotion of various agriculture practices					10	10	Agriculture / Municipality
Skill development programmes – production & marketing of value added products					10	10	Municipality/ DIC
Industry							

Project	Approximate Cost (in Lakhs)						Responsible Agency
	Land acquisition	Construction cost	Infrastructure Facilities	Maintenance / Reconstruction	Others	Total Cost	
Common Facility Center	50	40			10	100	
Training Programmes - Promotion of handicraft industries					10	10	Municipality/ DIC
Physical Infrastructure							
Mobile Septage Treatment Plant					80	80	Municipality
Storm water Pumping Station		100			20	120	Municipality/ KWA
Water Kiosk		20				20	Municipality
Awareness programmes on waste management					10	10	Municipality
Strengthening of distribution lines for water supply		50	150			200	KWA
Installation of Solar Panels					200	200	Municipality
Street Lighting						10000 per LED	Municipality/ KSEB
Sewage Treatment Plant	30	50				80	Municipality
Preparation of Drainage Master Plan					50	50	Municipality
Floating Solar Panel						3500	Municipality/ KSEB
Social Infrastructure							
Upgradation of infrastructure facilities in colonies			50			50	Municipality
Upgradation of infrastructure in hospitals			50			50	Municipality
Upgradation of infrastructure in schools			50			50	Municipality
Contagious disease monitoring & Prevention Center						100	Health Dpt
Mobile Clinic			50			50	Municipality

Project	Approximate Cost (in Lakhs)						Responsible Agency
	Land acquisition	Construction cost	Infrastructure Facilities	Maintenance / Reconstruction	Others	Total Cost	
Social Welfare & Security							
Development of infrastructure for woman in public spaces			100			100	Municipality
Oldage home	75	200			25	300	Municipality
Environment							
Development of Miyawaki Forests						50	Municipality
Development of green areas along road sides			50			50	Municipality/ PWD/ NH
Protection of sacred groves						10	Municipality
Rejuvenation of water bodies						5000	Municipality
Trade & Commerce							
Development of Street Vendors Area					125	125	Municipality
Renovation of markets					10	10	Municipality

Note:- All dimensions, quantities and cost calculations are approximate .

PART V

ZONING REGULATIONS

28 ZONING REGULATIONS

Zoning is a device of land use planning used in a Master Plan. The word is derived from the practice of designating permitted uses of land based on mapped zones which separate one set of land uses from another. Zoning Regulations are the means to achieve development of a use zone as envisaged in the Master Plan. In other words, Zoning Regulations are laws that define and restrict how to use a particular property coming under a Master Plan. Thus, it is the public regulation of land and building use to control the character of a place.

The development regulation for Alappuzha Municipal area is presented in four parts. Part A is the General guidelines which includes general provisions applicable to the entire Municipal area. Part B includes guidelines for each zone which includes specific regulation regarding confirmable uses applicable to the Municipal area. Part C includes the regulations for flood prone zones and Part D includes the Annex.

28.1 Part A – General Guidelines

The general guidelines shall apply to all zones irrespective of the zoning regulations for individual zones.

1) All future developments shall be in conformity with the provisions of the '*Master Plan for Alappuzha Town- 2041*' and all future constructions shall conform to the '*Kerala Municipality Building Rules, 2019*' and other applicable statutes in force and their time-to time amendments unless otherwise specified in this regulation or in any detailed town planning scheme prepared and made in force within the framework of this Plan.

2) For the implementation and enforcement of the proposals envisaged in this Master Plan, areas have been zoned under various zones such as '*Residential use zone, Mixed use zone, Commercial use zone, Industrial use zone, Public and semi-public use zone, Traffic and transportation use zone, Parks and open spaces use zone, Conservation zone, Water bodies, Heritage zone, Tourism promotion zone, Farm tourism promotion zone, Green Areas Conservation Zone, Mangroves, Pine buffer strip (beach oak/ kattadi), Sandy Beach and Special zones*' for securing the most efficient and effective use of land in public interest. Details regarding the nature of uses '*permitted*', uses '*restricted*' and uses '*prohibited*' in each zone are given in Table 28-1. These regulations shall be enforced in conjunction with other specific provisions if any mentioned elsewhere in the Master Plan and in accordance with the other statutes applicable.

3) For the purpose of reducing disaster risk, proposed land use and the developments in various flood prone zones are further modified by Flood prone zone overlay regulations in Table 28-2. Notwithstanding anything contained in the zoning regulations of the Master Plan, the additional regulations in Part C – Regulation for Flood Prone Zones shall prevail.

4) "*Uses permitted*" in a zone cover the uses that can be normally accommodated in the relevant zone. Such uses may be permitted by the Secretary, Alappuzha Municipality, (herein after referred to as Secretary) subject to satisfaction of applicable statutes. In some cases, it may be possible to permit some other uses also, which are not likely to affect the quality and environment in a zone specified for a particular use. Such cases have to be individually examined based on their performance characteristics and special locational factors. Such cases which come under this category are classified as "*Uses Restricted*".

   Uses Restricted -1 category deals with the restricted uses that may be permitted by the Secretary with the concurrence of the District Officer of the Local Self Government Department (Planning) having jurisdiction over the area (herein after referred to as Town Planner).

   Uses Restricted -2 category deals with the restricted uses that may be permitted by the Secretary with the concurrence of the Chief Town Planner of the Local Self Government Department (Planning).

5) "*Uses prohibited*" enlists the various objectionable uses in each zone which shall not be permitted under normal circumstances. All uses which does not come under '*Uses permitted*' or '*Uses restricted*' will be considered as "*Uses prohibited*".

6) Any use not specified either in the '*Uses permitted*' or '*Uses Restricted*' category of a particular use zone but which is of a similar nature to any use '*Permitted*' or '*Restricted*' in that particular use zone, may be permitted by the Secretary with the concurrence of the Town Planner.

7) Concurrence does not imply that permission shall be granted de facto. It shall or shall not be granted on a case-to-case basis, based on extraneous factors.

8) In addition, regulations are also proposed to conserve the heritage character of the planning area, with due regard to the historical significance and architectural character of the area.

9) Zoning regulations are not intended to prohibit existing uses that have been lawfully established prior to the enforcement of these regulations, unless otherwise specifically

mentioned in this Master Plan. Existing uses may be permitted to continue in all the zones and shall be treated as permitted uses. Zoning regulations are essentially intended to help the competent authority in taking decisions regarding granting or refusal of permits for land development and construction of buildings/ structures.

10) If any portion of a zone is put to a '*Use Prohibited*' as stated in para 5, before coming into operation of this Master Plan, such use shall be termed as '*non-conforming use*'. A non-conforming use may be allowed to continue in its existing location and essential repairs and maintenance for the structure may be permitted by the Secretary, provided that the said use create no adverse environmental influence in the zone. Addition, alteration or reconstruction, if found necessary as part of any mitigation measures may be permitted for such uses by the Secretary with the concurrence of the Town Planner. The total built up area of such non-confirming use shall not exceed 1.5 times the existing built up area.

