MASTER PLAN FOR CHENGANNUR TOWN - 2041

(DRAFT)

Prepared by

LOCAL SELF GOVERNMENT DEPARTMENT PLANNING

for

CHENGANNUR MUNICIPALITY

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FOREWORD

Chengannur is known as Edathavalam of Sabarimala Pilgrims (Gateway of Sabarimala). Famous Chengannur Mahadeva temple, Pazhaya Suriyani Pally, Pandavan para etc are situated with in the Municipality. As a taluk headquarters, commercial centre and a halting centre for Sabarimala pilgrims, Chengannur Municipality attracts floating population from other regions. Chengannur town having very good traffic connectivity either by road and rail. The municipal road network has been experiencing traffic problems at the town centre. Transportation corridors are carrying overburden of traffic volume especially during the peak hours and pilgrim season. Chengannur is situated on the banks of Pamba river. Some canals are also running in the municipal limit. Lot of agricultural land is available in the Municipality. Major portion of this remain uncultivated. There is a constant need to maintain compatibility between demand and supply of infrastructural facilities within the town and its environs. In view of the limited resources at the disposal of development agencies, a system has to be evolved for the optimal utilization of infrastructural facilities. This felt need for planned development in the Municipality.

Town needs an integrated approach to development encompassing all the issues whether it is in infrastructure, environmental conservation, service delivery in various social sectors etc. These requirementscan be addressed only through preparation of a comprehensive Master Plan for the town with a long-range vision. Land being the scarcest and expensive resource, it is imperative to formulate and implement specific scientific measures in land use planning with foresight and inclusive regional outlook. Besides, provision of urban services, management of ecologically sensitive areas, disaster management, resource mobilization etc. are to be efficiently planned. The Master Plan for Chengannur 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 developed one. I am sure that it will also ensure peaceful and healthy living atmosphere for the inmates of the town.

Chengannur Municipality is one of the worst affected Municipality during 2018 flood. In Chengannur Municipality, out of 27 wards, 16 wards faced the severe effect of flood. (Ward no. 1 to 12, 24 to 27). In 2019 also Chengannur region has faced a similar flood situation but its intensity was less. In view of those flood happened, A Risk Informed Master Plan has been prepared for the Municipality area as part of the Rebuild Kerala Initiative and was published in June 2021. Subsequently, the municipal council decided to revise the draft master plan and republish it with the approval of the council by correcting the issues pointed out by the council as there were defects in the published master plan. Now, the published master plan is modified considering the suggestions received from the council members and discussions held at various level.

All the members of the council have 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 Special Committee and Working Group members also put in considerable efforts in materializing this Plan. I appreciate the concerted efforts exerted by the Local Self Government Department Planning, under the notable leadership of Smt. Sheeba Rani Y, Chief Town Planner (Planning) in the time bound

preparation of this comprehensive Risk Informed Master Plan taking the ground realities into consideration.

With great pleasure and faith, I present the risk informed Master Plan for Chengannur Town, 2041 herewith. I actively exhort to implement this Master Plan in its full spirit, which would certainly help Chengannur 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.

Sobha Varghese
Chairperson
Chengannur Municipality

Chengannur
November 2024

PREFACE

The mega flood of 2018 in Kerala warranted urgent need to build foundations of multi resilience in Kerala. Under Rebuild Kerala Development Programme (RKDP), it was aimed to carry out revision of urban planning framework including Act and guidelines for preparing and implementing Master Plans effectively and to enable risk informed planning and its implementation based on detailed review and assessment of existing planning system. Amendments to the Kerala Town and Country Planning Act, 2016 have been brought into force vide ordinance no: 42 of 2021 to enable preparation of Risk Informed Plans. Time bound Preparation and publication of Risk Informed Master Plan for two Urban Local Bodies is also target included in Priority Action under this Rebuild Kerala initiative. Chengannur Municipality is one among them.

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 urbanization and migration result in multi fold growth of urban areas. Adhoc efforts neither result in better environment nor strengthen the economic base. 74th Constitution Amendment Act envisages empowerment of the Urban Local Bodies (ULBs) with planning functions, which is enshrined in the Twelfth Schedule to Article 243 – W of 74th Amendment. The first three functions – urban planning including town planning, regulation of land-use and construction of buildings, planning for economic and social development related to spatial planning.

The earlier planning attempts in the Chengannur Municipal Area were IDSMT Scheme for Chengannur Town prepared by the Department of Town and Country Planning in 1996 under the Scheme for Integrated Development of Small and Medium Towns. This was basically a project-oriented report. An Interim Development Plan for Chengannur was prepared by the Department of Town and Country Planning in 1999. However, the process was not carried forward to the ultimate approval of the Government under Town Planning Act to enable the Plan to become a statutory document for implementation. Chengannur Municipality is located in the eastern boundary of Alappuzha district in the Pamba River basin with an area of 13.14 sq.km and population of 23,466 as per 2011 census. Nearly 60% of the Municipal area was inundated during the Mega flood in 2018. Hence a master plan designed for this town should be in such a way that it must encompass all possibilities to overcome a future calamity. In view of these flood events, Risk Information has also incorporated in the Master Plan for the Chengannur Municipality area as part of the Rebuild Kerala Initiative and was published in June 2021. Subsequently, the municipal council decided to revise the draft master plan and republish it with the approval of the council by correcting the issues pointed out by the council as there were defects in the published master plan. Now, the published master plan is modified considering the suggestions received from the council members and discussions held at various level.

I would like to appreciate the Chengannur Municipal Council for taking initiative in the preparation of this plan. The contributions of the Master Plan Committee constituted for the preparation of the Master Plan as well as the Working Groups were significant in the task.

I take this opportunity to appreciate the officials of the Alappuzha District office of the Local Self Government Department Planning, especially Shri. Joseph K. F, Town Planner for his sustained efforts in the preparation of this plan. I also appreciate the team in the head office, for their efforts in vetting and finalizing the Master Plan for Chengannur Town. 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.

The contributions of Smt. Indu Vijayanath, Former Town Planner; Smt. Nimmy Kurian, Smt. Rahana.H and Smt. Jayasree. V. K, Former Deputy Town Planners; Smt. Beeta Bhadran, Former Assistant Town Planner, Kottayam; Smt. Poornima Rajan, Former GIS Assistant is also mentioned at this juncture.

Definitely, this 'risk informed' Master Plan for Chengannur Municipality will provide the necessary framework for the sustainable development of this town, which was affected by 2018 and 2019 flood. I optimistically look forward to effective implementation of this plan. Certainly, the Master Plan will provide a vision for use by all agencies with an interest in the future development of Town.

Sheeba Rani Y

Chief Town Planner (Planning)
LSGD Planning
Government of Kerala

Thiruvananthapuram
November 2024

ACKNOWLEDGEMENT

The preparation of risk informed Master Plan for Chengannur Municipality was kicked off as a joint effort of Chengannur 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 Chengannur Municipality was initiated as per resolution number 4 of the Municipal Council on 21/12/2012. In view of the flood events that happened recently, Risk Information has also incorporated in the Master Plan for the Chengannur Municipality area as part of the Rebuild Kerala Initiative and was published in June 2021. Subsequently, the municipal council decided to revise the draft master plan and republish it with the approval of the council by correcting the issues pointed out by the council as there were defects in the published master plan. Now, the published master plan is modified considering the suggestions received from the council members and discussions held at various level.

I am sincerely acknowledging the valuable guidance and involvement of Municipal Chair Person Smt.Sobha Varghese, former Municipal Chair Person Smt. Mariyamma John Philip, and former Municipal Chairmen Sri. Shibu Rajan, Sri. John Mulankattil during the preparation of Master Plan for Chengannur Municipality. I gratefully acknowledge the contributions of all councilors of the Municipality for their support. The sincere efforts put in by the Secretary and Municipal Engineer needs special mention here.

I am extremely grateful to Dr Jayaragan P, Adhoc Faculty, Civil Engineering Department, NIT, Kozhikode and Professor Abdul Raoof A, Civil Engineering Department, RIT, Kottayam, for their wholehearted help while carrying out the studies and analysis required regarding water resource management.

I express my sincere gratitude to Smt. Sheeba Rani Y, Chief Town Planner (Planning), Sri. H. Prasanth, Smt. K.S Girija and Sri Gigi George former Chief Town Planners (Planning), former Chief Town Planner, Sri. C.P Pramod Kumar, Sri. Rajesh. P. N, former Senior Town Planner and Sri. Baiju K, former Town Planner for their unmatched support and guidance in bringing out this draft plan. I would also like to thank Smt. Sindhu K.M, Town Planner and Smt. Mitzie Thomas, former Deputy Town Planner for their support and sincere efforts in getting access to necessary data for the study. Special thanks also go to all Department persons who gave their valuable support and guidance 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 Spatial Integration Committee, Working Groups 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 Chengannur municipal area 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 of Smt. Gladis William and Smt. Hinduja VL, Deputy Town Planners, Smt. Remya A V & Shri. Vishnu Prasad, Assistant Town Planners and Kumari Namitha Vimal Raj, GIS Assistant in completing all the works in a time bound and organized manner and bringing out the draft plan within the stipulated time. The contributions of Smt. Indu Vijayanath, Former Town Planner; Smt. Nimmy Kurian, Smt. Rahana.H and Smt. Jayasree. V. K, Former Deputy Town Planners; Smt. Beeta Bhadran, Former Assistant Town Planner, Kottayam; Smt. Poornima Rajan, Former GIS Assistant 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.

I also remember Smt. Ashina Jamal, Smt. Tinu Susan Scaria, Planning Assistants, Shri. Manmohan M, Assistant Town Planner, and Sri.Aneesh. S, Statistical Assistant Grade I, all other members both in the technical and non technical section for all the co- operation and timely action extended. The contributions of Smt.Beeta Bhadran, Assistant Town Planner, Kottayam is also to be mentioned at this juncture.

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
November 2024

Joseph K F
District Town Planner
LSGD Planning

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1 INTRODUCTION

1.1 Concept of Risk Informed Master Plan

Disasters make it difficult for the human race to exist in the planet. They are mainly two types - Natural disasters and Manmade disasters. Flood, Land slide, Earthquake, Volcanic eruptions, Tsunami etc. are the major natural disasters. Nuclear attacks, terrorist attacks, other chemical & biological attacks all are included in manmade disasters. Various activities of human being actually increase the intensity of the impact of many naturally occurring calamities including flood, landslides etc. These natural disasters are the result of unscientific activities of human towards nature in the vulnerable area.

Disaster is the serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses that exceed the ability of the affected community or society to cope with it. Disaster risk reduction is the policy objective of disaster risk management. Sustainable development initiatives will fail unless they are risk informed. Disaster risk management is the application of disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses.

Following are the major factors affecting the disaster

- Climate change
- Environmental degradation
- Unplanned city expansion
- Poor land management/ governance
- Inadequate participation in decision making (inclusive planning/diverse stakeholders in planning)
- Limited implementation of environment protection laws

Risk informed development mainly aims the development of resilience for sustainable development. Resilience is the ability of a system, community or society expose to hazards to anticipate, resist, absorb, accommodate, adapt to and transform & recover from the effects of hazard in any effectively manner including through the preservation and restoration of its essential basic structure and functions through risk management.

Following are the methods to make a town to be resilient.

- Organize for disaster resilience
- Identify, Understand and Use Current and Future Risk Scenarios
- Strengthen Financial Capacity for Resilience
- Pursue Resilient Urban Development and Design
- Safeguard Natural Buffers to Enhance Ecosystems' Protective Functions

- Strengthen Institutional Capacity for Resilience
- Understand and Strengthen Societal Capacity for Resilience
- Increase Infrastructure Resilience
- Ensure Effective Disaster Response
- Expedite Recovery and Build Back Better.



Figure 1:1 Sustainable development and risk reduction

Figure 1:1 depicts the flow of sustainable development through risk reduction, by preventing risk creation thereby strengthening resilience. Chengannur municipality was one among the worst hit region during 2018 flood. And hence a master plan designed for this town should be in such a way that it must encompass all possibilities to overcome a future calamity. It should be risk informed then only we can achieve our aim.

1.2 Back Ground Of The Study

Any human settlement, urban or rural needs a Plan to guide its overall development and judicious use of resources. The focus on such a Master Plan is on improving the infrastructure and the orderly use of land and other natural resources on the belief that such a planned approach for the physical improvements shall directly contribute to the economic and social wellbeing of the people living and working in the settlement area. Moreover, such an orderly forward-looking plan and the ensuring development may contribute to the State as a whole in its economic and social progress.

Realising the need and urgency of guiding the developments of our urban centres, Government of Kerala have introduced a scheme for preparation of master plan for municipalities. The scheme aims preparation of master plans of all municipalities in the State. Chengannur Municipality is included in the second phase of the Scheme.

The organisational structure and planning process adopted for the preparation of this master plan is governed by the guidelines for preparation of general town planning schemes issued by Government vide G.O.(Rt) No. 2766/2009/LSGD dated 24-10-2009.

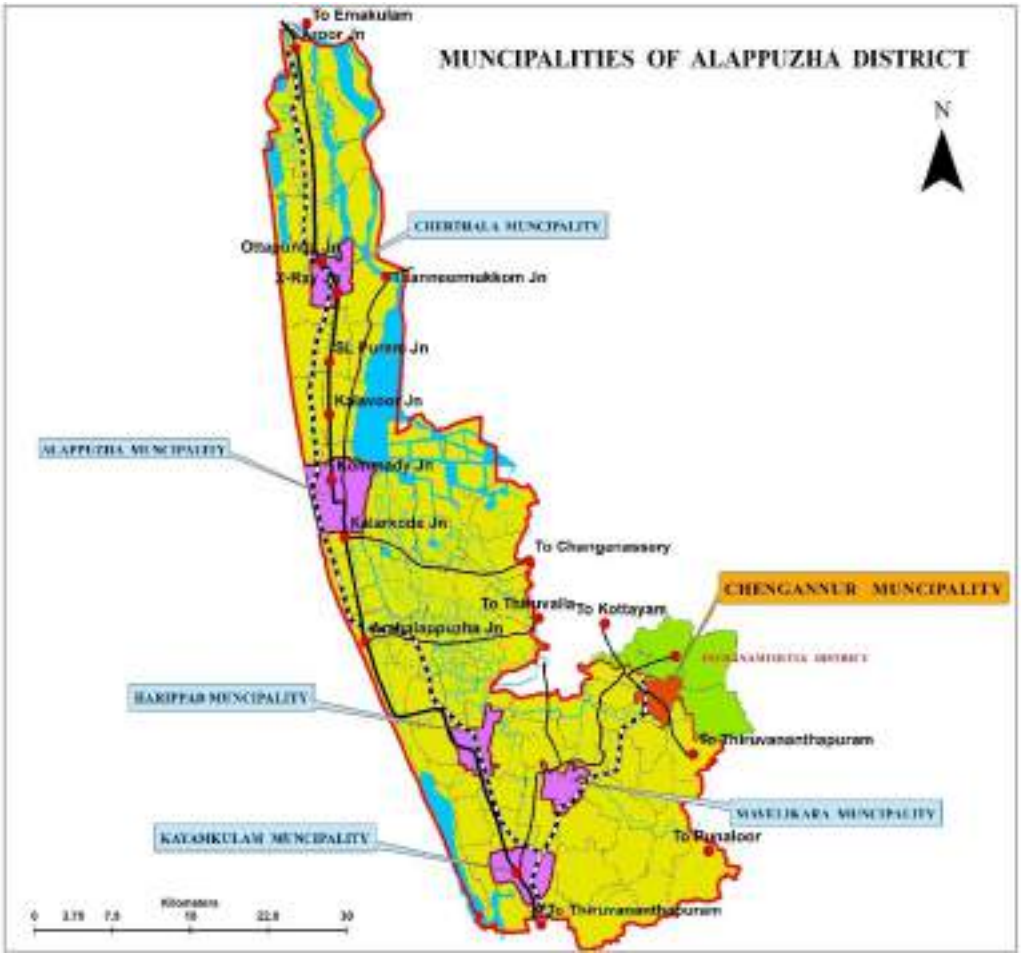

Figure 1:2 Municipalities of Alappuzha District

Chengannur is a municipal town in Alappuzha District. The town is located in the extreme eastern part of Alappuzha district, on the banks of Pamba River. The town is connected to the neighbouring districts of Kollam and Kottayam by NH-183 and railway line. Chengannur is also a major destination of Sabarimala Pilgrims known as the 'Gate way to Sabarimala'. The road and rail connectivity are attracting a heavy volume of through traffic that adds to the chaos of the town.

1.3 Earlier Planning Efforts

The earlier planning attempts in the Chengannur Municipal Area were IDSMT Scheme for Chengannur Town prepared by the Department of Town and Country Planning in 1996

under the Scheme for Integrated Development of Small and Medium Towns. This was basically a project-oriented Report.

An Interim Development Plan for Chengannur was prepared by the Department of Town and Country Planning in 1999. However, the process was not carried forward to the ultimate approval of the Government under Town Planning Act to enable the Plan to become a statutory document for implementation.

The Interim Development Plan for Chengannur Town was prepared with utmost care in order not to disturb much the existing dry cultivation area and paddy fields. The circulation system was derived as a ring road pattern with radial connections to the urban centre, by giving priority to the existing network with widening proposal. A by-pass was also proposed to divert the heavy traffic and to relax the traffic congestion within the town centre. Provisions had been made to accommodate facilities like Stadium, Civil Station, Municipal Bus Terminal, Lorry Stand etc. Since Pampa is flowing through the town, and there is a possibility of soil erosion and flooding. In order to prevent this, a stretch of land with a width of 50m was zoned as greenery zone. Since this plan has not become a statutory document, the proposals in the scheme were not implemented.

Being the headquarters of Chengannur Taluk and by virtue of its location especially with respect to transportation corridors (both rail and road), the town acts as a major activity centre. Apart from being a pilgrim centre, the town serves as a halting centre for pilgrims visiting the famous Sabarimala Temple. All these strategies call for guided development of the town. It is in this context that preparation of this Master Plan was initiated.

1.4 Need For The Plan

A Master Plan is a blue print for the city's future, for its spatial elements and density. This provides a long-term vision and strategy to sustainably manage the renewal of the area.