11) Subject to the zoning regulation of the respective use zones, more than one use may be combined in a building/ plot, provided that the floor area of individual uses shall be limited to that prescribed for each such use in the zoning regulation for the respective zone.

12) If different land use zones fall within a single plot, all uses permitted as per zoning regulations of such land use zones may be permitted in the plot by the secretary. If application submitted includes any of the restricted uses and not included in such permitted uses, the secretary shall issue permit with the concurrence of the Town Planner/ Chief Town Planner, as the case may be. However, for the part of the plot which comes under *Water bodies*, *Parks and open spaces use zone* and *Special zones* this provisions shall not be applicable.

13) Constructions and/ or land developments if any, in paddy lands and in wet lands, shall be in conformity with '*The Kerala Conservation of Paddy land and Wetland Act, 2008*' in force in the State. However, in paddy lands and in wet lands coming under any of the Flood prone zones, constructions and/ or land developments shall not be permitted.

14) Provisions/ regulations under the '*Disaster Management Act 2005*, *The Ancient Monuments and Archaeological Sites and Remains Act 1958*, *Coastal Regulation Zone Notification 2011*, *Aircraft Act 1934*, *Environment Protection Act 1986*, *Wetland (Conservation and Management) Rules 2017*' and any other applicable statutes as amended from time to time shall prevail over the respective provisions of this Master Plan.

15) Silence Zone, as prescribed by the '*Noise Pollution (Regulation and Control) Rules, 2000*' as amended from time to time, shall be applicable to such areas under this Master Plan.

16) Operational constructions as defined in the '*Kerala Town and Country Planning Act, 2016*' shall be treated as permitted use in the Master Plan area.

17) Regulation of constructions and land development on the sides of new roads/ roads proposed for widening shall be governed by the distance from the center line of the road, unless otherwise specified in the Master Plan or Detailed Town Planning Scheme in force or any detailed road alignment approved by the Government. If widening on one side of any stretch of road is constrained due to the physical barriers of water bodies, railway land or protected archeological monuments/ sites, the road widening in that stretch shall be accounted from the other side.

18) In the event of change in alignment of new road proposal in the Master Plan, after the commencement of land acquisition of the new alignment, the land parcels in stretches excluded from the original alignment may be changed to adjacent suitable land use zone with the concurrence of the Town Planner. This provision is applicable only to new road development proposals and not to widening proposal.

19) Any piece of land which is marked as *Conservation zone* but not designated as paddy lands or wetlands under the *Kerala Conservation of Paddy land and Wetland Act* can be deemed as part of the immediate surrounding zone and constructions shall thereafter be allowed with the concurrence of the District Town Planner. The Secretary may, with the concurrence of the Town Planner, after verification of the revenue ownership documents, accord sanction for development by adopting the regulations of the surrounding land use zone in the proposed land use map, subject to the provisions as per applicable Acts, Rules and Government orders in force in the state.

20) Expansion of Public and Semi-Public Institutions and existing industrial units including their incidental uses in same plot or to adjacent plots shall be treated as permitted use in all built up zones such as *Residential use zone, Mixed use zone, Commercial use zone, Industrial use zone, Public and semi-public use zone and Tourism promotion zone; if* such uses are not included in the permitted uses or restricted uses as per the zoning regulations applicable. However, such projects shall confirm to provisions under *Heritage Zone*, *Special Zones*, widening of roads or new road alignments envisaged in the Master Plan.

21) Only the existing areas under Public and Semi Public uses and Industrial uses are intended to be included under *Public and Semi Public Zone* and *Industrial use zone* respectively. If any private property put under uses other than those permitted or restricted in the above zones has got included within such zones, the Secretary may, with the concurrence of the Town Planner, after verification of the revenue ownership documents, accord sanction for development by adopting the regulations of the surrounding land use zone in the proposed land use map, subject to the provisions as per applicable Acts, Rules and Government orders in force in the state.

22) If public activity ceases or do not exists in a private land, uses permitted/ restricted in the surrounding land use zone shall be allowed in the plot with the concurrence of the Town Planner, if no records are available with Alappuzha Municipality regarding any proposal for acquiring that particular land for any public use at the time of application of building construction or land development.

23) Disaster Mitigation projects by competent authorities shall be permitted in all zones.

24) Construction of new critical Infrastructure facilities such as hospitals, bus terminals, railway stations and institutions of critical importance such as offices of district administration, Police stations, Fire stations, etc. shall not be permitted in Flood prone areas. However, Reconstruction or maintenance of existing authorized uses/ buildings/ addition of new blocks shall be permitted with adequate flood resilient measures with the concurrence of the Town Planner in a case to case basis.

25) All existing ponds shall be preserved considering its infiltration characteristics and impact on ground water recharging, other environmental and aesthetic values.

26) No building shall be permitted within 2m from any plot boundary abutting natural/ manmade drains and canals having width of 2m to 5m. This distance shall be 5m for drains and canals having width more than 5m. In case of existing authorized buildings in these prohibited areas, only repair/reconstruction of the existing building limiting to the existing built-up area is permissible.

27) No construction/ land development shall obstruct/ reduce drainage capacity in the area.

28) Transmission/ Telecommunication Towers, Wireless Stations, ATMs, Water Tanks, Electric charging stations for vehicles, Waste management Units and public utility buildings/ Structures shall be treated as permitted uses in all zones except in Waterbodies.

29) Projects of Central/ State Government, Local Self Government Institutions, Public Sector Undertakings and other Government Institutions may be permitted with the concurrence of the Town Planner in all built up zones such as *Residential use zone*, *Mixed use zone*, *Commercial use zone*, *Industrial use zone*, *Public and semi-public use zone*, *Tourism promotion zone and Farm Tourism Promotion Zone*; if such uses are not included in the permitted uses or restricted uses as per the zoning regulations applicable. However, such projects shall confirm to provisions under *Heritage Zone*, *Special Zones*, widening of roads or new road alignments envisaged in the Master Plan.

30) In case of uncertainty in identifying the alignment and boundary of thodu, canal, river, existing public road, railway line, and in the absence of survey boundaries for the same in the Proposed Land Use Maps, it shall be referred to the actual position on the ground as well as revenue records and decision taken by the Secretary in this regard shall be final.

31) The land specially demarcated for certain projects as *Special Zones* may be procured as per the provisions of *The Kerala Town and Country Planning Act 2016*, by Alappuzha Municipality or other agencies concerned. If the proceedings to procure such land had not been initiated within 7 years from the date of sanctioning of this Master Plan, the areas so specifically demarcated may be released and assigned to a use permitted/ restricted in the surrounding land use zone in the Proposed Land Use Map or to a zone as specified in the regulation by the Secretary with the concurrence of the Town Planner, based on the application for the building permit received.

32) For the purpose of these regulations, floor area means the total floor area of the building on all floors.

33) The government shall have the power to issue clarifications in respect of technical interpretations, if any, required on any of the provisions of the Master Plan in consultation with the Chief Town Planner concerned of the Local Self Government Department (Planning).

34) General Guidelines for Large Scale Projects:

Large Scale development projects in an area 1 hectare or more, exceeding an investment of Rs.100 crores, which provide direct employment (after commissioning of the project) to the tune of not less than 500 may be permitted in all zones other than waterbodies and heritage zone, if not included in the permitted uses or restricted uses as per zoning regulation applicable. In such cases, the recommendation of a committee with constitution as below shall be obtained, subject to satisfying the procedures laid out here under and the secretary shall comply the same while issuing permit.

Adequate provision shall be made for supporting infrastructure such as water supply, Sewerage, Solid Waste Management, Power supply etc. Separate system for management of solid waste and sewage shall be provided and maintained by the developer at his /her cost. The project shall be completed within a period of 5 years or as suggested by the committee.

Procedure to be followed

a) The developer shall submit the project report, detailing the demand, feasibility and environmental impact assessment aspects of the project, together with the approval, if necessary, obtained from the Ministry of Environment and Forest, Government of India to the convener of the committee and the convener shall make all arrangements for convening meeting of the committee at the earliest and the committee shall consider and dispose of the project report within a period of one month from the date of receipt of the same.

b) The constitution of the committee shall be as given under:

Principal Secretary/ Secretary of Government, Local Self Government Department	- Chairperson
The Director, Local Self Government Department (Urban)	- Member
The Chief Town Planner, Local Self Government Department (Planning)	- Convener
The District Officer of the LSGD (Planning) having jurisdiction over the district concerned	- Member
Secretary(s) of the Local Self Government(s) concerned	- Member

The convener shall fix the venue, date and time of the meeting in consultation with chairperson and shall be responsible for the safe custody of the records and communications thereof.

The meeting shall be presided over by the Chairperson or in his absence by a member to be authorized by him.

The quorum of the meeting shall be majority of the total number of members of the committee for the project.

The developer shall also produce before the committee, all required clearance from the State and Central Government agencies concerned.

28.2 PART B – Specific Guidelines

Table 28-1: Zoning Regulation for the Various Land Use Zones in Alappuzha Municipality

Sl. No.	Uses Permitted	Uses Restricted-1	Uses Restricted-2	Uses Prohibited
1	2	3	4	5
1	Residential Use Zone			
1.1	Residential buildings consisting of single or multifamily dwellings, residential flats/apartments, residential quarters, night shelters, orphanages, old age homes, Dharma Sala, Guest House, Hostels.	Public utility areas and public buildings other than those included in the permitted use		Any other uses not specified in columns (2), (3) and (4)
	Shops, Professional Offices, Commercial Offices, Establishments, Banking and financial institutions, Restaurants/Canteen, Hotels, IT/ Software units – floor area limited to 200m^2.	Fuel filling stations.		
	Cottage Industries including coir, Service Industries of non- nuisance Nature (See Annex-I), with number of workers limited to 6 without power or 3 workers with power limited to 5 HP.	Cremation Ground/ Crematorium, Burial Ground/ Common Vault.		
	Educational institutions essentially serving the needs of residential community such as Day Care, Crèche, Nursery Schools, Kindergartens and schools offering general education (up to High school level).			

	Health institutions essentially serving the needs of residential community such as dispensaries, Clinics (Out Patient), etc. and having a floor area limited to 200m^2.			
	Community facilities such as Community Halls, Recreational Clubs, social Welfare Centres, Gymnasium/ Yoga Centres, Libraries etc. having a floor area limited to 200m^2 .			
	Utility Installations and Civic Amenities essentially serving the needs of residential community such as post office, police station, telephone exchange, fire station, tot lots, parks, play grounds.			
	Plant nurseries, Pump House, Wells and Irrigation Ponds incidental to community needs.			
	Ashram /mutt, places of worship.			
	Police Stations, Post, Telegraph Offices, Reading Room etc.			
1.2	**Provided that the access road has a width of 5m minimum.**			
	Hospitals with 5 beds, Automobile workshops for two/ three wheelers – floor area limited to 200 m^2.			Any other uses not specified in columns (2),(3) and (4)
	Shops, Professional Offices, Commercial Offices/ Establishments, Banking and financial institutions, Restaurants/Canteen, Hotels, IT/ Software units – floor area limited to 500 m^2.			
	Godowns, warehouses, Storage of non-hazardous materials, Stacking yard – Floor area limited to 200 sqm.			
1.3	**Provided that the access road has an existing or proposed width of 8 m minimum**			
	Convention Centres/ Auditorium/ Wedding Halls/ Community	LPG distribution		Any other uses not

	halls/Exhibition Centres and Art Gallery- floor area limited to 500 m^2.	centres (excluding bottling plants and bulk storage) with floor area limited to 50 m^2		specified in columns (2),(3) and (4)
	Shops, Professional Offices, Commercial Offices/ Establishments, Banking and financial institutions, Restaurants/Canteen, Hotels, IT/ Software units – floor area limited to 1000 m^2.			
1.4	**Provided that the access road has an existing or proposed width of 12m minimum**			
	Educational Institutions of Higher Order. Hospitals & Health centres up to 100 beds.			Any other uses not specified in columns (2), (3) and (4)
	Godowns/ Ware houses/ Storage (non-hazardous) - floor area limited to 500 m^2.			
	Automobile workshops/ Automobile Service stations for Heavy vehicles/ Movie Halls/ Auditorium/ Wedding Halls/ Community Halls – floor area limited to 1000 m^2. Markets – Floor area above 500 Sqm.			
2	**Mixed Use Zone**			
	The following areas in residential use zone will also be deemed as part of Mixed Use Zone. **Land to a depth of 100 m on either sides of following roads viz.** 1. NH 66 2. Thanneermukkom Road up to boundary from Zilla Court Bridge(SH-40) 3. Alappuzha – Changanassery Road(SH-11) **Land to a depth of 75 m on either sides of following road viz.** 1. Kommady - Kaichoondy Road			
2.1	All uses that are permitted in Residential Use Zone, buildings up to 500 m^2 in Commercial use zone and Public & Semi Public Zone and all buildings up to 500 m^2 in industrial zone other than hazardous industries.	Museum, Exhibition centres and art gallery		Any other uses not specified in columns (2), (3) and (4)

	Auto mobile workshops for 2/ 3 wheelers, Service Industries of non-nuisance nature (See Annex I) engaging not more than 19 workers without power or 9 workers with power limited to 15 HP, Civil defence and home guard.	Places of worship		
	Clinics (outpatient) Diagnostic centres – floor area limited to 200 m^2	Fuel filling stations		
	Parking Plaza, Taxi/ Jeep Stand.			
2.2	**Provided that the access road has a width of 5m minimum**			
	Diagnostic Centres, Clinics(Out Patient), – floor area limited to 500 m^2.			Any other uses not specified in columns (2),(3) and (4)
	Shops, Professional Offices, Commercial Offices/ Establishments, Banking and financial institutions, Restaurants/Canteen, Hotels, IT/ Software units – floor area limited to 1000 m^2.			
2.3	**Provided that the access road has an existing or proposed width of 8 m minimum**			
	Shops, Professional Offices, Commercial Offices/ Establishments, Banking and financial institutions, Restaurants/Canteen, Hotels, IT/ Software units – floor area above 1000m^2.			Any other uses not specified in columns (2), (3) and (4)
	Weigh Bridge, Social Welfare Centres – floor area up to 500 m^2.			
	Secondary/ Higher Secondary Schools, Junior Technical Institutions, Movie Halls/ Auditorium / Wedding Halls/ Community Halls – floor area limited to 500 m^2.			
	Diagnostic centres, Hospitals and health centres – Up to 10 beds.			
	Markets – Plot area up to 500 m^2.			