The preparation of a new Master Plan is necessitated by the change in focus of development planning brought about by the 74th Constitutional Amendment Act, 1992 and subsequent legislations in the country. The Kerala Municipality Act, 1994 enacted subsequent to the constitutional amendment, prescribes that every Municipality shall prepare a master plan for its development in the prescribed manner with focus on scientific spatial planning. The Town and Country Planning laws in force in the state provides for the preparation of such a Master Plan.

As per the Kerala Town and Country Planning Act, 2016 (Act No.9 of 2016) every Municipality shall prepare or get prepared for the Local Planning Area or part thereof. A master plan, taking into account the Plans, if any, prepared under this Act which have relevance to the Local Planning Area. Execution plans, taking into account the master plan and other plans, if any prepared under this Ordinance which have relevance to the Local Planning Area. According to the Act, the Master Plan shall be prepared through a participatory process and shall generally indicate the manner in which development of the Local Planning Area or part thereof shall be carried out and also the manner in which the use of land shall be regulated.

Chengannur is one among the six municipal towns in Alappuzha District. It is the Head Quarters of Chengannur Taluk. Regional setting studies revealed that Chengannur is a second order settlement in the district that serves a wider region covering grama panchayats of Pandanad, Thiruvanvandoor, Ala, Puliyoor and Mulakkuzha, Kuttoor, Eraviperoor, Koipuram, Aranmula in its service area. Hence the town has to serve the higher order requirements of these settlements also in addition to the requirements of its own resident population.

It is observed from the Census figures that the population in Municipal area is decreasing and the population of surrounding local bodies is also decreasing. As a taluk headquarters, commercial centre and a halting centre for Sabarimala pilgrims, Chengannur Municipality attracts floating population from other regions. Transportation corridors are carrying overburden of traffic volume especially during the peak hours and pilgrim season. There is a constant need to maintain compatibility between demand and supply of infrastructural facilities within the town and its environs. In view of the limited resources at the disposal of development agencies, a system has to be evolved for the optimal utilization of infrastructural facilities. This felt need for planned development in the Municipality is expressed by the resolution number 4 of Chengannur Municipal Council dated 21.12.2012 to prepare the master plan for Chengannur Municipality.

A Master plan will provide for and hence facilitate improvement of basic infrastructure including roads, power and water supply as well as facilities for parking, telecommunication, modern facilities for commercial development including shopping centers, restaurants, recreational facilities like parks and play grounds etc. It will also accommodate systems for effective solid and liquid waste management systems.

In addition to that Chengannur Municipality has faced a flash flood in the year 2018. Hence a master plan designed for the Chengannur should be risk informed for the sustainable development. Here comes the importance of risk informed master plan for Chengannur 2041.

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 for Chengannur town is delineated as Chengannur Municipal Area itself. The planning area is the present Chengannur Municipality, which comprises three revenue villages such as Chengannur (full) and portions of Mulakkuzha and Pandanad villages of Chengannur taluk with a population of 23,466 (As per 2011 Census) and stretches over an area of 13.14 sq.km.

1.6 Methodology

As per G.O (Rt) No.1376/2012/LSGD dated 17.05.2012 Government accorded Administrative and Financial Sanction for the preparation of Development Plans for 29 towns, Chengannur is one among them. The guidelines issued by the Government as per G.O (Rt) No. 2766/2009/LSGD dated 24.10.2009 for the Scheme for the preparation of development plans for municipalities aim to prepare statutory town planning schemes for towns as per Town Planning Act in force in a time bound and a participatory manner.

The General process of preparation of Master Plan involves four major steps in Figure 1:3.

- Data Collection
- Analysis
- Envisioning process
- Detailing

The process in detail is shown in figure below.

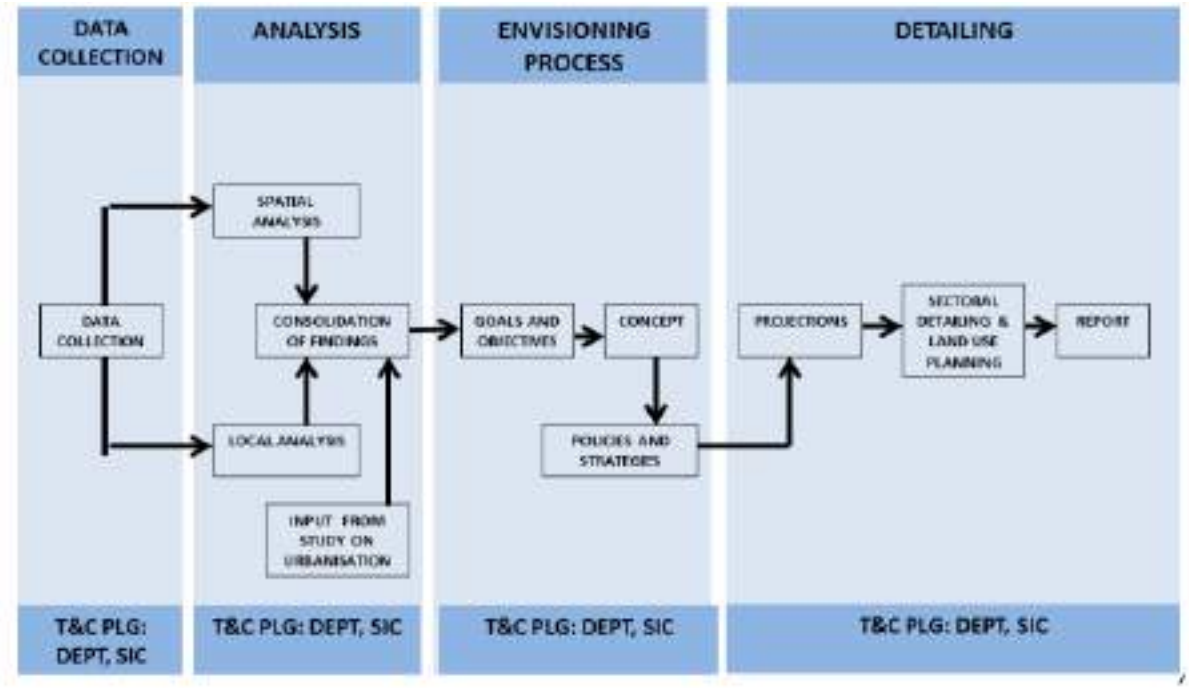

Figure 1:3 General Process of Preperation of Master Plan

1.6.1 Data collection and compilation

The primary data required for the preparation are land use survey, socio-economic survey and traffic survey. In addition to this, data of flood 2018 was also collected for hazard analysis. This was mainly taken from Nammal Namukkayi report prepared by Chengannur Municipality and other flood related studies conducted by various agencies. Since the inundation details were not available in the above reports, a primary survey on selected spots were conducted by the district office on February 2021.The land use survey was conducted by surveyors engaged on daily wages basis under the supervision of departmental surveyors and cross checked by officers of the department. Socio-economic survey was conducted on a format prepared at the state level for all the towns. The data collection was conducted by the enumerators on daily wages under the supervision of the Statistical wing of the LSGD Planning, Alappuzha office 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, Thiruvananthapuram.

1.6.2 Analysis

The analysis is done in two stages. The local level analysis focuses on the development trend of each sector, its potential and development problems associated with each sector. This includes development aspirations of the people also. The Spatial Integration Committee constituted in the Municipality was responsible for this analysis. The Town Planner of the LSGD 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 (conducted by the LSGD Planning for all the districts in the state) of the district are then integrated to form consolidation of findings in order to facilitate the envisioning process.

1.6.3 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 Master Plan follows these policies and strategies.

1.6.4 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 Master Plan and details of implementation and monitoring including the provisions for monitoring of the Master Plan.

In connection with materialising the plan preparation, a Spatial Integration Committee (SIC) was constituted in the Chengannur Municipality. The SIC played crucial role in collection of secondary data, conducting sectoral studies as well as in sectoral detailing etc and also extended support to the planning team constituted in the district office of the LSGD Planning, Alappuzha in connection with preparation of this Master Plan.

The municipal council of Chengannur resolved to prepare a new master plan for the town as per resolution no.4 dated 21.12.2012. In connection with materialising the plan preparation, a Spatial Integration Committee (SIC) was constituted as per the same resolution by the Municipal Council with Chairperson of Municipality as the Chairperson, Secretary as the convenor, Municipal Engineer as Joint convener, 13 Councillors, and District Town Planner as members. The SIC played crucial role in collection of secondary data, conducting sectoral studies as well as in sectoral detailing etc and also extended support to the planning team constituted in the district office of the LSGD Planning, Alappuzha in connection with preparation of this Master Plan.

People's participation is inevitable in the preparation of a meaningful Master Plan. In the preparation of master plan for Chengannur, the first level of consultation with the stake holders was through questionnaire and interviews. The household survey conducted using a well framed questionnaire helped to extract the citizens vision regarding the development priority in wards as well as the town as a whole.

The initial seminar conducted to give awareness of citizen's participation in framing the development plan of the town got very good response. Presence of Municipal chairperson, Plan Co-ordinator and other personalities gave significant suggestions about their vision of the town. The participants of the seminar pin pointed the issues unresolved for the long time.

In this plan, the concept evolved is based on the surveys, studies, analysis and consultations with the concerned stake holders, concerned departments and public in general who used the town as daily commuters. The present trend of development is considered for evolving the concept plan. The jurisdiction of the Chengannur Municipality at present is limited for an area of 13.14 sq.km. Whereas the service population of this town spread along the peripheral local bodies. The influence of the activities in these local bodies also considered to formulate the final plan.

Because of the mega flood 2018 and flood at 2019, Chengannur is listed one among the major flood prone area in the entire Kerala itself. Hence the disaster risk & methods to mitigate the future disasters is also addressed & added in the risk informed master plan of Chengannur Municipality for the sustainable development.

2 PROFILE OF THE TOWN

2.1 Location

Chengannur town located in the Chengannur Taluk is in the extreme eastern part of Alappuzha district. This Municipality is situated in between 76^{0}36'50" E longitude and 09^{0}19'06" N latitude. It is 117 kilometres north of the state capital Thiruvananthapuram on the MC Road. Chengannur is connected to Kollam and Kottayam by NH-183. Chengannur is noted for its famous Shiva temple known as Chengannur Mahadeva Temple and the Old Syrian Church. Chengannur is one of the major Sabarimala pilgrim destinations. Chengannur became Municipality in the year 1978.

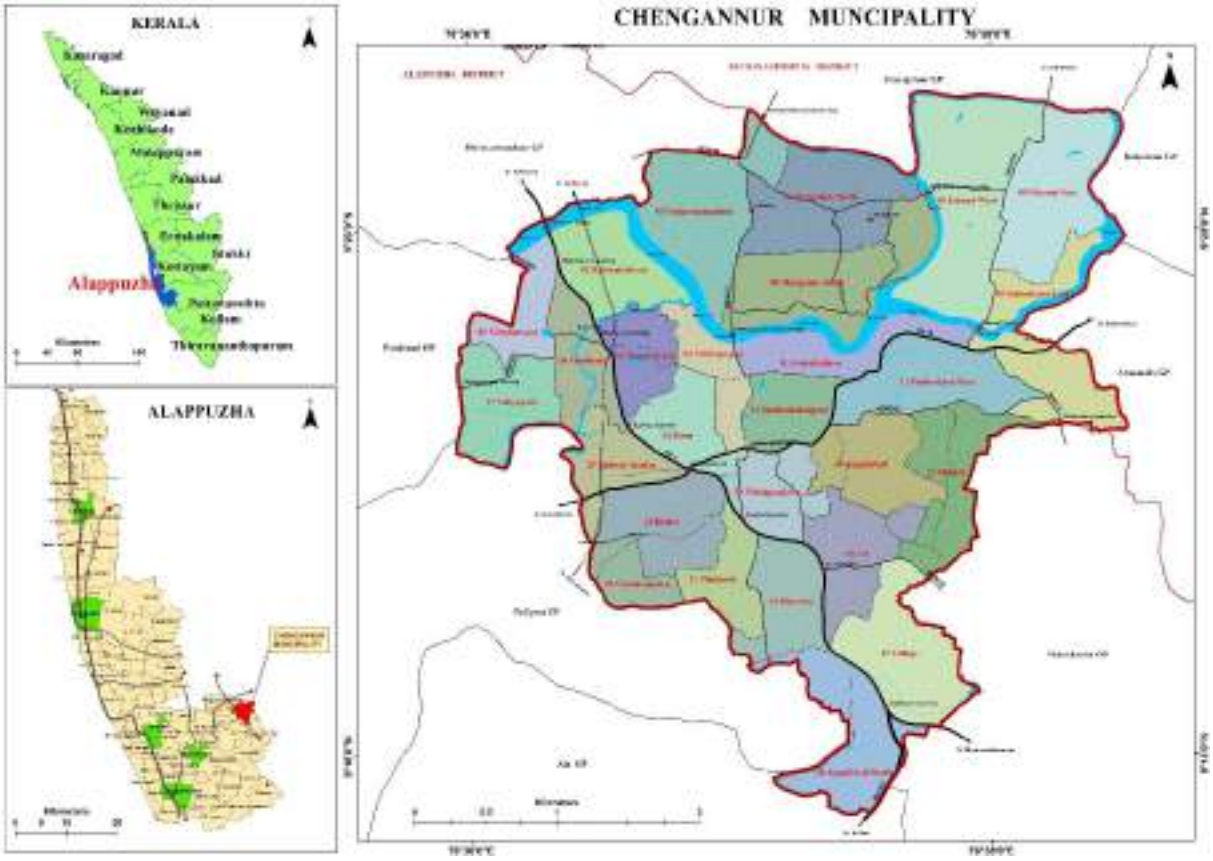

Figure 2:1 Location of Chengannur Municipality

The nearest towns are Pandalam to the South, Thiruvalla to the North, Mavelikara to the West and Aranmula, Kozhencherry, and Pathanamthitta to the East. Chengannur is well connected by road and rail. SH-1 popularly known as the Main Central (MC) Road passes through the heart of the town and connects Chengannur to Thiruvananthapuram and Kottayam. The Chengannur-Kottayam stretch of the MC Road is also a part of the NH-220 which stretches between Kollam and Theni. Another major road is the SH-10 which connects Chengannur to Mavelikara and Aranmula.

The Municipality of Chengannur is bordered by the grama panchayats of Thiruvanvandoor (Alappuzha district), Kuttoor and Eraviperur (Pathanamthitta district) to its North, on its South by Mulakkuzha and Ala grama panchayats (Alappuzha district), on its

East by Koyipram and Aranmula (Pathanamthitta district) grama panchayats and on its West by Puliyoor and Pandanad (Alappuzha district) grama panchayats as shown in Figure 2:2.



Figure 2:2 Chengannur Municipality & Surrounding LSGIs

2.2 Area and Population

Chengannur Municipality consist of the revenue village of Chengannur, Pandanad (part) and Mulakkuzha (part). Presently, the limits of the Municipality extend to an area of 13.06 sq km. with 27 wards having a population of 23,466 as per Census of India 2011, of which 10933 were male & 12533 were female. Population of children of age group 0 to 6 were 2112, of which 1107 were boys and 1005 were girls as per 2011 census.

2.3 Climate

The climate is generally hot and humid. The highest temperature is 41.1°C & lowest temperature is 28.8°C during summer and it is 31.1°C & 24.4°C respectively during winter. The annual average rainfall is 2488mm (Nammal Namukkayi Durantha Nivarana Asoothrana Rekha, 2020). The dry seasons lasts from December to February. It is characterised by moderate humidity and occasional rains. The days are fairly hot but the nights are cool. Hot season lasts from March to May. Fairly high temperature, occasional showers and thunder storms are the characteristics of these months. South-west monsoon begins in June and lasts till September. Maximum rainfall is in the month of June. The monsoon weakens about the middle of August. North-west monsoon is in the months of October and November. During the season, rains are generally preceded by thunder storms. By the beginning of December, the rain becomes less frequent and dry weather sets in.

During 2018, entire Kerala has seen an abnormally heavy rainfall which leads to flood in different locations of Kerala. Other than Kuttanad region the most affected region during mega

flood 2018 was Chengannur. Chengannur region has faced a flash flood due to its position and physiography. But due to the presence of number of distributaries this flood water removed very fast. In 2019 also Chengannur region has faced a similar flood situation but whose intensity was less. Generally, Chengannur region has two monsoon seasons but due to the mega flood of 2018 climatic studies needs more attention.

2.4 Physiography

Based on physiography, Kerala is divided into three regions namely highland, midland and lowland. Chengannur town falls within the low land regions of the state. The Municipality is situated on the banks of Pampa river. Illimala-Moozhikkal thodu, Vettu thodu etc are the main canals running through the municipal limit. The secondary canals are used to serve as natural drainage channels in the town, but today they are in an advanced state of deterioration through silting and waste dumping. Some part of the town is water logged with considerable extent of paddy fields. Even it is in the low land region, its geographic location is very close to mid land region also. Hence it shows the properties of Midland area too. In another classification Alappuzha district falls under three micro sub regions, i.e Alappey coast, Kuttanad low lying plain and Chengannur rolling plain etc.

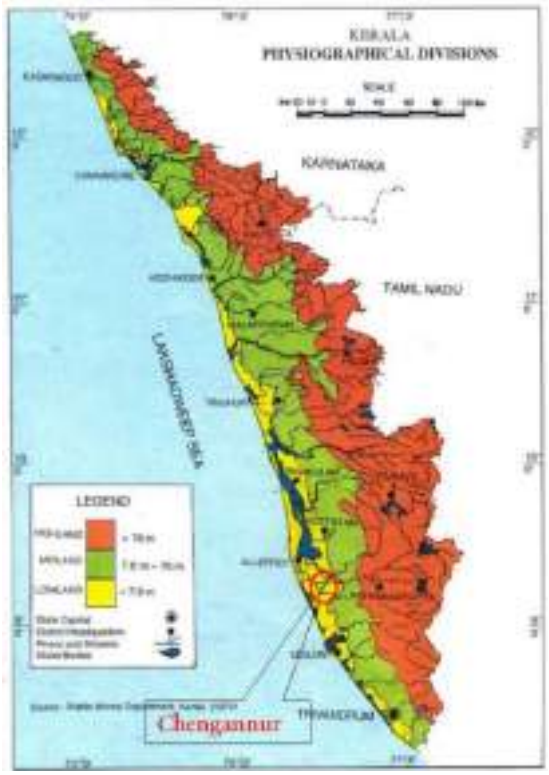

Figure 2:3 Physiographical Divisions of Kerala



Figure 2:4 Lithology map of Chengannur

Source: Author generated based on LRIS data

According to the lithology map of Chengannur, the major part of the town is covered by laterite and syrite soil. The western part of Chengannur town has alluvial soil. The southern part of the town is characterised by laterite soil and northern part by syrite soil. The water table is relatively high in this region.