	Godowns/ Warehouses/ Storage non-hazardous – floor area limited to 200 m^2.			
	Service Industries of Non Nuisance Nature (see Annex II) engaging not more than 19 workers without power or 9 workers with power limited to 30 HP.			
	Marble and Granite Storage/ Cutting centres, Industrial Estates & Industrial Parks Automobile workshops/ Automobile service stations – Light Vehicles.			
2.4	**Provided that the access road has an existing or proposed width of 12m minimum**			
	Shops, Professional Offices, Commercial Offices/ Establishments, Banking and financial institutions, Restaurants/Canteen, Hotels, IT/ Software units – floor area upto 3000m^2.		Bus Terminal / Stand, Lorry Stand	Any other uses not specified in columns (2), (3) and (4)
	Educational Institutions of Higher Order. Hospitals & Health centres up to 100 beds.			
	Godowns/ Ware houses/ Storage (non-hazardous) - floor area limited to 500 m^2.			
	Automobile workshops/ Automobile Service stations for Heavy vehicles/ Movie Halls/ Auditorium/ Wedding Halls/ Community Halls – floor area limited to 1000 m^2.			
	Markets – Floor area above 500 Sqm.			
2.5	**Provided that the access road has an existing or proposed width of 18m minimum**			
	All shops including shopping complexes, shopping malls, hypermarkets.		Container Terminal,	Any other uses not specified in columns (2), (3) and (4)
	Hospitals & Health centres upto 300 beds, Movie Halls/ Auditorium/ Wedding Halls/ Community Halls -		Multiplex	

	floor area above 1000 Sqm with parking at 1.2 times that of KMBR.			
3	**Commercial Use Zone**			
3.1	All shops including shopping complexes, shopping malls, hypermarkets, restaurants, hotels, markets.	Places of worship.		Any other uses not specified in columns (2), (3) and (4)
	Professional offices, commercial offices & establishments, banking and financial institutions, IT software units, Movie halls, Auditorium, Wedding Halls, Community Halls.	Higher educational institutions, provided that the access has a minimum width of 8m.		
	Godowns/warehouse/storage of non-hazardous materials, stacking yards.	Other Public Utility Areas and Public Buildings.		
	Gymnasium/ Yoga centres.	Fuel filling stations		
	Cottage industries, automobile workshops, automobile service stations, cold storage, service industries of non- nuisance nature with number of workers limited to 19 without power or 9 workers with power limited to 30HP(See Annexe-I), saw mill, weigh bridges, printing press, IT hardware / electronic industries, marble and granite storage / cutting centres.	Outdoor games stadium		
	Expansion of existing residential buildings, Single Family Residences, residential flats/apartments with lower floors for commercial use, night shelters, orphanages, old age homes, Dharma Sala, hostels and boarding houses, lodges and guest houses, ashram/ mutts. Residential buildings floor area limited to 300m^2.		Multiplex	
	Government (Local /State/ Central) or Public Sector Offices.		Transport Terminals	

	Day care, Crèche, Nursery/ Kindergarten, Schools up to Higher Secondary level, expansion of existing educational institutions.			
	Social welfare centres, museum, convention centres, Library and Reading rooms, exhibition centres, art gallery.			
	Clinics, diagnostic centres and hospitals up to 50 beds.			
	Tot lots, Parks & playgrounds, fair ground, open air theatre.			
	Parking plaza.			
	Plant nursery, storage of agricultural produces and seeds.			
3.2	**Provided that the access road has an existing or proposed width of 12m minimum**			
	Educational Institutions other than those mentioned in clause 3.1.			Any other uses not specified in columns (2),(3) and (4)
	Hospitals & Health centres (above 50 beds).			
4	**Industrial Use Zone**			
4.1	All industries listed in Annexure I & II, Automobile Workshops & Automobile Service Stations, Spray Painting Workshops, Saw Mills, Timber Yard, Ice Factory, Cold Storage, Fish and Meat Processing Units, Printing Press, Marble and Granite Storage and Cutting Centres, Industrial Estates & Industrial Parks, IT Software Units.	Other Public Utility Areas and Public Buildings.	Container Terminals with minimum access width of 18m.	Any other uses not specified in columns (2), (3) and (4)
	Godowns/Warehouses/Storage of non-hazardous material, stacking yards, weigh bridge.	Crematorium, Burial Ground, Common Vault.		
	Diary and Dairy Farms, Dairy related Industries, Poultry Farms, Piggery Farm, Smoke House. Dry Cleaning Plants, Power Plants, Sub Stations, Smoke Houses, Agro Service Centres.	Storage of Explosives and Fire Works, Gas Godowns,		

	Government or Public Sector Offices, Transport Terminals incidental to industrial use.	Sewage Treatment Plants.		
	Residential uses incidental to the industrial use.	Fuel Filling Stations.		
	Any other activity incidental to industrial use. Tot lots, Parks and Play Grounds attached to incidental residential use.			
	Slaughter House.			
5	**Public & Semipublic Use Zone**			
5.1	Local/State/Central Government/ Public Sector Offices and Other Related Public Buildings. Additions and alterations to the existing buildings including addition of new blocks without altering the use.	Cremation Ground / Crematorium, Burial Ground, Common Vault.	Bus Terminals / Stands	Any other uses not specified in columns (2), (3) and (4)
	Public Utility Areas and Buildings.	Fuel Filling Stations.		
	Residential Quarters, other buildings incidental to public and semi-public use with floor area up to 200 Sq.m.			
	Buildings for incidental uses with floor area limited to 100m^2.			
	Parking plazas, auto rickshaw/ taxi/jeep stands. Auditorium / wedding halls / community halls incidental to public and semi-public uses. Tot lots/parks/playgrounds, open air theatre, camping sites.			
	Educational institutions (including professional education/collegiate education /higher education institutions), library and reading rooms, social welfare centres, museum, swimming pools, exhibition centres and art gallery, convention centres, indoor/ outdoor games stadium. Clinics, diagnostic centres and hospitals.			
	Police Stations, Post, Telegraph Offices, Religious Buildings, Ashram / Mutt, Places of Worship.			
6	**Traffic and Transportation Use Zone**			
6.1	Any Incidental Uses to the transport terminals such as Retail Shops, Restaurants, Canteen.	Fuel Filling Stations.	Transport terminals, Mobility hubs.	Any other uses not specified in

	Comfort stations.			columns (2), (3) and (4)
	Staff Quarters, Offices, Night Shelters, Guest Houses, Parks			
	Parking Plazas.			
	Constructions related to boat jetties and other infrastructure of Canal restoration and promotion of inland water navigation, taxi / jeep / lorry stands.			
7	**Parks & Open Spaces Use Zone**			
7.1	Any construction/land development essential for the development/ improvement of open air recreational facilities.	Public Utility Areas and Buildings which will not affect the character of the area.		Any other uses not specified in columns (2), (3) and (4)
	Fish Landings, Boat Jetties, Guided Boat Rides, Watch Towers, Eco Walk Ways, Water Sports Facilities, Fair Grounds.			
	Tot Lots, Park, Play Grounds, Swimming Pools, Open Air Stadium, Open Air Theatre, Zoological and Botanical Garden, Bird Sanctuary.			
8	**Conservation Zone**			
8.1	Paddy cultivation/ Agriculture/ Horticulture/ floriculture/ Fodder cultivation, Fish Farms/ Seed Farms/ Wells and Irrigation Ponds without any building construction, Pump House. Building constructions or land developments in conformity with '*The Kerala Conservation of Paddy land and Wetland Act, 2008*' in force in lands designated as paddy lands or wetlands under the said act.			Any other uses not specified in columns (2),(3) and (4)
9	**Water bodies**			
9.1	All existing water bodies shall be conserved. Restoration and rejuvenation of waterbodies.			Any other uses not specified in columns (2),(3) and (4)
	Bridges, side protection walls, bathing ghats, floating jetty based on community level requirements.			

	Traditional fishing and allied activities undertaken by local communities.			
	Activities related to tourism like water sports, spot fishing, aquaculture without affecting and altering the natural environment may also be permitted.			
10	**Heritage Zone**			
	General Guidelines: As per the provisions of Section 91, Sub section (3), clause (iv) of the Kerala Town and Country Planning Act 2016, the following regulations shall apply to conserve the character of the following heritage areas/ buildings, with due regard to the historical significance and /or architectural character of the area. i. The architectural character of the façade of the proposed construction shall be in tune with the surrounding environment and as per the advice of the Kerala Art and Heritage Commission. ii. The Local Self Government Institution concerned shall insist on any such recommendations of the Commission. iii. The Commission, if found necessary may entrust the following regulatory aspects to a Committee/ Subcommittee, constituted for the purpose. iv. Changes if any required in the following regulation shall be permitted by the commission on receipt of the recommendation of the Committee/ Subcommittee constituted, if any, for the purpose. v. In addition to the above, the following regulations shall also apply.			
10.1	Land to a depth of 20m from the outer edge of the streets on both sides of the canals (Vadai Canal, Commercial Canal and the two link canals connecting them) come under heritage zone. The Façade of any building, which has direct view from these streets, but falls outside the heritage zone shown in proposed land use map shall be in harmony with the architectural character of the heritage zone. 1. Notwithstanding anything contained in the zoning regulations of the Master Plan and subject to modifications as prescribed hereunder, no development, redevelopment, construction including additions, alterations, repairs, renovations, replacement of special and architectural features, demolition of any part or whole thereof in respect of any objects or buildings in the area, coming under the heritage zone, shall be allowed except with prior written recommendation of the Kerala Art and Heritage Commission constituted by the Government, under Section 86 of the Kerala Town and Country Planning Act 2016 and Rule 103 of the Kerala Municipality Building Rules 2019, in order to conserve the heritage character of the area. Provided that, no area or buildings or objects, which in the opinion of the said Commission have architectural, aesthetic, archaeological, cultural or historic value will be allowed to be altered from the existing condition without the prior written recommendation of the Commission. Provided also that, new constructions and additions or alterations to existing buildings may be permitted in this area with the following additional regulations namely: i. The façade of the proposed construction shall be in harmony with the architectural character of the heritage zone and as per the advice of the commission.			

	ii. Sloping roof forms (hip roof/ gabled roof) with a preferred slope angle ranging from 35-45 degrees which depicts the character of the street shall be adhered to. iii. The roof in façade shall be finished with Mangalore Pattern (MP) terracotta colour tiles. iv. The sunshade in facades if any provided, shall have the same slope and finish as that of the main roof. v. Existing street character shall be maintained. vi. The exterior wall surfaces shall be finished in white or off-white colour. The exterior walls shall be given plain texture finish. vii. The overall height of the construction including the existing structure if any, up to the topmost point of the proposed construction shall not exceed 12 metres from the average ground level Provided further that, the use or reuse of any site or building shall be as per the recommendations of the commission.			
11	Tourism Promotion Zone			
	Residences, Apartments, Guest Houses, Camping Sites, Residential Cottages, Hostels and boarding houses.	Fuel filling stations.		Any other uses not specified in columns (2), (3) and (4)
	Hotels, Motels, Restaurants, Canteen, Curio Shops, Coffee Shops, Tourism Information Centres, parking area and other similar amenities related to Tourism.			
	Police posts/police stations, post and telegraph offices			
	Parks, Open spaces, play grounds, Aquarium, Open air theatre, Swimming pools, Botanical gardens, Temporary use for fairs/ exhibition/ circus/ cinema, bathing Ghats, Riverside walkway, Boat Jetties, Floating Jetty and such other facilities related to back water tourism			
	Libraries and Reading rooms, exhibition centres and art gallery, gymnasium/ yoga centres, community halls, social and cultural establishments			
	Shops, professional offices/ commercial offices, banks and financial institutions, with floor area limited to 200m^2			

	Clinics (Out Patient) and Diagnostic Centres floor area limited to 100m^2			
	Places of worship, Public utility areas and buildings, Erosion control measures.			
	Any constructions / Land development essential for development of tourism related activities.			
12	**Farm Tourism Promotion Zone**			
	Residences, Public Utility areas and buildings, Guest Houses, Camping Sites, Residential Cottages, Homestays. Additions and alterations to the existing buildings including addition of new blocks without altering the use.			Any other uses not specified in columns (2), (3) and (4)
	Ticket counter, guardroom, stalls or shopping area related to sale of farm yields, Restaurant/ Coffee shop/ Snack bar, Tourist information centre, Communication centre and other incidental amenities related to farm tourism with floor area limited to 200m^2.			
	Any constructions / Land development essential for development of farm tourism related activities.			
13	**Green Areas Conservation Zone**			
	Single Family Residences			Any other uses not specified in columns (2),(3) and (4)
	Water landings, Pump houses/ Wells & Irrigation Ponds, Agriculture/ Horticulture/ Fodder Cultivation/ Pastures/ Grazing Grounds/ Seed farms and protective works. Walk ways, parks/ maidans/ grounds without any building constructions may be permitted.			