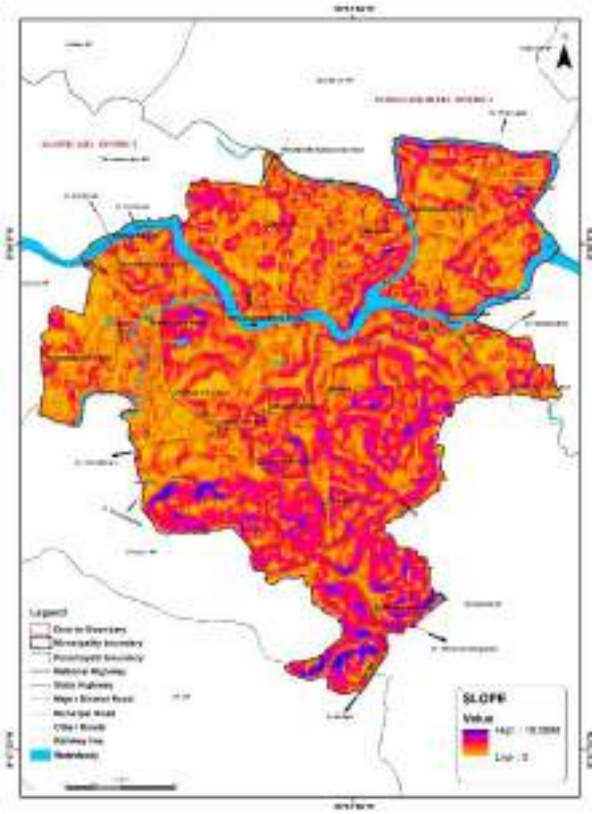

Figure 2:5 Slope profile



Figure 2:6 Contour Map

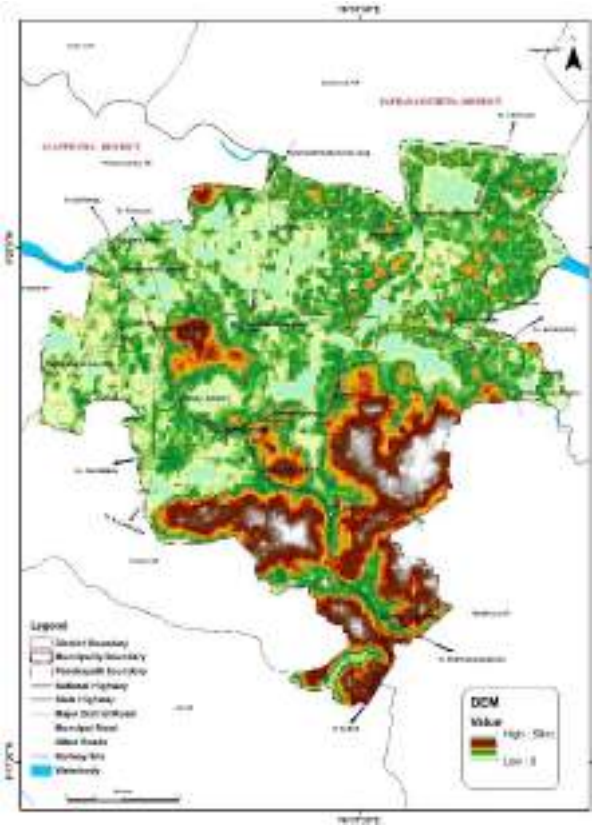

Figure 2:7 Digital Elevation Model



Figure 2:8 Triangulated Irregular Network
Source: Author generated based on LRIS data

Figure 2:5 to Figure 2:8 shows the Slope, Contour, Digital Elevation Map and TIN of Chengannur. The elevation pattern shows that the southern part of Chengannur is more elevated with rocky structures than the lower lying northern side with marshier land.

2.5 History of the Town

Chengannur means land (ur) of the red (Chenga) soil. This soil is different from the soil of surrounding Kuttanad, hence the name "Chengannur". It is believed that in the prehistoric era, Chengannur was known as "Shonadri" which means Red Mountain and which is later transformed as "Chenkunnu" and Chengannur later. In early modern period, Chengannur was a part of Kayamkulam dynasty and which is later came under Travancore kings when Kayamkulam was ceded by Marthandavarma in 18th Century.



Figure 2:9 Anizham Thirunal Marthanadavarma

Marthandavarma gave special kshathriya's privillages to Namboothiri Madam in Chengannur which is known as Vanjipuzha Chiefs. They had a palace situated near the river Pamba. The palace had close architectural similarities to that of Thrichitatt Maha Vishnu Temple. Vanjipuzha Chief has a relevant position in the history of Travancore and they had the right to sit along with Maharaja of Travancore. They were appointed protectors of the temples at Vaikom and Chengannur.

Cheran empire history shows Chengannur as one of the most important townships of their times. The Chengannur Mahadevar Temple is a very important place of worship since olden times. There are several old sayings and historical facts associated with the temple. The temple is famous for the Menses period of goddess Parvati. This period is considered very auspicious. Chengannur Bhagavati Temple is one of the oldest Mahakshethrams (big temples) of Kerala. The temple is dedicated to Goddess Parvati. For centuries, Chengannur temple was described as Nayanar Thiruchenkuntoor Kovil. The deity is seen facing west and Lord Shiva is seen facing east. The image of the deity is made in panchaloha. Varada and abhaya postures are depicted by the Devi. The specialty of the Bhagavati temple is that the deity gets menstrual period, a phenomenon that is not heard of in any other temples. This phenomenon still continues. The priest performs the daily ritual of changing the clothes worn by the deity. If upon inspection, there are signs of bleeding, the priest sends the petticoat to the traditional residence of the temple Tantri (female priest) to confirm to be the blood of menses. This stained petticoat is then sold to the public as a blessing from the deity. The shrine remains closed during the three days and the fourth day is celebrated as the festival called the 'Thripoothe Arattu'. Legend tells that Shiva and Parvati came to reside at this place during the goddess's menstrual period. The temple is built



Figure 2:10 Chengannur Mahadeva temple

in Kerala style architecture in six acres. The front side of the Shiva sanctum is made low in order to prevent the devotees from having a direct view of the deity. In front of the entrance, lies the Kuttambalam pillar obstructing the view from outside.

Pazhaya Suriyani Pally (Old Syrian Church) of Chengannur is an ancient Syrian Christian church of Kerala. It is considered as one among the oldest still standing church buildings in Kerala and across IndiaIt is believed that the church was built about 1650 years ago. The structure of the church building certifies that it is very old. Architectural style is a blend of 18th Century Christian and Hindu temple architecture and something fast disappearing from Kerala landscape. Its gopuravathil, nadapanthal, kalluvilakku and doors adorned with carved figurines includes a Hanuman holding a baton. The Church is famous Aval Nercha (offering of sweetened rice flakes) held on every Monday Thursday, for the last four centuries.



Figure 2:11 Pazhaya suriyani pally

Chengannur is a famous place by all means. The famous "Mills Mythanam"(this history of central Travancore's Indian Independents movement participation related activities took place at Mills Mythanan (presently Chengannur KSRTC Bus stand premises), which is relatively unknown to keralites), Parumala Church, temple for Pandavas - Puliyoor (Bhiman), Thiruchittatu (Sahadevan), Thiruvanvandoor (Nagulan), of course Aranmula temple (Arjunan) is near to Chengannur; Pandavan Para (Giant Rocks of Pandavas at Hill top), Noottavar Para (Giant Rocks of Hundred men) are located in Chengannur. The old name was Chenkunnathu, now known as Chengannur.



Figure 2:12 Veluthambi Dalawa

Pepper, popularly known as "black gold", was a major export item of Chengannur. Angadical (Angadi means market in Malayalam) was the main market in Chengannur. Current Chengannur market is developed by Velu Thampi Dalawa. During 19th century and 20th century, this market played a major role in selling and buying goods produced in eastern region of the state with the coastal part of Kerala.

Chengannur's Munsif court, which recently completed its centenary, was long the most important judicial center of the region. Chengannur Municipality

was formed in the year 1978 April 1 and first elected council formed in 1980 with Shri. P.K John Plammoottil as its First Municipal Chairman.

2.6 Biodiversity of Chengannur

Chengannur town falls mostly within the low land regions of the state. It is situated on the banks of Pamba river. In addition to that small canal such as Vettu thodu, Illimala – Moozhikkal thodu etc. are running in the limit of Chengannur Municipality. These secondary canals are used to serve as natural drainage channels in the town, but today they are in an advanced state of deterioration through silting and waste dumping. Some part of the town is water logged with considerable extent of paddy fields.

The major part of the town is covered by laterite soil. The western part of Chengannur town has alluvial soil. The eastern part of the town is characterised by clayey soil. The water table is relatively high in this region.

Chengannur depicts a typical Kerala town. The prominent crops in the municipal area are rubber and mixed crops. The paddy field area has largely been filled up for construction purposes and the dry cultivation area is also converted. During the rainy season, rains are generally preceded by thunder storms. By the beginning of December, the rain becomes less frequent and dry weather sets in.

2.7 Inference

Chengannur Municipality extend to an area of 13.01 sq.km with 27 wards having a population of 23,466 as per Census of India 2011. Moderate rainfall, warm humidity of atmosphere and a fairly uniform temperature throughout the year are the characteristic climatic features of the town. Chengannur town falls within the low land regions of the state. The general flat terrain with gentle slopes of the town is the peculiar geographic feature of the town. Even it is in the low land region, it's geographic location very close to mid land region. Hence Chengannur shows midland characteristics also. Chengannur is 7m above the mean sea level, but high-altitude places are also seen in the Municipality vicinity. The major part of the town is covered by laterite and syrite soil and the western part of Chengannur town has alluvial soil. Chengannur town is located on the banks of Pamba river. Illimala-Moozhikkal thodu, Vettu thodu etc are the main canals running through the municipal limit. One of the main reasons for the 2018 flood in these areas were the blockage in flow of water from the Pamba through canals (thodukal) in the area. These canals have nature's own drainage system for draining rainwater from land into rivers. Rejuvenation of these canals is one of the methods to mitigate the impact of major floods in the future. In 2018 flood disaster happened in Chengannur due to submergence of Pamba river. This was happened due to continuous rainfall in the Chengannur region and the catchment area of Pamapa river. Hence climatic studies are more important and needs special attention.

3 REGIONAL SETTING

3.1 Regional Significance

The regional setting of a Town can be arrived at only 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 Alappuzha district in connection with the Scheme of Preparation of Development Plans for Municipalities, which has been documented as the District Urbanisation Report (DUR). 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 Chengannur Town has been brought out with clarity in both DUR and IDDP and is explained hereunder.

As per the State urbanization report of Kerala published in 2012, Chengannur Municipality is envisaged as a 5th order hierarchy urban centre, where other Municipalities of Alappuzha district such as Cherthala & Kayamkulam Municipalities included as 4th order hierarchy and Alappuzha Municipality is referred as 3rd order hierarchy in the report.

3.2 Spatial Structure of the District & Role of Chengannur Town

Spatial structure of the district is a derivative of the inputs from the analyses 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 as per the District Urbanisation Report 2011 is represented in Figure 3:1. This structure is a representation of the reflection of various aspects in the district. It may be stated that these aspects are influenced by factors both within and outside the district. Alappuzha, geographically being a small district, the economics and developments are highly influenced by external forces. The spread effect and backwash effect of developments in towns in immediate proximity of the district impart considerable influence on the spatial structure of the district.

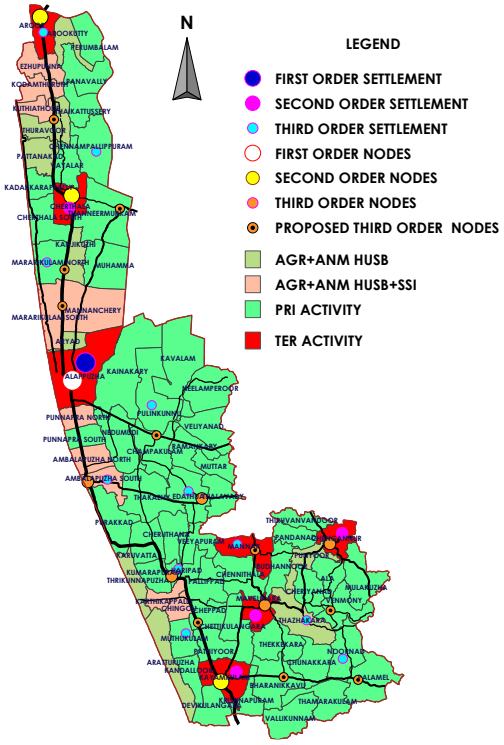

Figure 3:1 Spatial Structure of Alappuzha District
Source: DUR Alappuzha, 2011

3.2.1 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 found 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. Combining the various activity patterns, the final activity pattern of the district is evolved.

Table 3-1 Combinations in Activity Pattern

Urban Profile	Land use concentration Pattern	Functional Classification	Main Activity
Urban	Non-Agriculture	Urban	Tertiary Activity
Urban	Agriculture	Semi-Urban	Agriculture +Small Scale Industries + Animal Husbandry
Urban	Agriculture	Semi- Rural	Agriculture + Animal Husbandry
Urban/Non-Urban	Agriculture	Rural	Primary Activity

Various activity patterns result from combinations of the components under consideration. According to the district urbanization report Chengannur town shows tertiary activity as shown in Figure 3:2. If the character of a settlement is urban as per urban profile, non-agricultural as per land use concentration and urban as per functional classification, then the settlement can be grouped in tertiary activity. The workforce is predominantly non-agricultural. There is concentration of non-agricultural land uses. If the character of settlement is agricultural as per land use concentration and rural as per functional classification, even though the urban profile may categories as rural or urban, activity predominant is termed as primary activity. Settlement with land use concentration pattern as non-agriculture/urban, semi urban in functional classification and urban in urban profile have secondary activity as most suitable activity. The work force dominating is non agricultural.

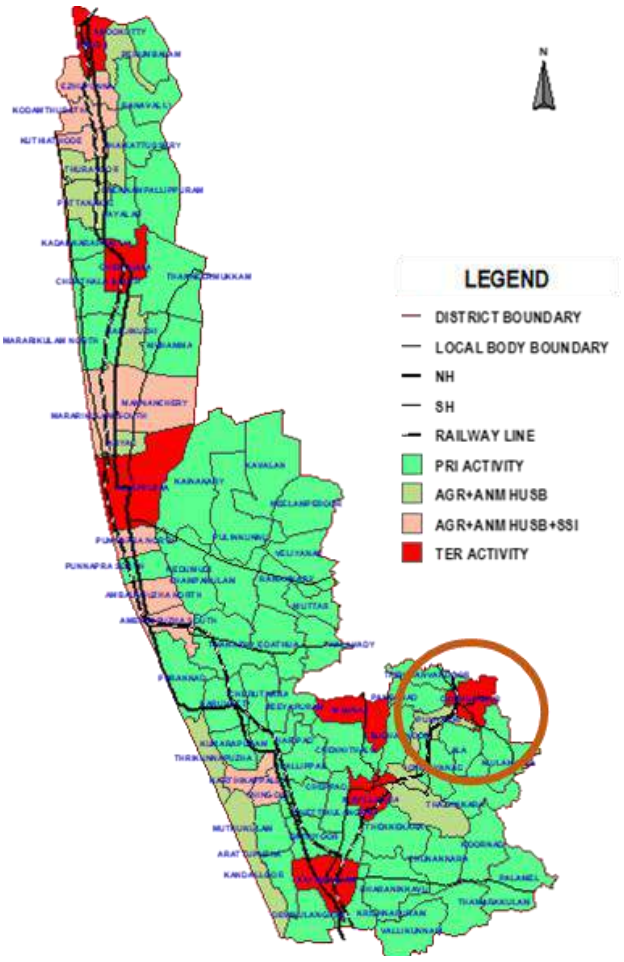

Figure 3:2 Activity Pattern of Alappuzha District
Source: DUR Alappuzha, 2011

Figure 3:3 shows the functional character of settlements as per district urbanization report of Alappuzha 2011. Chengannur Municipality shows rural nature along with Haripad. Other Municipalities in the district shows urban nature. Figure 3:4 shows the future urban character of settlements in the district.

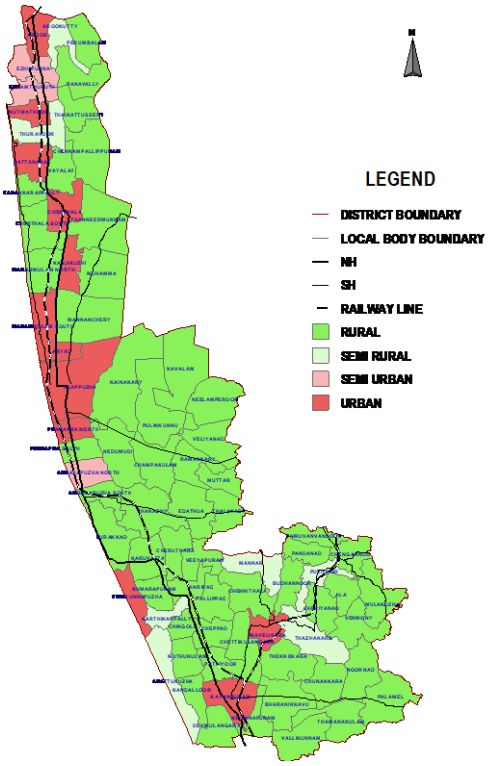

Figure 3:3 Functional Character of settlements in Alappuzha

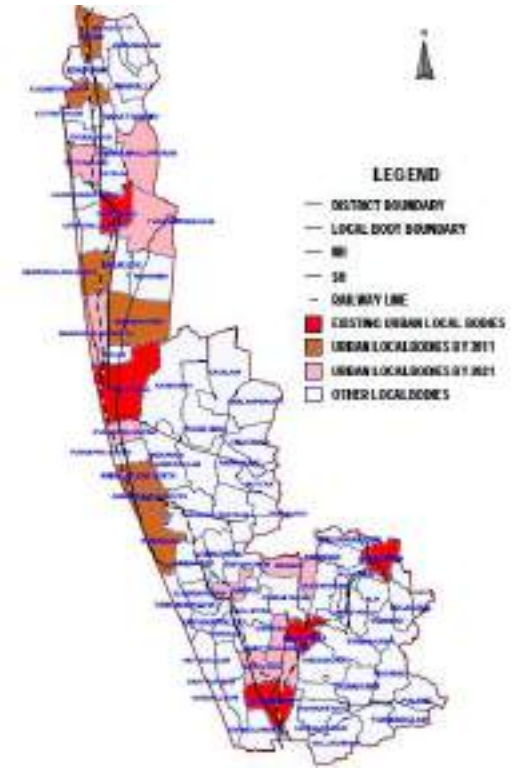

Figure 3:4 Future Urban Character of Alappuzha District
Source: DUR Alappuzha, 2011

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. Considering the ground realities in the district and general applicability, two indicators are taken to assess the connectivity of an area under consideration - existence of a road of the category of NH, SH or District road and the grade of the railway station in the area under consideration. Connectivity by water is applicable to certain areas only and this means of transportation meets only a partial requirement of the area. As mentioned earlier, in determining the proposed hierarchy of settlements, the presence of NH, SH, MDR and



Figure 3:5 Regional Connectivity of Chengannur Town

railway stations are given weightages and this is reflected in the suggested hierarchy of settlements.