	Activities related to inland fisheries/ Aqua culture without affecting and altering the natural environment may also be permitted.			
	Canal beautification works are permitted in this zone for Vadai Canal, Commercial Canal and the two link canals connecting them.			
14	**Mangroves**			
	No construction/ reconstruction/site development permitted. Planting of indigenous species of mangroves as specified by concerned authority.			Any other uses not specified in columns (2),(3) and (4)
15	**Sandy Beach**			
	Beach nourishment activities, coastal protection works and any other activities for reducing the effects of coastal erosion are permissible. Construction and/ or development activities which are of permanent nature are not permissible in this zone, however, constructions and/ or developments in conformity with the Coastal Regulation Zone Notification in force is permissible.			Any other uses not specified in columns (2),(3) and (4)
16	**Pine Buffer Strip (Beach Oak/ Kattadi)**			
	No construction/ reconstruction/ site development permitted. Planting of pine and other related species as specified by concerned authority.			Any other uses not specified in columns (2),(3) and (4)
17	**Special Zones**			
Special use zones include the areas demarcated for specific uses or projects. No other activity unless otherwise specified shall be permitted in such zones.				
17.1	**Special Zone –A: Common Facility Center.**			

	If the project is not materialized within a period of 7 years from the date of sanctioning of the plan the area shall be deemed as part of Conservation Zone. Facilities for storage, processing and marketing of agricultural produces. Cooperative marketing facilities, Agricultural machinery and equipment's, etc. Training centre for capacity building of farmers and other stakeholders in agriculture and allied activities. Labs, Waste processing / disposal units, eco-parks, cafeteria, sanitation facilities. Any buildings/ structures which forms an integral part of a Common Facility Center, Buildings for incidental uses. Retention basins, water treatment facilities.
17.2	**Special Zone –B: Parking Zone.**
	If the project is not materialized within a period of 7 years from the date of sanctioning of the plan the area shall be deemed as part of immediate surrounding zone and constructions shall thereafter be allowed with the concurrence of the Town Planner. Parking areas, multi-level car parking, Truck Terminal, information kiosk, Commercial and office use incidental to the main use.
17.3	**Special Zone –C: Urban Park.**
	If the project is not materialized within a period of 7 years from the date of sanctioning of the plan the area shall be deemed as part of immediate surrounding zone and constructions shall thereafter be allowed with the concurrence of the Town Planner. Construction/ land development essential for the development/ improvement of open air recreational facilities. Fish Landings, Boat Jetties, Guided Boat Rides, Watch Towers, Eco Walk Ways, Water Sports Facilities, Fair Grounds. Park, Play Grounds, Swimming Pools, Open Air Stadium, Open Air Theatre, Zoological and Botanical Garden, Pavilions, shops/ cafeteria of temporary nature. Retention ponds, water treatment facilities. Permitted construction shall be done with sustainable, indigenous materials.
17.4	**Special Zone –D: Wetland Park.**
	If the project is not materialized within a period of 7 years from the date of sanctioning of the plan the area shall be deemed as part of Conservation Zone. Fish Landings, Boat Jetties, Guided Boat Rides, Watch Towers, Eco Walk Ways, Water Sports Facilities, Fair Grounds. Retention basins, water treatment facilities. Park, Play Grounds, Swimming Pools, Open Air Stadium, Open Air Theatre, Zoological and Botanical Garden. Storage shed for horticulture on stilts, wetland awareness and conservation centres made of sustainable materials and designed on stilts, bridges for essential connectivity.
17.5	**Special Zone –E: Detention/ Retention Basins.**

	If the project is not materialized within a period of 7 years from the date of sanctioning of the plan the area shall be deemed as part of Conservation Zone. Construction/ site development required for construction/excavation of water-holding basins, side protection walls, wet agriculture, aquaculture, pisci-culture
17.6	**Special Zone –F: Multipurpose Rescue Shelter.**
	If the project is not materialized within a period of 7 years from the date of sanctioning of the plan the area shall be deemed as part of immediate surrounding zone and constructions shall thereafter be allowed with the concurrence of the Town Planner. Development of land and construction of multi-storied building built with resilient techniques. Any buildings/ structures which forms an integral part of a Multipurpose Rescue Shelter. Retention basins, water treatment facilities.
17.7	**Special Zone–G: Sewage Treatment Plant.**
	If the project is not materialized within a period of 7 years from the date of sanctioning of the plan the area shall be deemed as part of immediate surrounding zone and constructions shall thereafter be allowed with the concurrence of the Town Planner. Construction/ land development essential for the development of sewage treatment plant. Buildings for incidental uses.

28.3 PART C – Regulations for Flood Prone Zones

Flood prone Zones: These are areas which are exposed to floods and are classified into various Zones (Very High, High, Medium and Low) based on the intensity of likely Floods in the design scenario of 50-year return period. This map is part of proposed landuse map as an overlay.

Low Flood prone zones are areas likely to be inundated to a depth up to 0.6m in the design flood scenario.

Moderate Flood prone zones are areas likely to be inundated to a depth of more than 0.6m and up to 1.5m in the design flood scenario.

High Flood prone zones are areas likely to be inundated to a depth of more than 1.5m and up to 2.5m in the design flood scenario.

Very High Flood prone zones are areas likely to be inundated to a depth of more than 2.5m in the design flood scenario.

For the purpose of reducing Disaster Risk, proposed land use and the developments in various flood prone zones are further modified by Flood prone zone overlay regulations in Table 28-2. These additional regulations are aimed at reducing damages and losses to people and assets in the flood prone areas. Flood Hazard Overlay regulations have to be read in conjunction with the zoning regulations in Part B Table 28-1 and wherever a conflict occurs the additional regulations in the Flood prone zone overlay shall prevail.

Table 28-2: Zoning Regulations for flood prone zones

	Permitted Uses in Flood Prone Zones
1.	All existing authorized uses will be permitted to continue including their maintenance and strengthening works.
2.	Height of compound wall shall not exceed 1.2 meter and no sharp-edged projections shall be fixed on the compound walls or gates, to facilitate easy evacuation.
3.	No portion of open space shall be paved. Only 25% of the total open space in the plot shall be paved if required, with suitable materials enabling percolation of rain water.
4.	Construction/ Reconstruction of toilets with Septic tanks having control valves/ non return valves and inspection chamber is mandatory for every new building, if sewerage connectivity is not available.
5.	All new constructions/ additions to upper floors shall have an open balcony /open passage/a terrace in the upper floors or an open stair connecting the upper floors to the ground facing the yard abutting the adjoining street to facilitate easy evacuation.
6.	All new buildings or addition of upper floors shall have a minimum of 50% of the roof terrace kept open to sky, which shall be accessible to facilitate easy evacuation.
7.	Electrical points shall be provided above 1.2 m from finished floor level
8.	Essential utility services with suitable flood proofing.
9.	Agriculture, horticulture, pisci culture, fodder cultivation, and other types of cultivation including social forestry. Ancillary structures to the above including pump house, well, irrigation pond and Granary for temporary storage.
10.	Parks and other organised recreational open areas with essential ancillary structures.
	Low Flood Prone Zone: (inundation depth up to 0.6m)
i.	Constructions in respective land use zones as in the Proposed Land Use Plan.
ii.	Basement floors are not allowed for any use other than parking.
iii.	All new buildings or additions in the ground floor shall be built on a minimum plinth height of 60cm from the surrounding ground level.
	Moderate Flood Prone Zone: (inundation depth greater than 0.6m and up to 1.5m)
i.	Constructions in respective land use zones as in the Proposed Land Use Plan.
ii.	Basement floors are not allowed for any use other than parking.
iii.	All new buildings or additions in the ground floor shall be built on a minimum plinth height of 90cm from the surrounding ground level.
iv.	Coverage shall be limited to 60% for buildings having building footprint above 100sqm.
	High Flood Prone Zone: (inundation depth greater than 1.5m and up to 2.5m)
i.	Expansion of existing buildings to upper floors under permitted uses in Part B of the respective land use zone will be allowed.