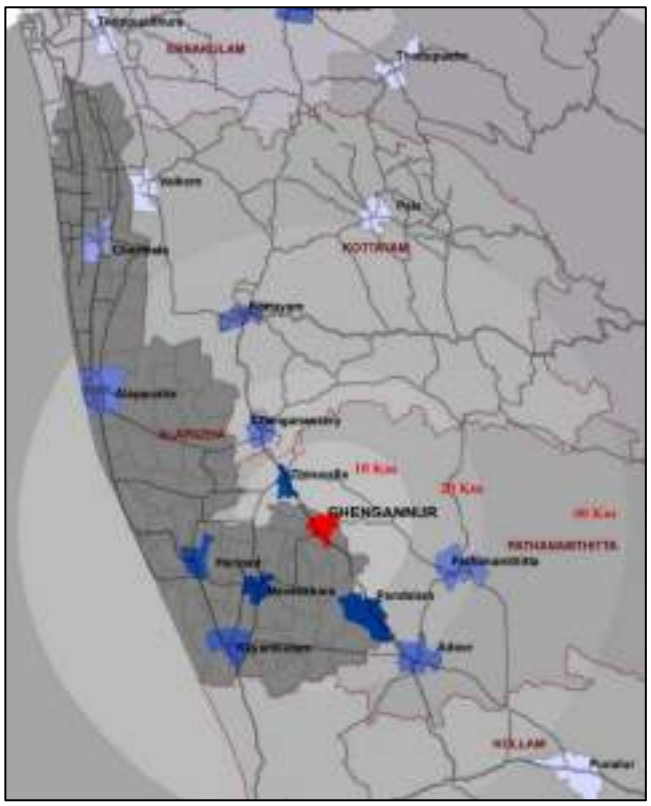

Figure 3:6 Connectivity to nearby towns

Chengannur is well-connected by road and rail. State Highway 1 (SH-1), popularly known as the MC Road, passes through the heart of the town and connects Chengannur to Thiruvananthapuram and Kottayam. The Chengannur - Kottayam stretch of the MC Road is also part of the NH 183 which stretches between Kollam and Theni. Another major road is the State Highway 10, the Mavelikara – Kozhenchery road, which connects Chengannur to Mavelikkara and Sabarimala. Chengannur Railway Station is a major railway station in Thiruvananthapuram railway division of the Southern Railway Zone. It caters to the needs of two districts, viz. Alappuzha and Pathanamthitta. Recently, the station has been declared as "The Gateway to Sabarimala".

3.4 Inference

Chengannur town is a second Order settlement in the district. On analysing the functional character, Chengannur exhibits rural character. The LSGIs surrounding Chengannur except Puliyoor are also rural in nature. Puliyoor grama panchayat exhibits a semi-rural nature. The activity pattern of Chengannur town is tertiary activity whereas all the grama panchayats surrounding the town exhibit primary activity. This indicates that the character of Chengannur town is urban as per urban profile, non-agricultural as per land use concentration and rural as per functional classification. Hence the planning area for Chengannur town is delineated as the Chengannur Municipal Area. The connectivity patterns show that Chengannur municipal town, being one of the revenue divisional headquarters and commercial centre serving the entire district acts as the third 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 Chengannur Municipality.

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 endeavour. The chapter presents a detailed overview of the demographic profile of the city and its overall position with reference to the state and district. It also describes population growth trends, spatial distribution and other demographic characteristics of the city. In addition to that considering the floods of 2018, affected population is also discussed.

4.1 Population

Total population of Alappuzha district as per 2011 Census is 2127789, 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 Chengannur Municipality with an area of 14.68 sq. km. is 23466.The land use survey during 2018-19 showed the area as 13.06 sq km, thus for this study the area of 13.06 sq km is used. This is 1.1% of the total district population of Alappuzha (2127789) and 2.04% of the total urban population of Alappuzha district (1148146). The population from 1971 to 2011 of Alappuzha and Chengannur Municipality is shown in Figure 4:1.

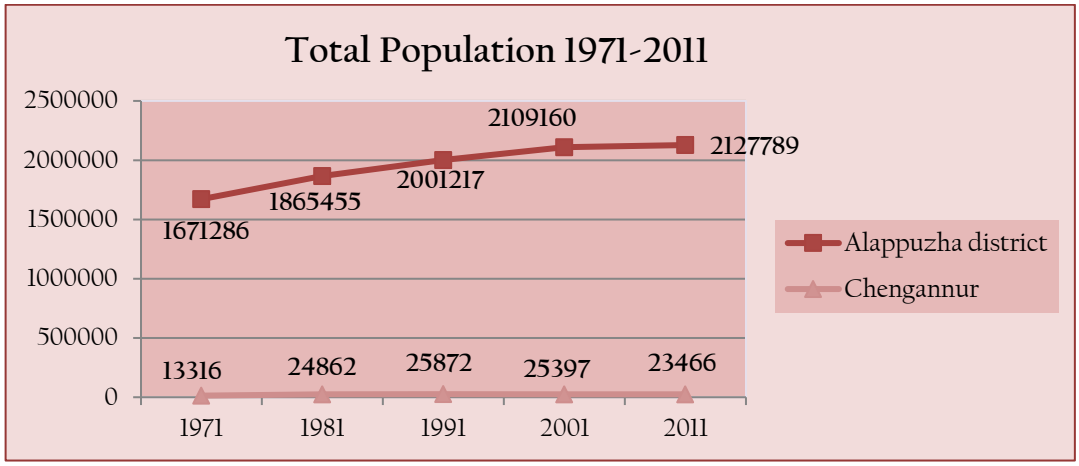

Figure 4:1 Population Comparison with district

Chengannur Municipality has 27 wards. The population of the wards are given in Table 4-1. The highest population is in Ward No. 25, Railway station with 1117 and lowest population is in ward no.1 1, Arattukadavu with 667 persons.

Table 4-1 Ward wise Population

Ward no	Ward name	Population	Ward no	Ward name	Population
1	Mundankavu	686	15	Malayil	873
2	Kodiyattukara	839	16	ITI	806
3	Temple ward	737	17	College	913
4	Mithrapuzha	805	18	Angadickal South	881
5	Vazharmangalam	900	19	Hatchery	1040

6	Mangalam South	952	20	Moolappadavu	956
7	Mangalam North	866	21	Thittamel	936
8	Edanadu West	716	22	Pandavanpara	941
9	Edanadu East	679	23	Bethel	843
10	Puthenkavu East	808	24	Town	1029
11	Arattukadavu	667	25	Railway Station	1117
12	Puthenkavu West	1071	26	Vandimala	766
13	Sasthamkulangara	816	27	Valiya Palli	846
14	Angadickal	977			

Comparing the population of Chengannur with the neighbouring urban centres (Figure 4:2), it is visible that Chengannur has the lowest population.

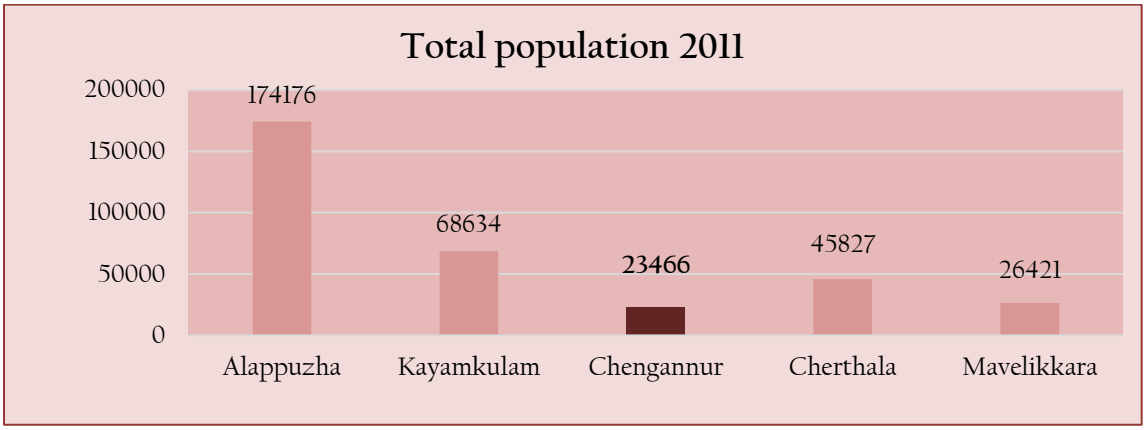

Figure 4:2 Comparison of Population with neighbouring areas

4.2 Population Growth Rate

During 2001-2011, the decadal growth rate of population of Chengannur town is -7.6 which is very low when compared to the district average of 0.88. Considering the period from 1981-91, 1991-01 & 2001-11 the growth rate is gradually decreasing (Figure 4:3). Comparing with other urban centres of the district the growth rate of the town is the least. The highest growth rate is for Cherthala town which is shown in Figure 4:4.

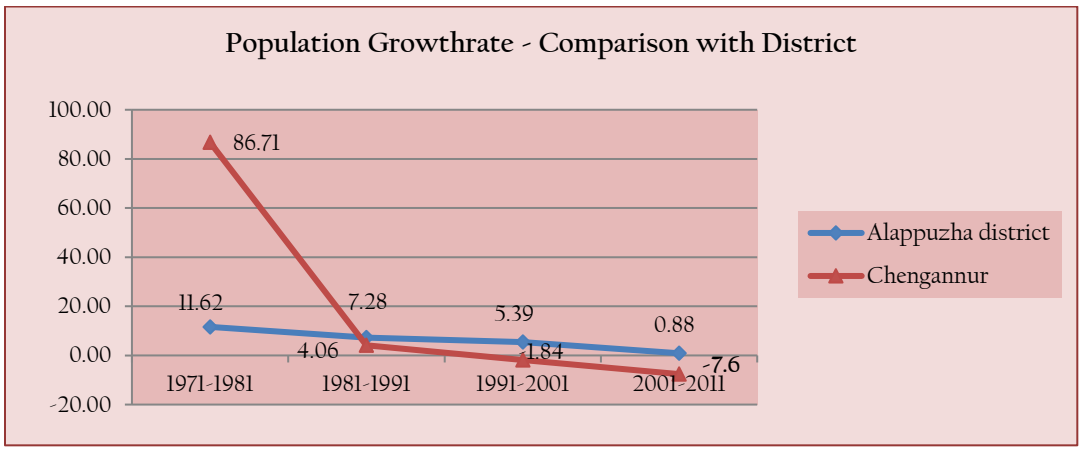

Figure 4:3 Population Growth rate Comparison with District

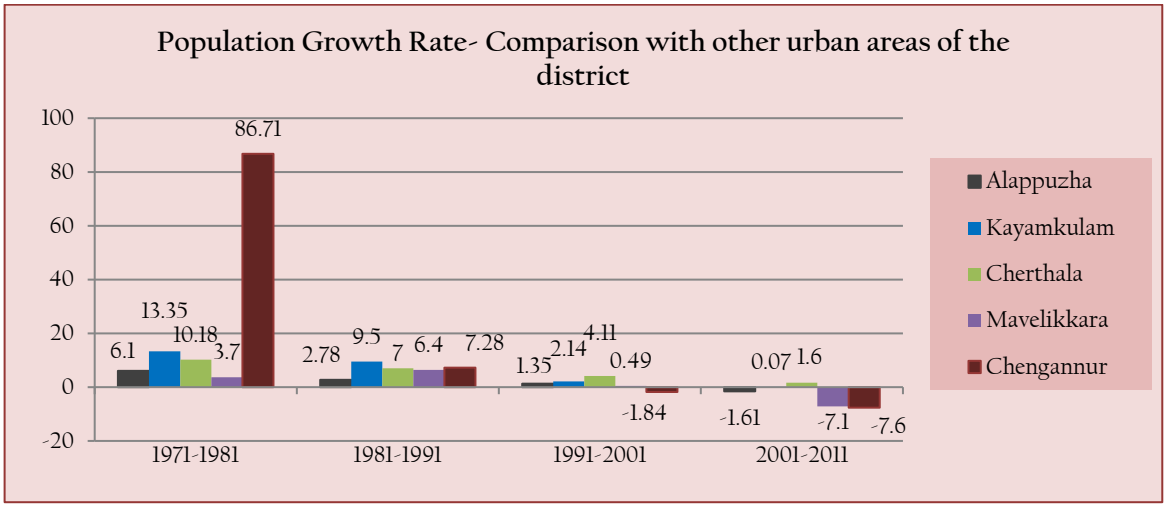

Figure 4:4 Population Growth rate Comparison with other Urban areas of Alappuzha

Compared to the neighbouring LSGIs the town has very low population growth rate because of its outward migration which is shown in Figure 4:5.

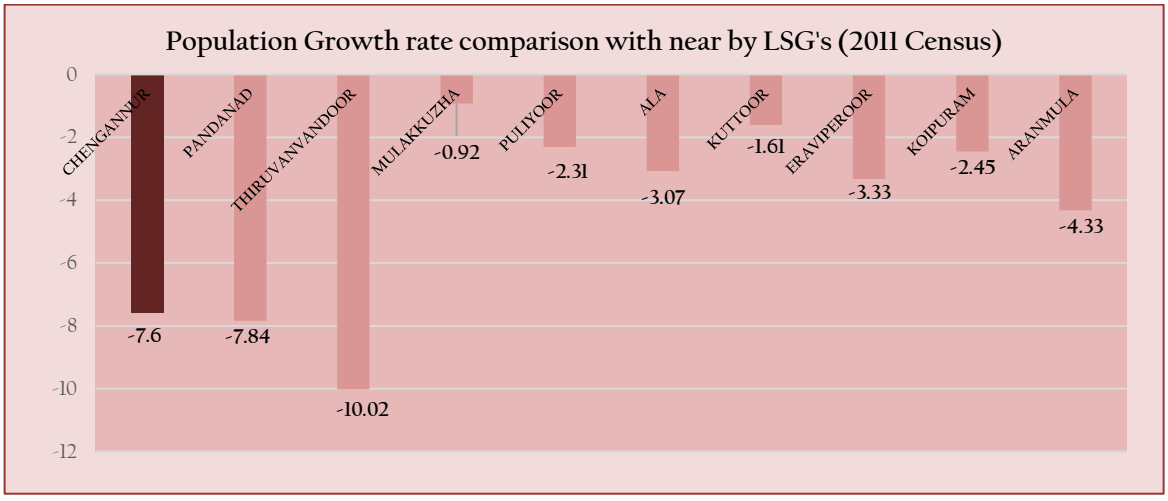

Figure 4:5 Population Growth Rate Comparison with nearby LSGIs

The comparison of population growth rate (2011 Census) of Chengannur and the other towns is shown in Figure 4:6. Negative growth rate is seen during 1991-2001 & 2001- 2011 period, this maybe because of the Out-Migration in search for better education and employment facilities. (As per Socio-economic survey 2013)

4.3 Population Density

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 gross population density of urban areas of Alappuzha district is 3180 persons per sq. km which is almost double the average density of the district (1502). The gross density of population in Chengannur town is 1607 which is least among the urban centres of the district (Figure 4:7). Comparing with the surrounding LSGIs Chengannur Municipality has the highest gross density (Figure 4:8).

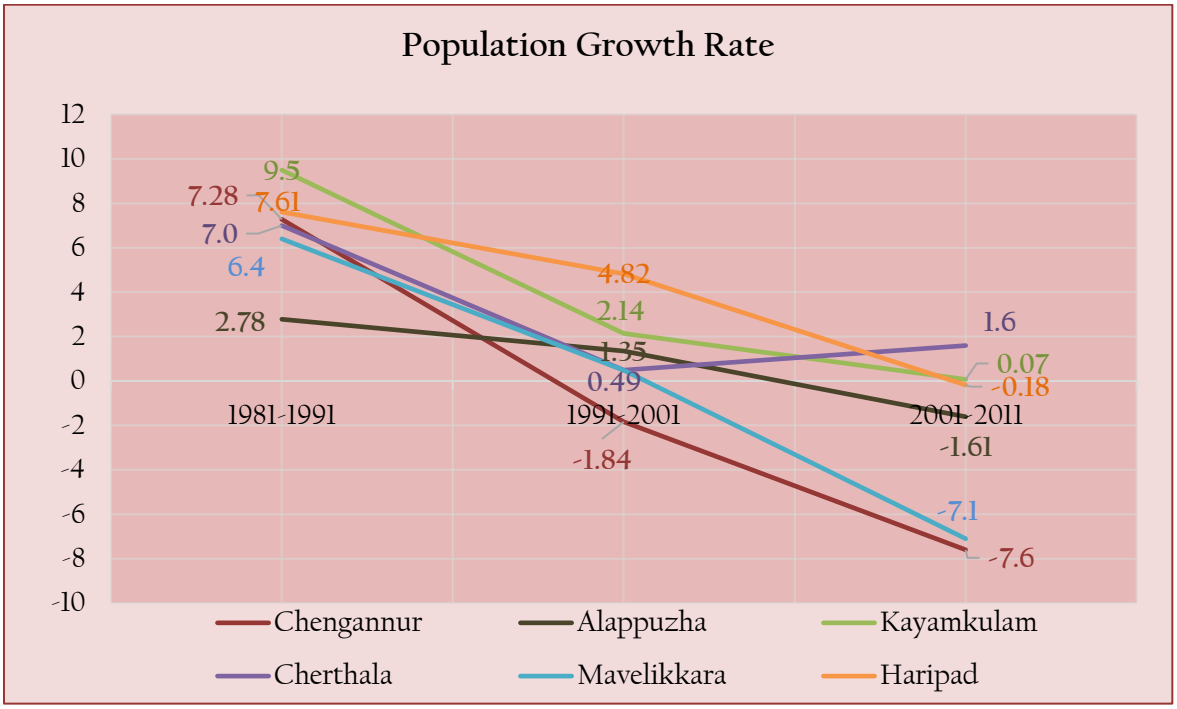

Figure 4:6 Population growth rate comparison with other towns

The density and population of the wards are tabulated in Table 4-2, the highest density of above 3000 is seen in ward numbers 25, 21, 24 and 22 (Railway Station, Thittamel, Town and Pandavanpara wards). Pandavanpara houses the largest colony of the Municipality, and has a smaller area thus causing the high population density.

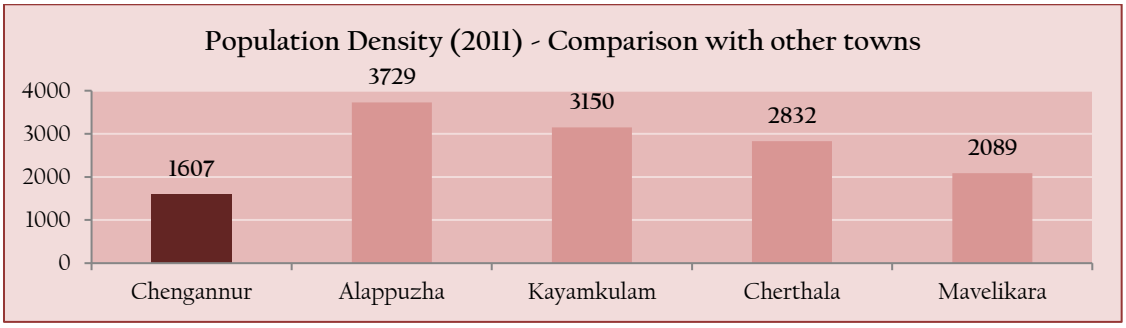

Figure 4:7 Population Density- Comparison with other urban areas of district

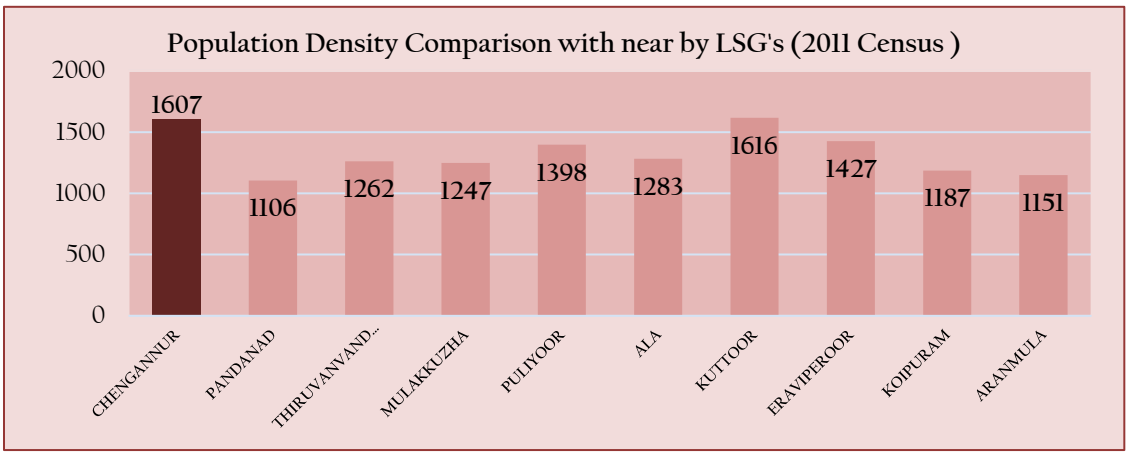

Figure 4:8 Population Density- Comparison with neighbouring LSGIs

Table 4-2 Ward wise Population density

Ward no	Ward name	Area of ward (sq.km)	Population	Gross Population density (Persons per sq.km)	Net Population density (Persons per sq.km)
1	Mundankavu	0.31	686	2186	2710
2	Kodiyattukara	0.53	839	1574	2444
3	Temple ward	0.30	737	2478	2528
4	Mithrapuzha	0.28	805	2920	3174
5	Vazharmangalam	0.76	900	1178	1764
6	Mangalam South	0.80	952	1188	1460
7	Mangalam North	0.69	866	1247	1581
8	Edanadu West	1.06	716	672	924
9	Edanadu East	0.69	679	983	1059
10	Puthenkavu East	0.66	808	1215	1604
11	Arattukadavu	0.38	667	1742	1967
12	Puthenkavu West	0.54	1071	1981	2521
13	Sasthamkulangara	0.31	816	2656	3621
14	Angadickal	0.45	977	2187	2229
15	Malayil	0.50	873	1755	1849
16	ITI	0.44	806	1817	1869
17	College	0.60	913	1518	1706
18	Angadickal South	0.57	881	1545	1635
19	Hatchery	0.39	1040	2633	2633
20	Moolappadavu	0.35	956	2733	2897
21	Thittamel	0.28	936	3366	3368
22	Pandavanpara	0.21	941	4456	4731
23	Bethel	0.48	843	1748	2065
24	Town	0.34	1029	3020	3402
25	Railway Station	0.33	1117	3380	3701
26	Vandimala	0.34	766	2229	2513
27	Valiya Palli	0.44	846	1922	2468
	Total	**13.06**	**23466**	**1797**	**2126**

4.4 Spatial Distribution of Population

The municipal area has been divided into 27 electoral wards as per the ward division in 2010. It ranges from 667 to 1117. Puthenkavu West (12), Hatchery (19), Railway Station (25) and Town (24) are the most populous wards. The spatial distribution of population is shown in Figure 4:9.

The town has a gross population density of 2126 person per Sqm. The wards, Pandavanpara and railway Station has the highest gross and net population density in the Municipality. The ward wise gross population density varies from 672 to 4456 and net population density ranges from 924 to 4731.

The ward wise distribution of population density is shown in Figure 4:11. From the figure it is seen that the wards with high density are located adjacent to the infrastructure facilities and



Figure 4:9 Ward wise population distribution

major roads except Bethel ward. Strict development control measures are to be exercised in the municipal area.

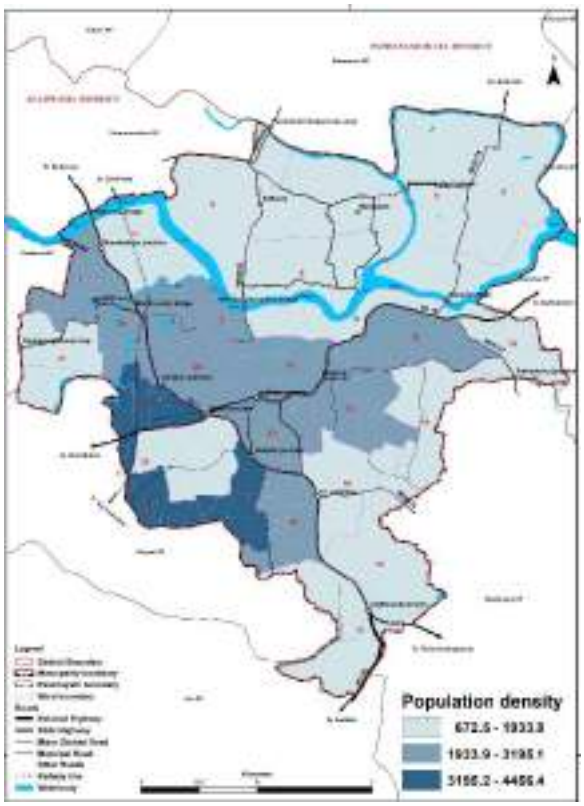

Figure 4:10 Gross Population density of wards



Figure 4:11 Net Population density of wards

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 4:12.

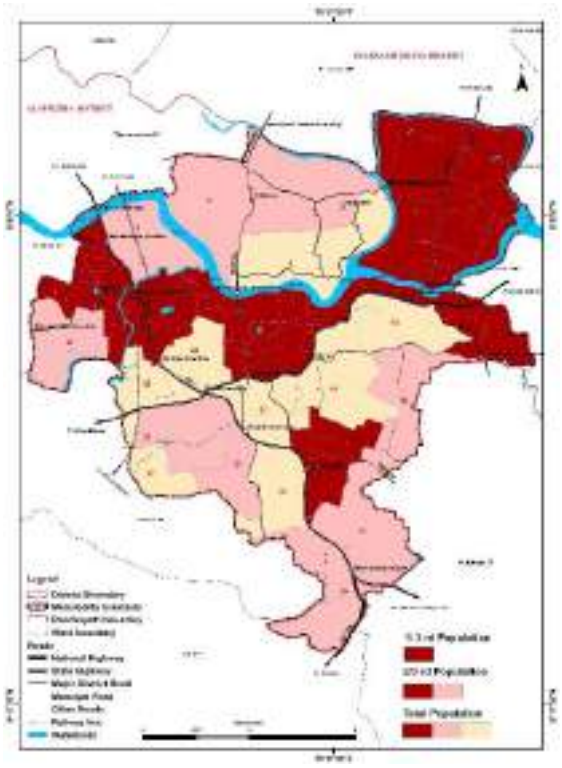

Figure 4:12 Population concentration pattern of Chengannur Municipality

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. The growth and development of women have direct impact on the general well-being of the society. Sex ratio is the most credible pointer towards the status of women in a society.

According to 2011 census sex ratio of Chengannur Municipality is 1146; whereas the sex ratio of the district is 1100. Variation of sex ratio for Chengannur Municipality in the previous decades is given in Table 4-3.

Table 4-3 Decadal variation of Sex Ratio in Chengannur Municipality

Year	1971	1981	1991	2001	2011
Sex ratio in Chengannur	1020	1085	1082	1098	1146

Data indicates that sex ratio of Chengannur Municipality is gradually increasing over the last two decades. Sex Ratio for population in the age group (0-6) in 2011 is 1029 and that for the district is 951. Sex ratios of Chengannur Municipality are higher than that of Cherthala, Kayamkulam and Alappuzha municipalities and lower than that of Mavelikkara Municipality. Sex ratio comparison with urban areas and adjacent LSGIs are shown in Figure 4:13 and Figure 4:14.

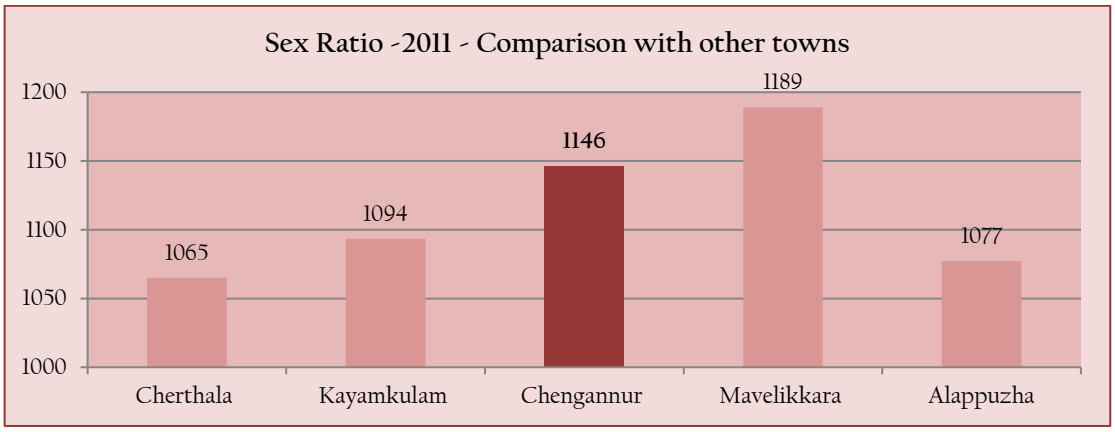

Figure 4:13 Comparison of Sex Ratio in Chengannur with other towns

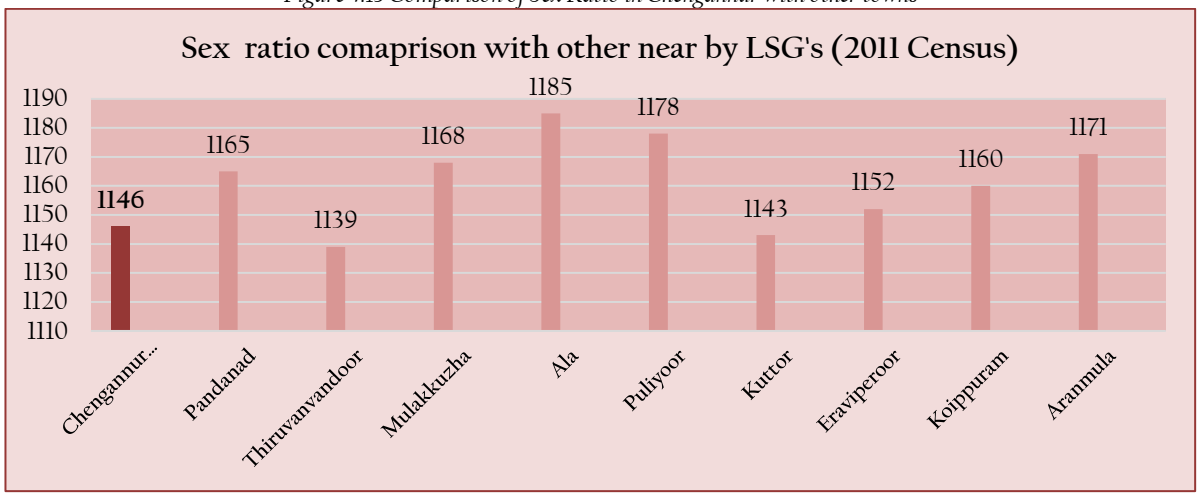

Figure 4:14 Sex ratio comparison with other nearby LSGI's

4.7 Age-Sex Pyramid

A population pyramid, also called an age pyramid or age picture is a graphical illustration that shows the distribution of various age groups in a population, which forms the shape of a pyramid when the population is growing. From the socio-economic survey, the age

structure of people is obtained. The values suggest that majority of people are within the age group of 45 to 50. The age structure is given in Figure 4:15. The age structure shows that the percentage of working population within the age group (20-60) is about 59%.

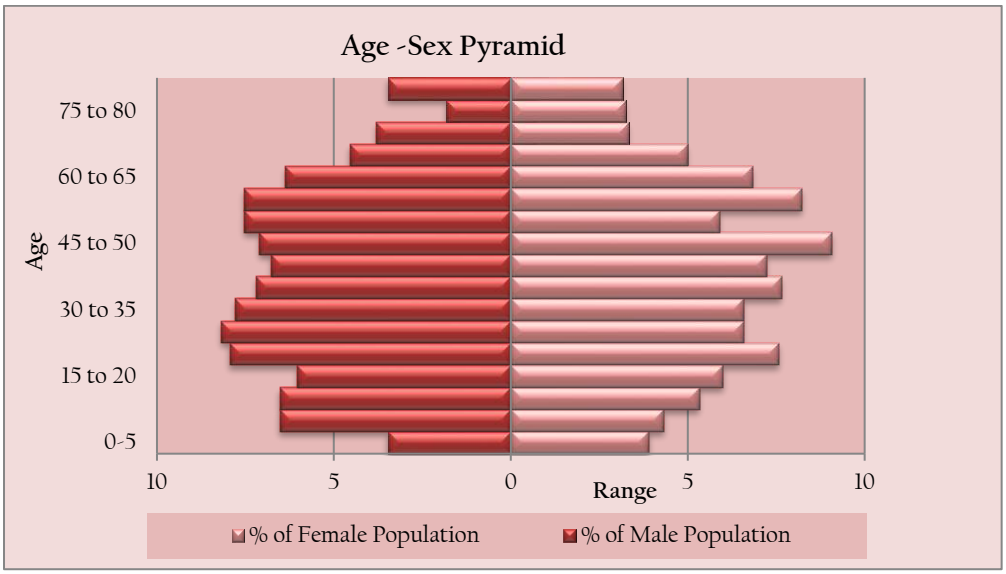

Figure 4:15 Age-Sex Pyramid for Chengannur Municipality

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. The district is also having a high rate of literacy compared to the State average. The Municipality shows a higher literacy rate compared to the state average and district average. The literacy rate of Municipality in comparison with the State and District is shown in Figure 4:16. The literacy rate of Chengannur Municipality is 97.82% as per census 2011; the male literacy rate is 98.35% and the female literacy rate is 97.36%. The literacy rate has increased over the past decades.

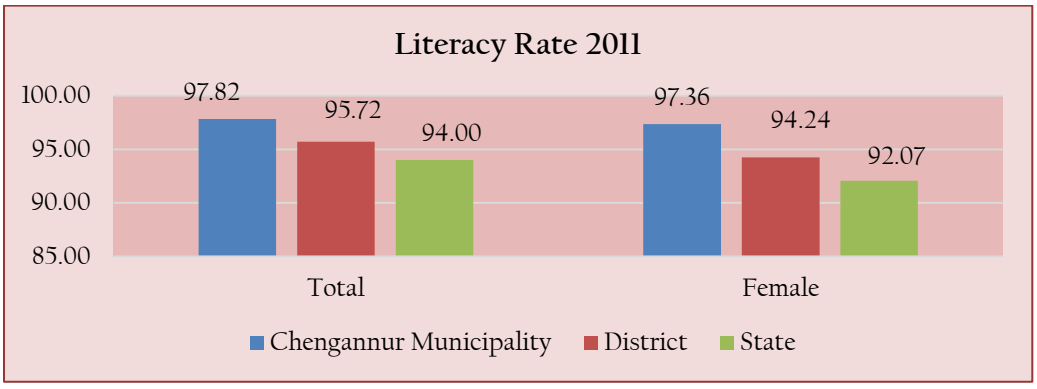

Figure 4:16 Literacy rate – Comparison with district & state

Chengannur has the highest rate of literacy among the municipal towns in the district and has third position when compared to the surrounding LSGI's. The comparison of literacy rate with other urban areas and adjacent LSGI's are shown in Figure 4:17 and Figure 4:18.