ii.	Constructions in respective land use zones as in the Proposed Land Use Plan subject to the condition that all new buildings or additions in the ground floor shall be built on a minimum plinth height of 1.20m from the surrounding ground level
iii.	Basement floors are not allowed for any use.
iv.	Coverage shall be limited to 60% for buildings having building footprint above 100sqm.
	Very High Flood Prone Zone: (inundation depth greater than 2.5m)
i.	Expansion of existing buildings to upper floors under permitted uses in Part B of the respective land use zone shall be permitted.
ii.	Constructions in respective land use zones as in the Proposed Land Use Plan subject to the condition that all new buildings or additions in the ground floor shall be built on a minimum plinth height of 1.80m from the surrounding ground level
iii.	Basement floors are not allowed for any use.
iv.	Coverage shall be limited to 60% for buildings having building footprint above 100sqm.

28.4 PART D – ANNEXURE

See Annex I & Annex II

ANNEX I

Type of Non-Obnoxious and Non-Nuisance Type of Service or Light Industries Permissible in Residential & Commercial Zones

1. Production of copra
2. Processing of arecanut
3. Rice and Flour Mills.
4. Production of rice, flour etc., by hand
5. Processing of Cardamom, ginger, pepper etc.
6. Production of Khandsri for sugar-cane
7. Carrying and preservation of fruits and production of jam, jelly etc.
8. Processing of and preservation of cashew nuts.
9. Bakeries.
10. Production of Dairy Products.
11. Oil mills (vegetables)
12. Extraction of oil by ghani.
13. Manufacture of hydrogenated oil.
14. Manufacture of "aval" (Beaten rice) appalam.
15. Production of vinegar.
16. Manufacture of soda, water, lemonade etc.
17. Manufacture of Ice.
18. Manufacture of ice cream.
19. Processing, packing and distribution of tea.
20. Processing, grinding, packing and distribution of coffee.
21. Manufacture of syrup.
22. Manufacture of beedi.
23. Manufacture of Cigar.
24. Manufacture of tobacco snuff.
25. Manufacture of chewing tobacco.
26. Cotton ginning, clearing, pressing etc.
27. Cotton spinning other than in Mills
28. Cotton spinning and weaving in Mills.
29. Cotton weaving in handloom.
30. Cotton weaving in power looms.

31. Handloom weaving.
32. Khadi Weaving in Handloom.
33. Printing of cotton textiles.
34. Manufacture of Cotton thread, rope twine etc.
35. Jute spinning.
36. Manufacture of jute products including repairing of gunny bags.
37. Weaving of silk by Handloom.
38. Manufacture of hosiery goods.
39. Making of embroidery products
40. Tailoring
41. Manufacture of quilts and mattresses.
42. Manufacture of Coir and Coir Products.
43. Manufacture and assembling of umbrellas and production of spare parts of umbrellas.
44. Repairing of umbrellas.
45. Manufacture of wooden furniture and fixtures.
46. Manufacture of structural wooden goods such as doors, beams etc.
47. Manufacture of wooden industrial good such as parts of handloom ambarcharka
48. Manufacture of wooden utensils, photo frames, toys, etc., and photo framing.
49. Cane industry including baskets, weaving etc.
50. Manufacture of miscellaneous wooden articles such as sticks, sandals, rulers etc.
51. Manufacture of paperboard and paper hand.
52. Making of paper boxes, bags, envelopes etc.
53. Printing and publishing of newspapers and periodicals.
54. Printing and publishing of books.
55. Miscellaneous printing works including type, cutting, book binding.
56. Manufacture and repairing of leather shoes and chappals.
57. Manufacture of leather products such as suitcase, bag etc.
58. Vulcanizing and repairing of tyres and tubes.
59. Manufacture of rubber gloves.
60. Manufacture of Rubber products such as rubber sheets, nipples and rubber shoes including smoke-rubber.
61. Manufacture of pharmaceuticals, chemicals, Ayruvedic medicine etc.

62. Manufacture of agarbathi and other cosmetics.
63. Manufacture of plastic products such as nameplates etc.
64. Manufacture of lemongrass oil, candles etc.
65. Manufacture of cement products such as wellkeros, tube, closets etc.
66. Manufacture of structural stone goods, stone crushing, stone carving, stone dressing, marble carving etc.
67. Manufacture of stone wares.
68. Manufacture of stone images.
69. Manufacture of chinaware's and crockery.
70. Manufacture of large containers and chinaware.
71. Manufacture of glass and glass products.
72. Manufacture of clay models
73. Manufacture of iron and steel furniture.
74. Manufacture and repairing of brass and bell metal products.
75. Manufacture of aluminum utensils and other products.
76. Manufacture of tin cars and copper vessels.
77. Electroplating, tinplating, welding etc.
78. Manufacture of agricultural implements, screws etc. (blacksmith and foundry)
79. Manufacturing assembling and repairing of machinery such as water pumps, oil mill chucks etc.
80. Manufacture of small machine tools and machine parts.
81. Manufacture of sewing machine parts and assembling and repairing of sewing machine.
82. Manufacture of electrical machinery and repairing of electric motors armature winding etc.
83. Manufacture and repairing of electric fans.
84. Charging and repairing of batteries.
85. Repairing of radios, microphones etc.
86. Manufacture of electric meters, production of electric and allied products, repairing and servicing of electrical appliances.
87. Bodybuilding of motor vehicles.
88. Manufacture and repairing of motor engine parts and accessories.
89. Serving and repairing of motor vehicle
90. Manufacture of cycles, parts and accessories.

91. Manufacture and repair of boats and barges.
92. Manufacture and repairing of animal drawn and hand drawn vehicles.
93. Repairing of photographic equipments, spectacles etc.
94. Manufacturing of medical instruments
95. Repairing of watches and clocks.
96. Manufacture of Jewellery.
97. Manufacture, repair and tuning of musical instruments.
98. Manufacture of sports goods, balloons etc.
99. Ivory, carving and ivory works
100. Miscellaneous Industries

ANNEX II

List of Obnoxious or Nuisance Industries Subject to Objectionable Odours, Fumes Effluents or Processors to be Located in Hazardous Zones. (Grouped under Indian Standard Industrial Classification)

I. Manufacture of Food Stuff :

1) Slaughtering, preservation of meat and fish and canning of fish.

II. Manufacture of Beverages:

1) Production of distilled spirits, wines, liquor etc., from alcoholic malt, fruits and malts in distillery and brewery.
2) Production of country liquor and indigenous liquor such as toddy, liquor form mahua, palm juice.

III. Manufacture of Textiles :

1) Dyeing and bleaching of cotton

IV. Manufacture of Wood and Wooden Products:

1) Sawing and planning of wood.
2) Wood seasoning and creosoting
3) Manufacture of veneer and plywood.
4) Paper, pulp and straw board.