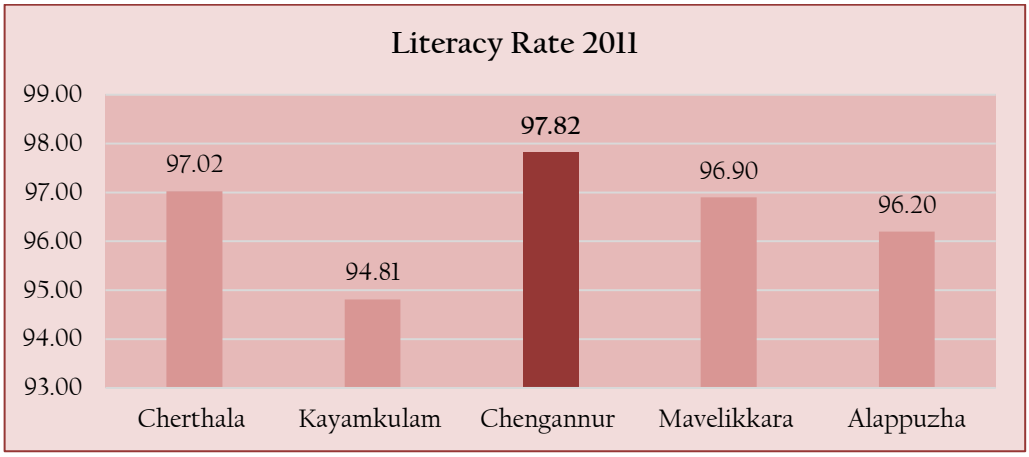

Figure 4:17 Literacy rate Comparison with other urban areas

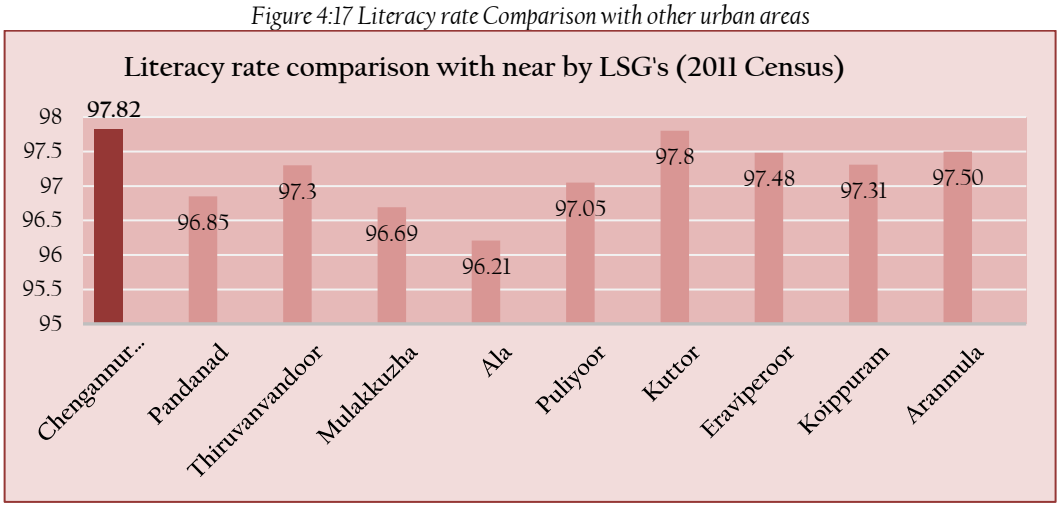

Figure 4:18 Literacy Rate in comparison with nearby LSGI's

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 Chengannur Municipality in 2011 is 6278. The total population being 23466, the average house hold size is 3.74.

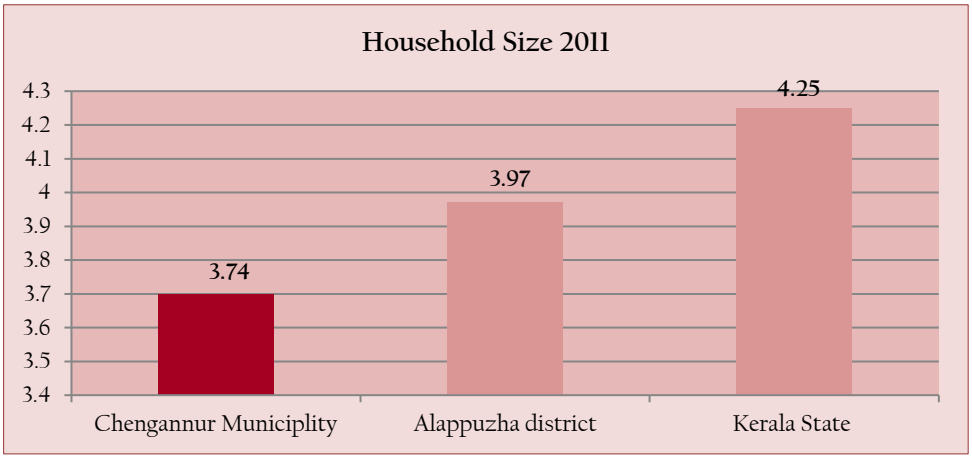

Figure 4:19 Household Size Comparison with District and State

As per census 2001, the household size for the Municipality is 4.18. It is observed that the house hold size is decreasing, the size being reduced to 3.74. This is lower than the average household size for the district (3.97) and state (4.25).

From the socio-economic survey conducted, it is observed that the house hold size is 4. House hold size of other municipal towns in the district is higher than Chengannur Municipality except Mavelikara Municipality as shown in **Error! Reference source not found.**Figure 4:20. The Municipality has fourth place in house hold size compared to nearby LSGIs (Figure 4:21).

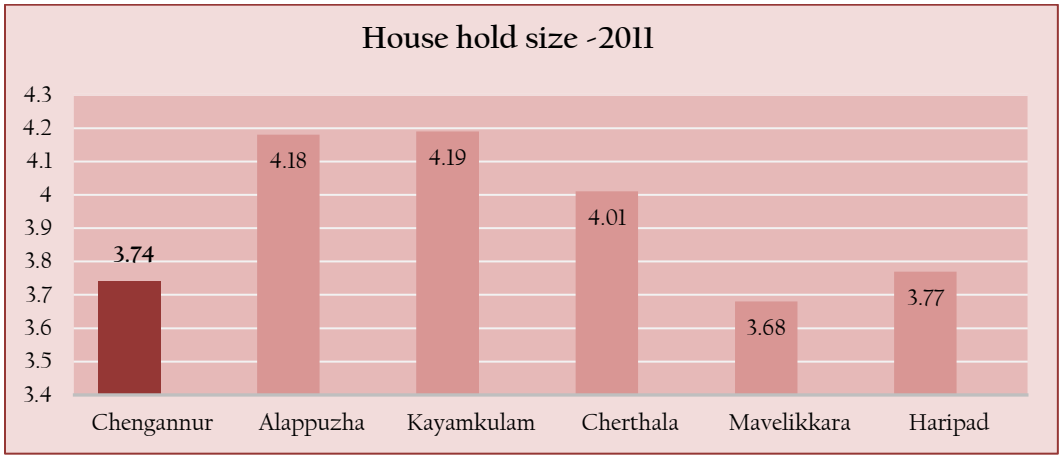

Figure 4:20 Comparison of household size with other towns

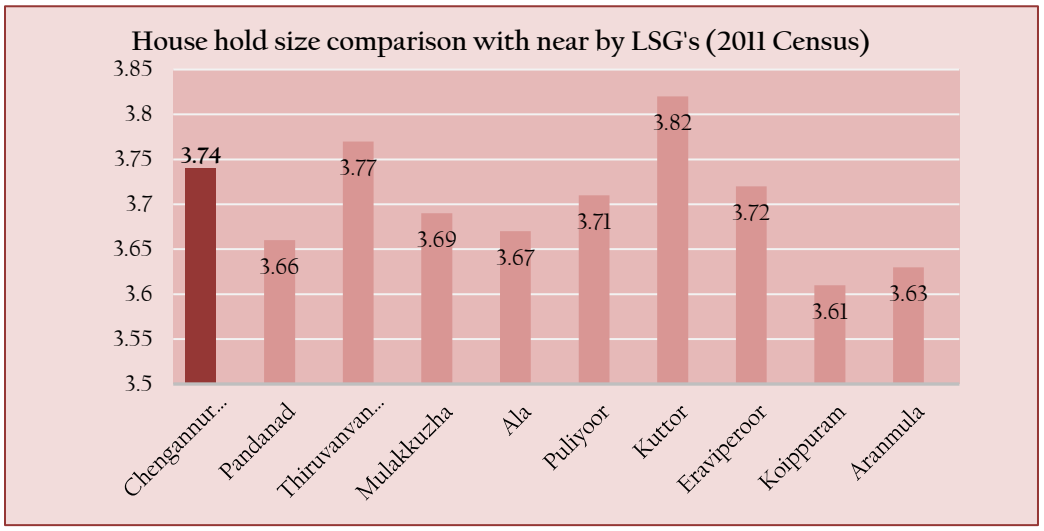

Figure 4:21 House hold size comparison with nearby LSGI's

4.10 Inference

Chengannur has a Population of 23466 which is 1.1% of the total district population of Alappuzha. The population growth rate of the town is showing a decreasing trend. During 2001-2011 the decadal growth rate of population of Chengannur town is -7.6 which is very low when compared to the district average of 0.88. Comparing with other urban centres in the district and the surrounding LSGI's, Chengannur is in the last position in the case of growth rate. The ward wise population density varies from 672 to 4456. The literacy rate is higher than the state average and the district average. The household size is lower than the state average and the district average.

5 EMPLOYMENT

In this chapter, the economic base of Chengannur Municipality 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 Chengannur Municipality as per 2011 Census is 7262. The total workers are further divided into main and marginal workers. The main and marginal workers constitute 25 % and 6 % respectively of the total population. This is shown in Figure 5:1.

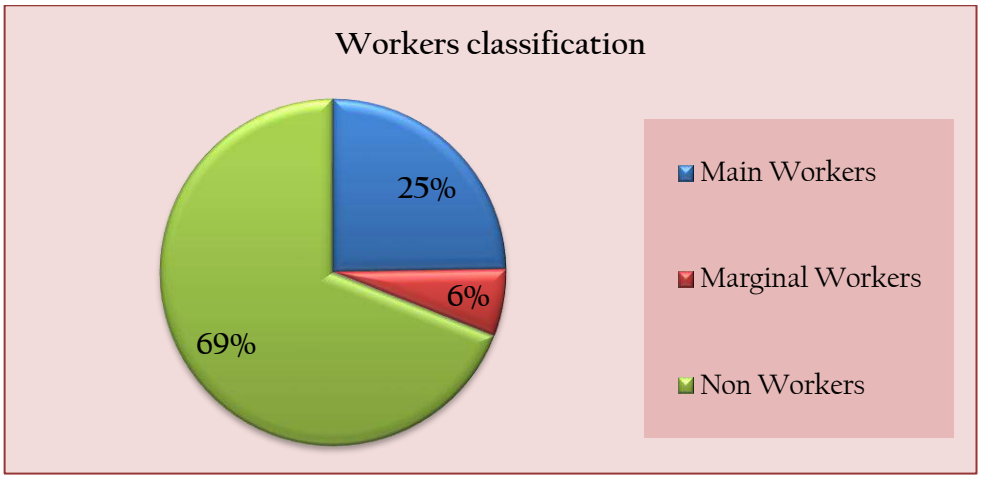

Figure 5:1 Main, marginal & Non workers – Chengannur Municipality

Source: Census of India

There is a significant increase in the total workers and the work participation rate of the town as per the census figures from 1981 to 2011 as the work participation rate has increased from 25.25 in 1981 to 30.95 in 2011. However, there is a slight decrease in the number of total main workers from 1991 to 2011 (Table 5-1 and Figure 5:2). This may be due to the decrease in the number of cultivators and agricultural labourers (from 1601 to 5019).

The decrease in main workers shows an economic instability. But another fact to be noted is the significant share of workers from other states like Tamil Nadu, Orissa, and 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.

Table 5-1 Decadal variation of workers at Chengannur Municipality

Year	Population	Total workers	Main workers	WFPR
1981	24862	6285	6052	25.28
1991	25872	6902	6460	26.68
2001	25397	7043	6047	27.73
2011	23466	7262	5803	30.95

Source: Census of India

The decadal variation of workers shows a slight decrease in main workers from 2001 to 2011 in Chengannur Municipality.

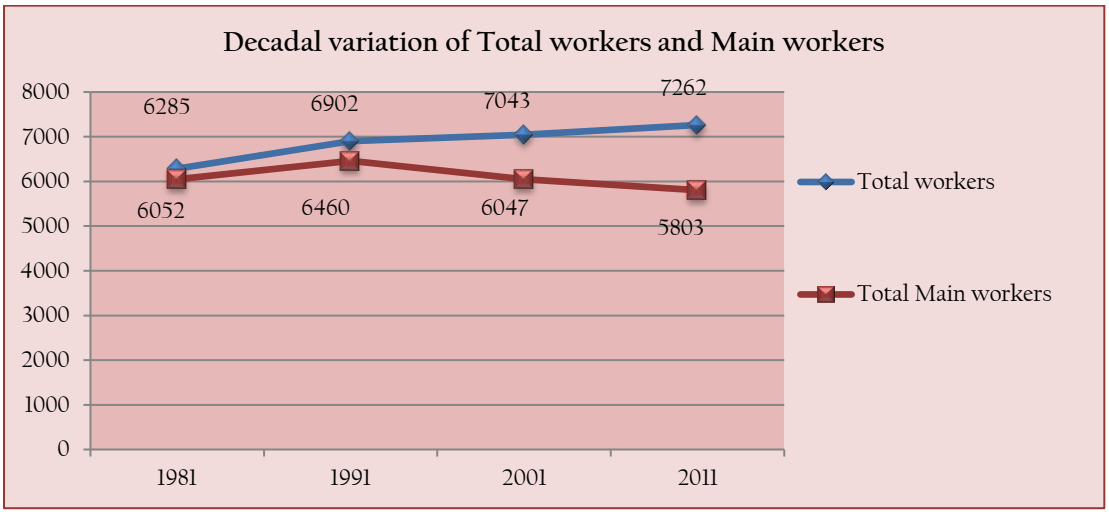

Figure 5:2 Decadal variation of total workers & main

Source: Census of India

Table 5-2 Different types of Employment in Chengannur Municipality

Sl.No.	Type of Employment	No. of Workers
1	Farmers	1899
2	Agricultural labourers	1744
3	Fishermen	89
4	Traditional Workers	1301
5	Daily wage workers	3844
6	Migrant workers	1300
7	Trade/Business	1488
8	Construction worker	698
9	Small scale industries	780
10	Salary based_Government	524
11	Salary based_Private	1125
12	NRIs	2101
13	Others	4461

Source: Local resource Group

5.2 Work force participation rate

The work participation rate of Alappuzha district (37.8%) is higher than that of the state (34.78%) in 2011. The WPR of Chengannur Municipality is 30.95%. Figure 5:3 shows the comparison of the WPR with that of district and state. It is seen that Municipality has low

WPR compared to District and State. The WPR of Alappuzha district is higher than the state and Chengannur Municipality. WPR value of Chengannur Municipality is in second last position compared to other urban local bodies.

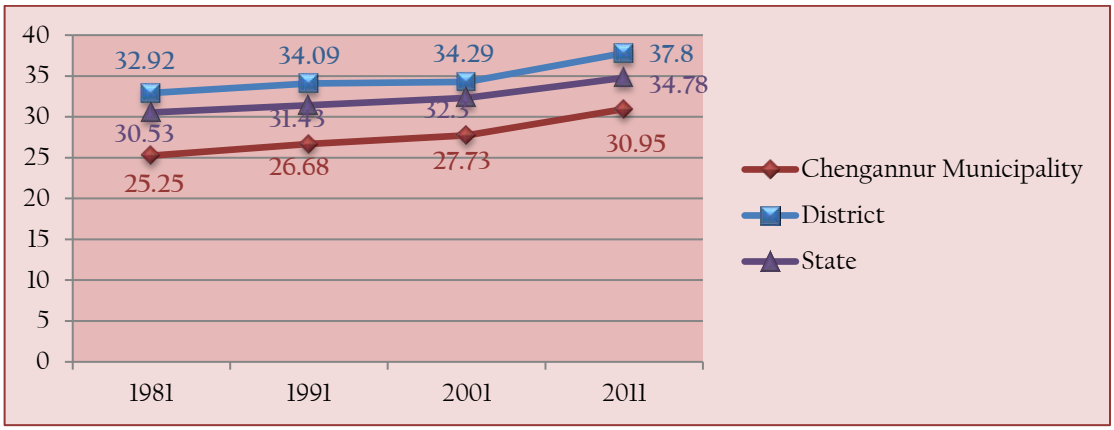

Figure 5:3 Comparison of WFPR with district and state

Source: Census of India

Cherthala and Alappuzha urban local bodies have higher values. The same is lower than the nearby local bodies except Thiruvanvandoor, Eraviperoor, Koipuram and Aranmula. Comparison of WPR of Chengannur Municipality with other urban local bodies and adjacent local bodies are shown in Figure 5:4 and Figure 5:5 respectively.

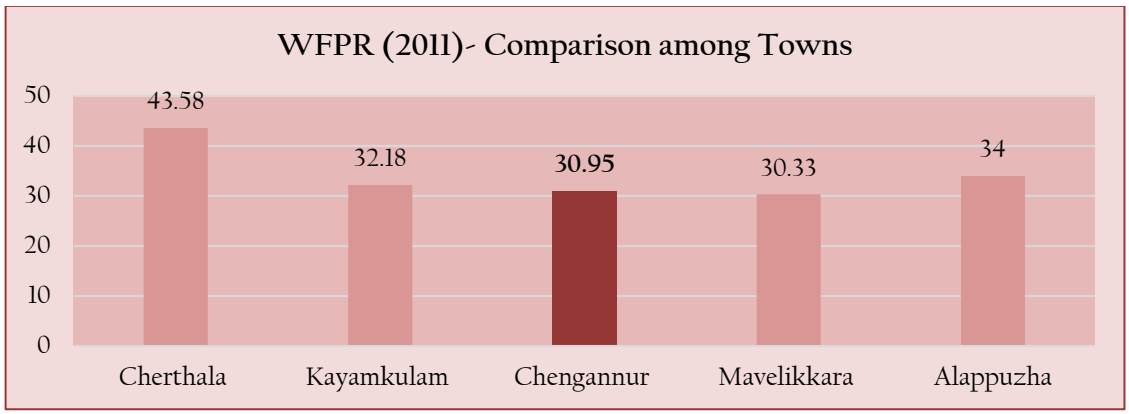

Figure 5:4 Comparison of WFPR with other urban local bodies

Source: Census of India

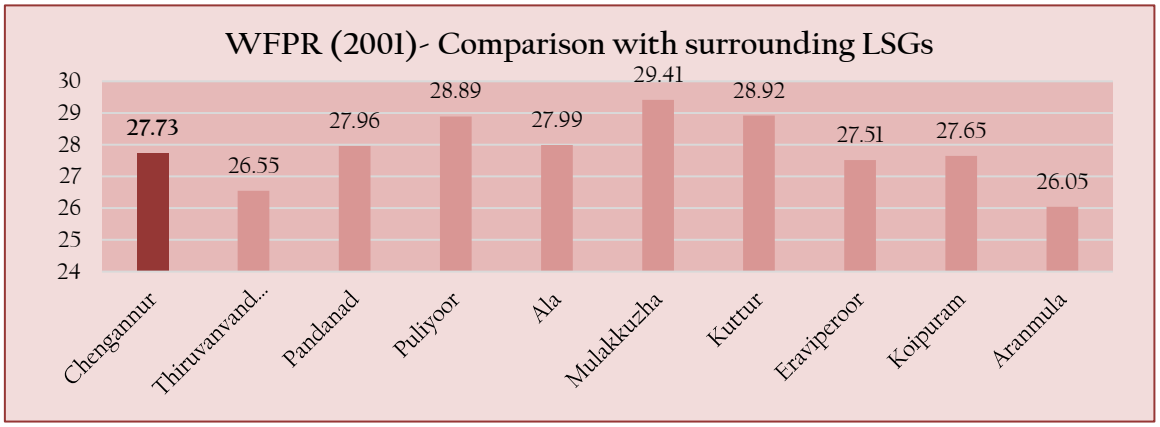

Figure 5:5 Comparison of WFPR with surrounding local bodies

Source: Census of India

5.3 Male & Female Work force

The total number of workers in Chengannur Municipality as per 2011 census is 7262, out this 5,165 were males while 2,097 were females. The share of female workers is also very low in Chengannur.

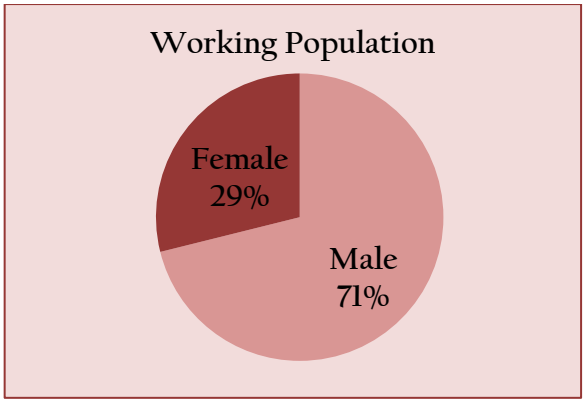

Figure 5:6 Male-Female working Population

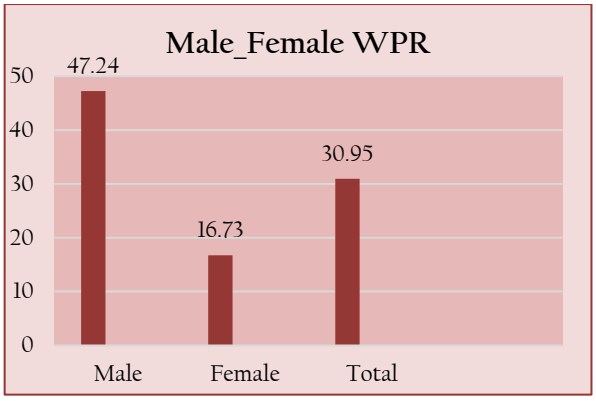

Figure 5:7 Male-Female WPR

Source: Census of India

There is a clear dominance of male in all the sectors. According to census 2011, the male workers constitute 71.12% of the total workers.

5.4 Four-Fold Classification

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 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
561	650	202	184	1109	951	453	335	108	102	198	235	4274	4757	6190	6508

Source: Census of India

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. This is due to the weakening of agricultural sector. Agricultural labourers and Cultivators constitute 7.15% of the total workers as per 2011 census, where as other workers form about 89.6% 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 3.24% of the total workforce which is also lesser than the district average.

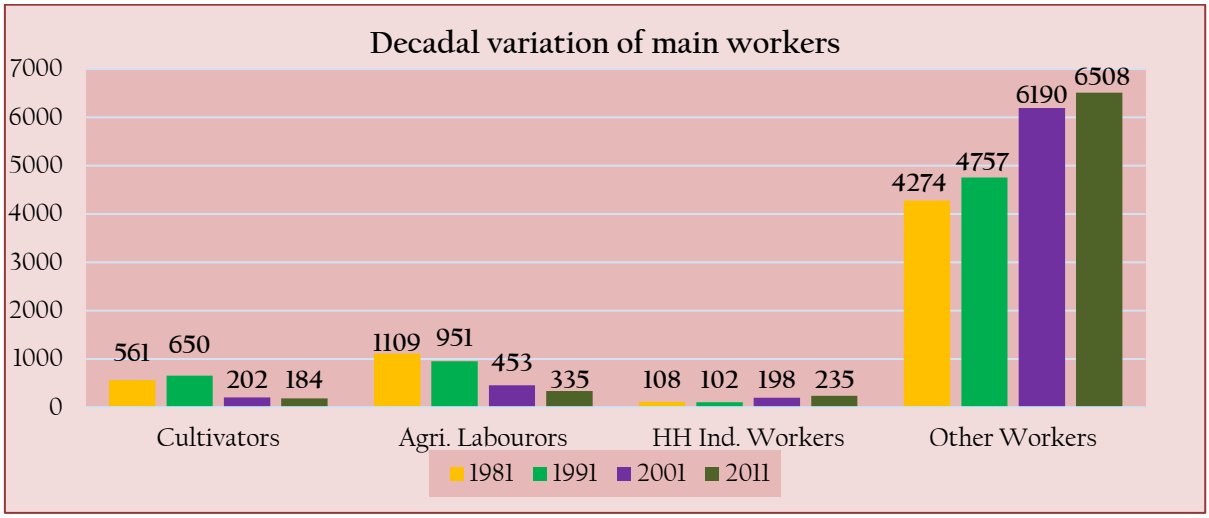

Figure 5:8 Decadal variation of four – fold classification of workers

Source: Census of India

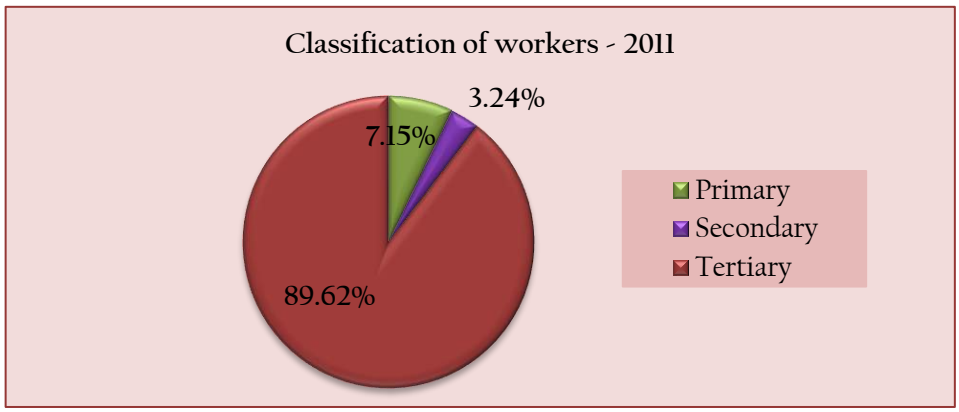

Figure 5:9 Classification of workers

Source: Census of India

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. From Socio economic survey analysis, it was found that majority of workers are engaged in Tertiary sector work. The percentage of workers is shown in Figure 5:9.

5.5 Spatial Distribution of Workers

Figure 5:10 and Figure 5:11 gives the ward wise concentration of cultivators and agricultural labourers. The maximum concentration of cultivators is seen in the ward of Edanad East and Edanad west and agriculture labourers are mostly concentrated in the wards of Edanad west, Mangalam north and Mangalam south.

The spatial distribution shows that both the category of workers, cultivators and agricultural labors are concentrated within the same or nearby wards as the agricultural land is distributed among these wards. The distribution of agriculture land as obtained from land use survey is shown in Figure 5:12.

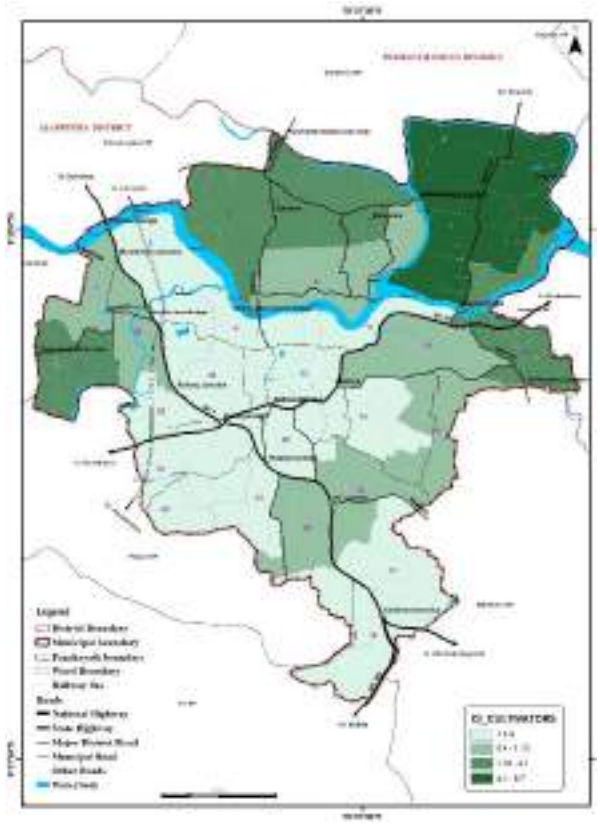

Figure 5:10 Concentration Pattern of Cultivators



Figure 5:11 Concentration pattern of Agricultural labourers

Source: Author generated from census 2011 data

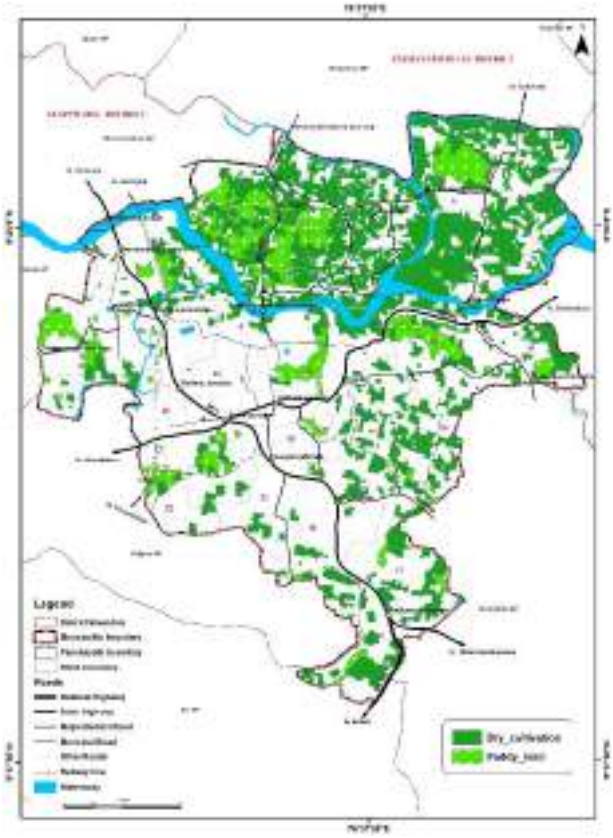

Figure 5:12 Spatial distribution of Agricultural land use

Source: Land use survey

Figure 5:13 and Figure 5:14 gives the ward wise concentration of household industrial workers and other workers respectively. HH industrial labourers constitute only 3.24% of the total workers. This concentration is more in the wards of Valiyapalli and Railway station. The other workers are concentrated more near the ITI, Vandimala and Temple ward.

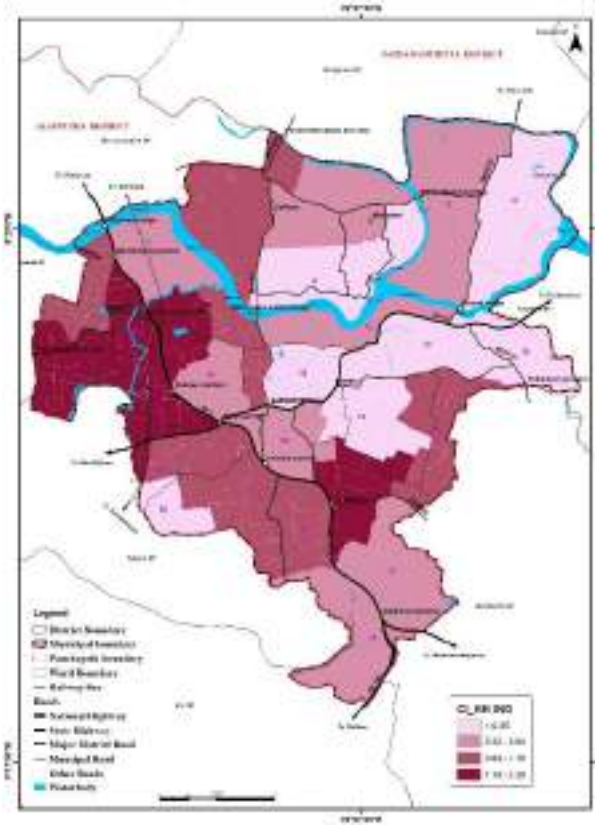

Figure 5:13 Ward wise concentration of HH industries Workers



Figure 5:14 Ward wise concentration of Other Workers

Source: Author generated from census 2011 data

5.6 Inference

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. Under production sector agriculture and industrial sector showing declining trends of growth. The service sector which is to supplement the production sector shows growth. Majority of the urban population depends on the service sector for their livelihood. It is observed that rural area of the Municipality is also slowly withdrawing from primary sector and is leaning more on service sector. The shift in occupational structure is conspicuous.

6 LAND USE

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. Land undergoes tremendous transformations due to sprawls in urbanisation, industrialisation, and agriculturalisation. The impacts of these have varying effects. The changes in land use affect the ecosystem in terms of land cover, land quality and capability, weather and climate, quantity of land that can be sustained and in short, the whole population and socio-economic determinants.

6.1 General Analysis of Land Use

The Land use break up of Chengannur Municipality is shown in Table 6-1. The existing Land use pattern of Chengannur Municipality is shown in Figure 6:1. It is seen that the major share of the geographical area is covered by residential area. The area under residential use is 600.6 hectares which is 45.98 % of the total land area. The commercial activity area is 261.7 hectares i.e. 2.03 %. Industrial area is 47.3 hectares which is 0.36 % of the municipal area. Paddy field area and dry cultivation constitutes 7.78 % and 27.43% respectively of total land area. The area of water courses is 6.67 % i.e. 73 hectares. Area under transportation is 35 hectares i.e. 5.68 %. Major share of the land use is residential which covers 45.98 % of the municipal area. The second major land use is dry cultivation covering about 27.43 %. Figure 6:2 shows the existing land use breakup of Chengannur Municipality.