V. Manufacture of Leather and Leather Products :

1) Currying, tanning and finishing of hides and skims and preparation of finished leather.

VI. Manufacture of rubber, petroleum and coal products:

1) Manufacture of tyres and tubes
2) Manufacture of Industrial and synthetic rubber.
3) Reclamation of rubber.
4) Production of petroleum, kerosene and other petroleum products in refineries.
5) Production of chemicals and chemical products.

VII. Manufacture of chemicals and chemical products:

1) Manufacture of basic industrial chemicals such as acids, alkali and their salts not elsewhere specified (especially sulphurous, sulphuric, nitiric, hydrochloric etc., acids) ammonia, chorine and bleaching powder manufactures.
2) Manufacture of dyes, paint, colours and varnishers, printing ink.
3) Manufacture of fertilizers (Specially from organic materials):
4) Manufacture of disinfectants and insecticides
5) Manufacture of ammunition, explosive and fireworks.
6) Manufacture of matches.

VIII. Manufacture of Non-metallic mineral products other than petroleum and coal:

1) Manufacture of cement and cement products

2) Manufacture of Lime
3) Manufacture of Plaster of Paris.

IX. Manufacture of basic metals and their products :

1) Manufacture of iron and steel including smelting, refining, rolling and conversion into basic forms.
2) Manufacture including smelting, refining etc., or nonferrous metals and alloys in basic forms.
3) Manufacture of Armaments.

X. Manufacture of machinery (other than transport) and electrical equipments:

1) Manufacture of all kinds of battery

XI. Miscellaneous items not covered above.

1) Incineration, reduction or dumping of offal, dead animals' garbage or refuse.
2) Manufacture of gelatin and glue.
3) Fat, tallow, grease or lard refining of manufacture.
4) Bone meal, bone grist and bone powder.
5) Manufacture of cashew nut shell oil.
6) Other similar types of nuisance industries.

References

(n.d.). Retrieved from United Nations: https://www.un.org/en/climatechange/what-is-climate-change

(n.d.). Retrieved from Environmental Resilience Institute: https://eri.iu.edu/erit/implications/sea-level-rise.html

(n.d.). Retrieved from The times of India: https://timesofindia.indiatimes.com/city/kochi/central-kerala-coastline-may-be-hit-by-rise-in-sea-level/articleshow/85413378.cms

(n.d.). Retrieved from Climate Central: https://coastal.climatecentral.org/map/14/76.3209/9.4947/?theme=sea_level_rise&map_type=year&basemap=roadmap&contiguous=true&elevation_model=best_available&forecast_year=2040&pathway=rcp45&percentile=p50&refresh=true&return_level=return_level_1&slr_model=

(2019). Alappuzha: Kerala State Electricity Board.

A GIS based approach to study the impacts of sea level rise on lakes. (n.d.). Retrieved from https://www.researchgate.net/publication/287608821_A_GIS_based_approach_to_study_the_impacts_of_sea_level_rise_on_lakes

A Special Package for Post - Flood Kuttanad. (2019). Retrieved from https://spb.kerala.gov.in/sites/default/files/2020-09/Kutanad_Large2.pdf

Agriculture Office, Alappuzha, 2019. (n.d.).

Alappuzha Municipality, H. T. (n.d.). *DPR on Solid Waste Management Alappuzha Municipality.*

(n.d.). *Annual Financial Statement.* Alappuzha Municipality.

ArchitectureBatch, 2.-1. (2016). *Urban Design Study on Alappuzha.* CET Thiruvananthapuram.

BSLLD Web Portal . (2016-2017).

(n.d.). *Census Data, 2011.*

Centre for Policy Studies (CPS) and Centre for Technology Alternatives for Rural Areas (CTARA). (2018). *Town Level Assessment of major polluters and pollutants in Alappuzha Town.*

Centre for Policy Studies (CPS), I. I.-B. (n.d.). *Participatory Water and Sanitation Assessment for Alappuzha Town.* Kerala Institute of Local Administration (KILA), Kerala.

Climate Change 2007: Mitigation of Climat Change. (n.d.). Retrieved from ipcc: https://www.ipcc.ch/site/assets/uploads/2018/03/ar4_wg3_full_report-1.pdf

(n.d.). *Climate Change: Impacts, Vulnerabilities and Adaptation in developing countries.*

(n.d.). *Coastal Zone Management Plan.* Department of Environment.

Commercial Survey. (n.d.).

(n.d.). *Development Plan - 2011, Alappuzha Town.*

(n.d.). *Directorate of Industries & Commerce.* Alappuzha.

(2018). *Disaster, Disaster Management and Livelihood of Fishermen: A study on selected areas of Kerala.* Kerala Institute of Labour and Employment.

(2015). *District Disaster Mnagement Plan Alappuzha* . Kerala State Disaster Management Authority.

(n.d.). *District Urbanisation Report, Alappuzha, 2011.*

(n.d.). *District Veterinary Center.*

(2019). *Economic review.* Kerala State Planning Board.

(2021). *Economic Review.* Kerala Staet Planning Board.

Güdel), E. H. (2008). *Solid Waste Management.* Eawag/Sandec (Department Water and Sanitation in Developing Countries).

H.Schenk. (1986). *Views on Alleppy.* Amsterdam: Netherlands Geographical Studies.

(2012). *Integrated District Development Plan for Alappuzha.* Department of Town & Country Planning.

(n.d.). *Kerala Tourism Statistics.* Tourism Department.

Kuriakose, B. (2018). *Conservation Development Plan - Alappuzha Heritage Project.*

LEE. (2006). Cheong Gye Cheon Restoration Project.

Managing the Risks of Extreme Events and Disasters to advance Climate Change Adaptation. (n.d.). Retrieved from ipcc: https://www.ipcc.ch/site/assets/uploads/2018/03/SREX_Full_Report-1.pdf

(n.d.). *Master Plan for Alappuzha Town - 2031.*

(2007). *Measures to mitigate agrarian distress in Alappuzha and Kuttanad Wetland system.* M S Swaminathan Research Foundation.

(2016). *National Disaster Management Plan.* National Disaster Management Authority.

(2018-2019). *PadhathiRekha.* Alappuzha Municipality.

(n.d.). *Prioritized Watershed Atlas of Alappuzha District.* Alappuzha: Department ofSoil Survey & Conservation.

(2021). *Resilient Kerala Program for Results.* The World Bank.

Sea Level Change Observations from Space. (n.d.). Retrieved from https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool

(n.d.). *State Urbanization Report, Kerala, 2012.*

Strengthening Climate Resilience through Disaster Risk Reduction. (2014). Retrieved from https://nidm.gov.in/PDF/pubs/Strengthening%20Climate.pdf

(n.d.). *Tourism Department, Alappuzha.*

(2020). *Traffic & Transportation Studies for AMRUT cities - Alappuzha Municipality.* KSCSTE - National Transportation Planning & Research Center.

VastuvidyaGurukulam. (2009). *Heritage Plan Alappuzha.* Department of Town & Country Planning.