Table 6-1 Land use breakup of Chengannur Municipality

Sl. No.	Land use	Area (Sq km)	% of Area
1	Residential	6.0284	45.98
2	Commercial	0.2617	2.00
3	Industrial	0.0473	0.36
4	Public and Semipublic	0.7420	5.68
5	Transportation	0.1439	1.10
6	Road	0.2146	1.64
7	Paddy	1.0167	7.78
8	Dry cultivation	3.5818	27.42
9	Marshy land	0.2752	2.11
10	Park and open space	0.0190	0.14
11	Rock	0.0106	0.08
12	Vacant land	0.0110	0.08
13	Waterbody	0.7317	5.59
	Total	**13.08**	**100%**

Source: Land Use survey 2019

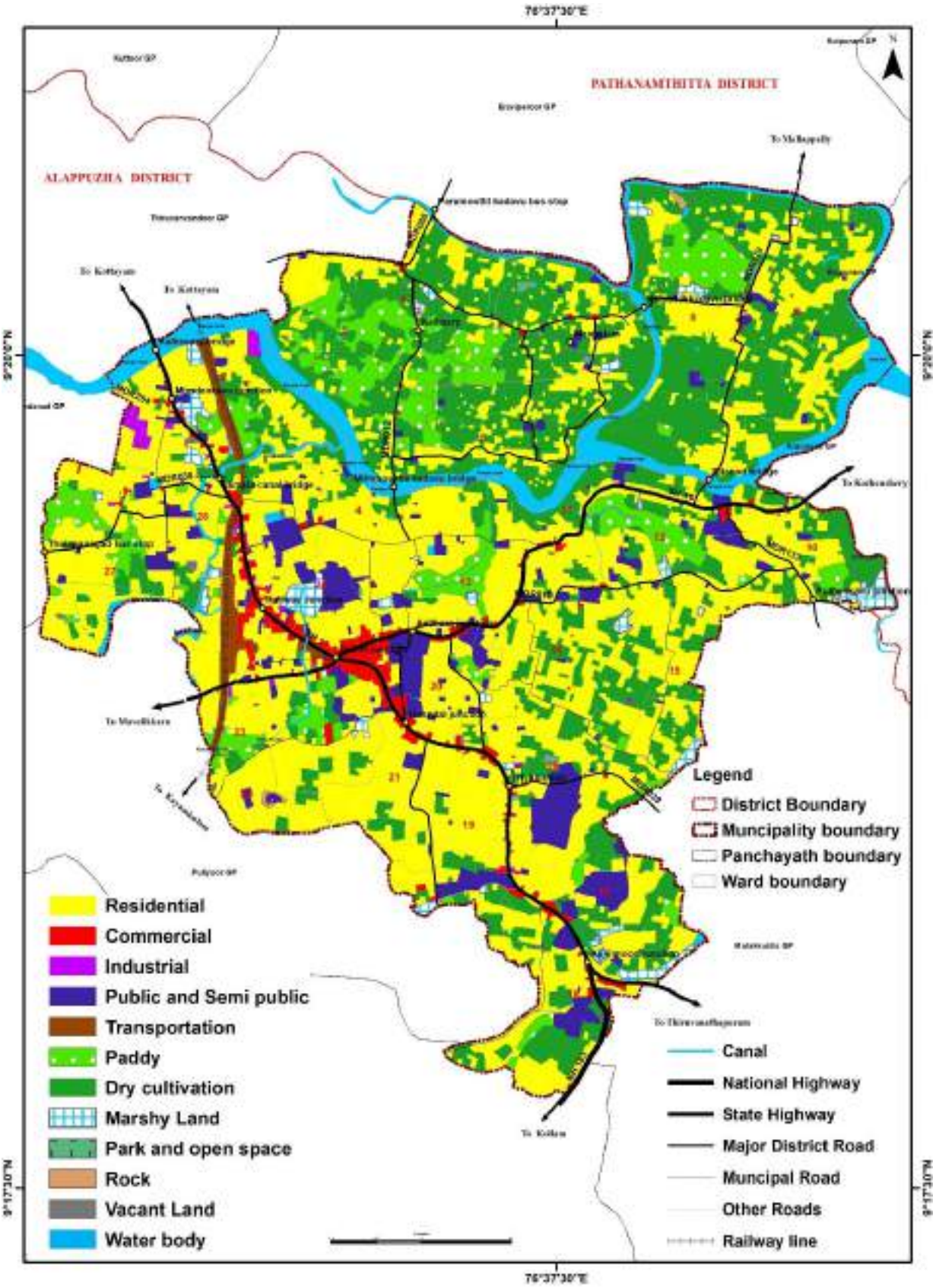

Figure 6:1 Existing land use pattern -2019

Source: Land use survey 2019

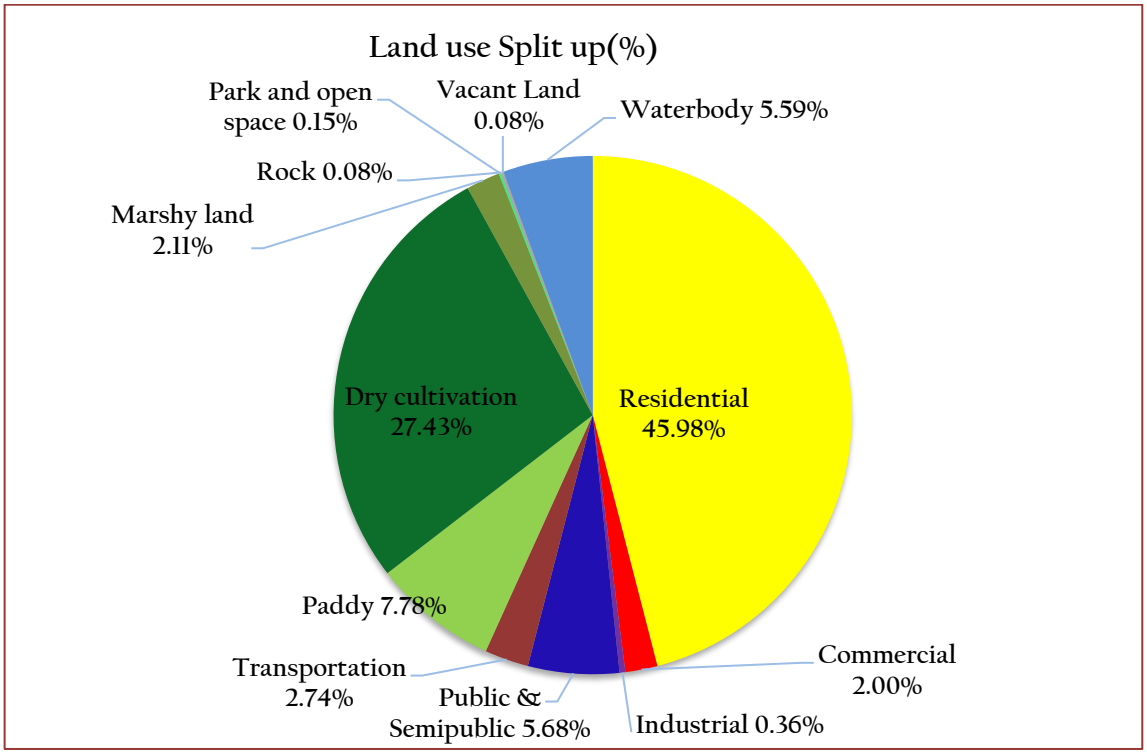

Figure 6:2 Existing land use breakup of Chengannur Municipality

Source: Land use survey 2019

6.2 Comparison of Land Uses with URDPFI Guidelines

Table 6-2 shows the comparison of land use of Chengannur 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 6-2 Comparison of Land use with URDPFI Guidelines

Sl. No.	Land use	Chengannur Municipality		Standards as per URDPFI
	Land use	Area (Ha)	% of Area	% of Developed Area
1	Residential	6.0061	45.98332	45-50
2	Commercial	0.2617	2.00353	2-3
3	Industrial	0.0473	0.36241	8-10
4	Public and Semipublic	0.7420	5.68077	6-8
5	Transportation	0.1439	1.10147	10-12
6	Road	0.2145	1.64222	
7	Paddy	1.0167	7.78398	
8	Dry cultivation	3.5827	27.42977	
9	Marshy land	0.2752	2.10700	
10	Park and open space	0.0190	0.14538	12.00-15.00
11	Rock	0.0106	0.08132	
12	Vacant land	0.0110	0.08448	
13	Waterbody	73.07	5.59	
	Total	**13.06**		

Source: Land use survey 2019 & URDPFI Guidelines

6.3 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.

The concentration of major categories of landuses (residential, commercial, industrial, public and semi-public and agricultural) are studied and details of distribution of other landuses are discussed in detail in the following paragraphs.

6.3.1 Residential Land Use

Residential land use constitutes 45.9 % of the municipal area. Its distribution is shown in Figure 6:3. While analysing the concentration pattern of residential landuse, higher concentration is seen in majority of the wards. The density in the already developed residential areas is not high, providing scope for accommodating more population. The land value of the town put some restriction to encroachment in dry agriculture lands or vacant lands. The concentration pattern of residential land use is shown in Figure 6:4. Higher concentration of residential land use is seen in Thittamel, Pandavanpara and Hatchery wards.

6.3.2 Commercial Land Use

Commercial area constitutes only 2 % of the Municipal area, the spatial distribution of which is shown in Figure 6:5. Commercial nodes are concentrated in the central area of the town and towards the major transportation corridors. Most important commercial nodes are Municipal and Railway Jn, Angadickal, ITI Jn, Mundankavu, Bethel Jn and Puthenkavu. The concentration pattern of commercial land use is shown in Figure 6:6.

6.3.3 Industrial Land Use

Industrial land constitutes only 0.36 % of the Municipal area, but this figure is deceptive. There is no major industry in the town. The spatial distribution of industrial land use and its concentration pattern are shown in Figure 6:7 and Figure 6:8 respectively. The higher concentration in Mundenkavu ward is due to the industrial estate in the ward.

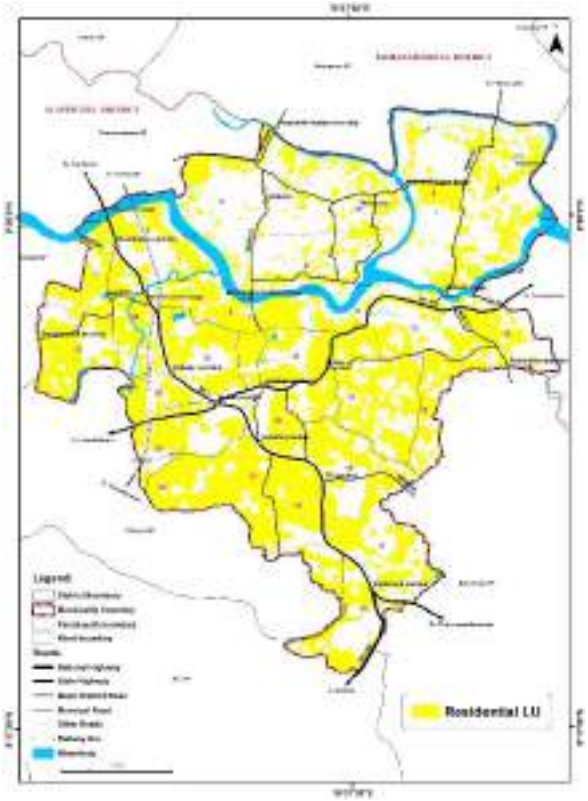

Figure 6:3 Spatial distribution of Residential land use



Figure 6:4 Concentration pattern of Residential land use

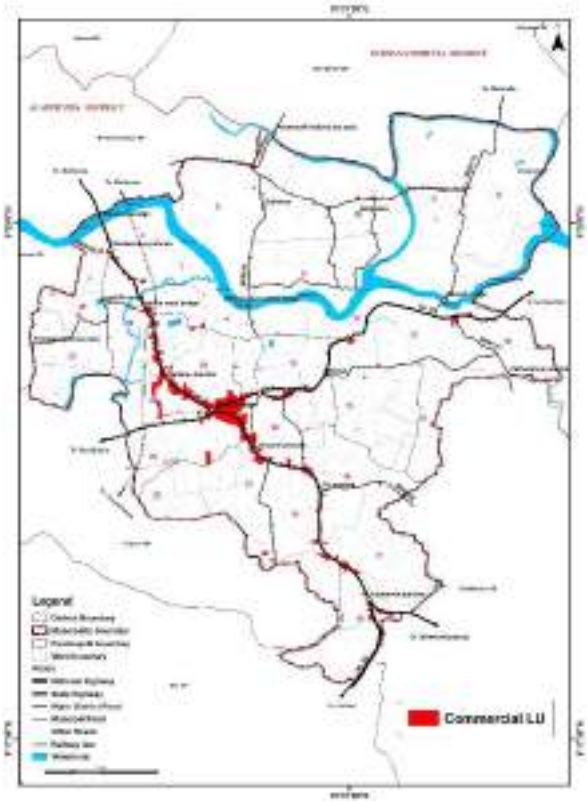

Figure 6:5 Spatial distribution of Commercial land use

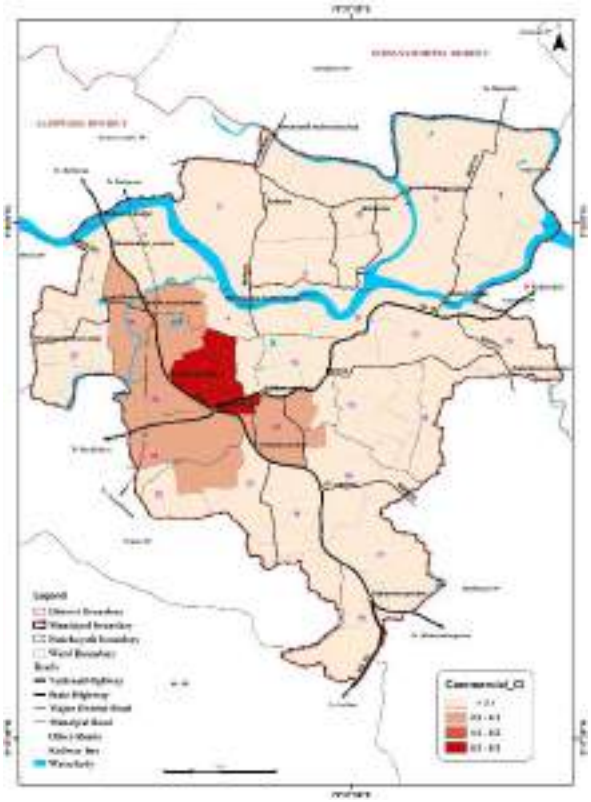

Figure 6:6 Concentration pattern of Commercial land use

Source: Land use survey 2019

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Figure 6:7 Spatial distribution of Industrial landuse

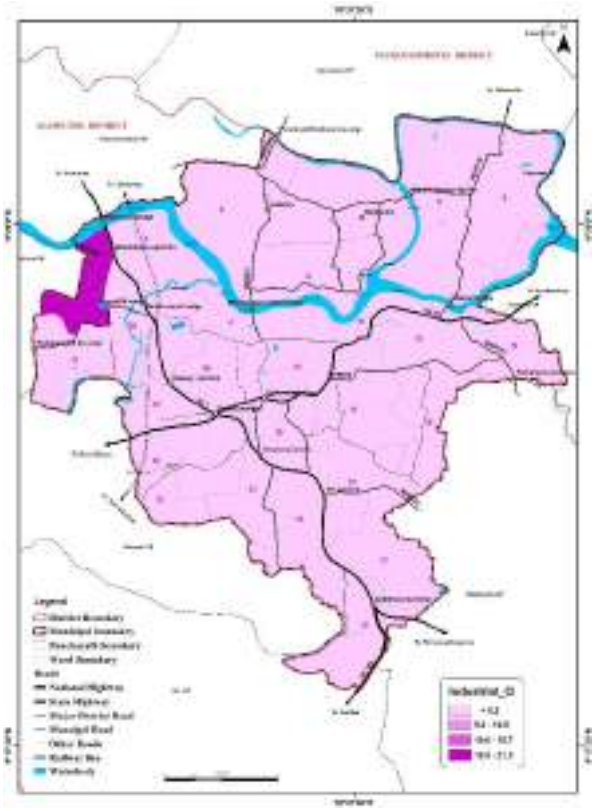

Figure 6:8 Concentration pattern of Industrial landuse

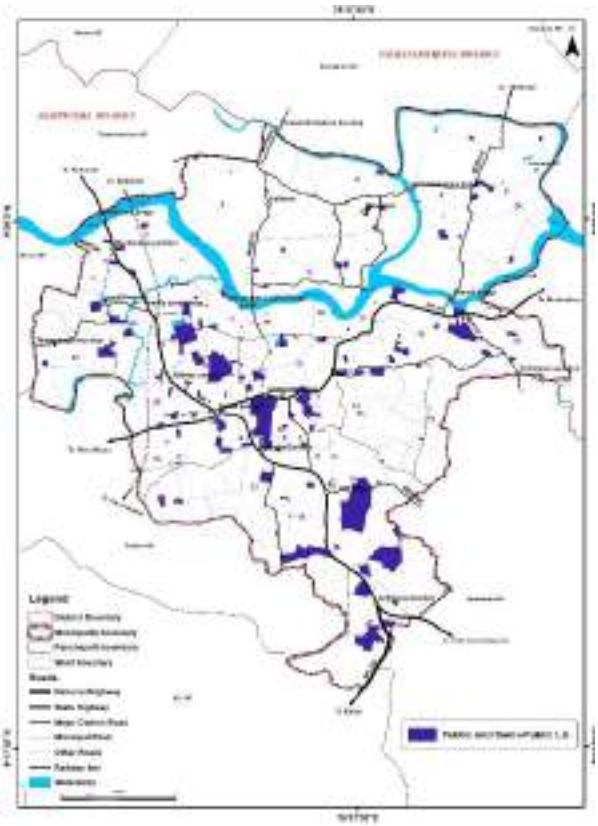

Figure 6:9 Spatial distribution of Public & Semipublic land use

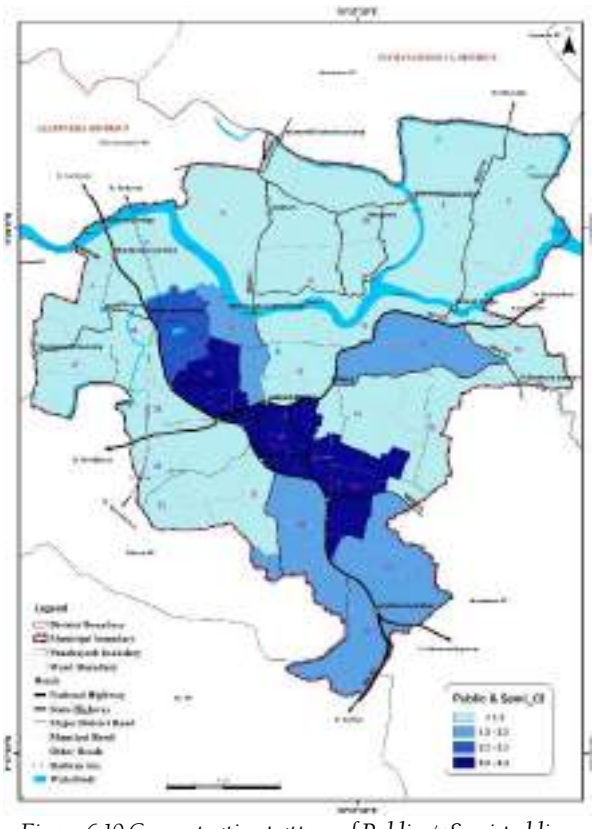

Figure 6:10 Concentration pattern of Public & Semi-public land use

Source: Land use survey 2019

6.3.4 Public & Semi public Land Use

Offices, educational institutions, hospitals and religious and cultural institutions are grouped under this category. There is a large number of government offices concentrated in the town centre. The total extent of land occupied by public and semipublic use comes to 5.72 % of the Municipal area. The spatial distribution of public and semipublic use is shown in Figure 6:9 and its concentration pattern is shown in Figure 6:10.

6.3.5 Agricultural Land Use

Paddy field constitutes 7.78 % and Dry Land (Mixed crops, Rubber and Coconut) constitutes 27.45 % of Municipal Area. The spatial distribution of paddy and dry cultivation are shown in Figure 6:11 and Figure 6:12 and their concentration index is shown in Figure 6:13 andFigure 6:14. The paddy lands exist mainly in Vazharmangalam ward, Mangalam north and south wards, Edanadu west, Puthenkavu west, Shasthamkulangara and Valiyapalli wards. The extent of paddy land comes to 101.17 Ha but majority of the land is left as such without cultivation.

Dry cultivation is mainly concentrated on Vazharmangalam ward, Mangalam north and south wards and Edanadu west ward. Rubber, coconut and mixed crops are the most important crop in the Municipality. Other agricultural activities include banana, tapioca, tuber crops, and arecanut to a very limited extent. This constitutes 27.45 % of the total municipal area. Higher concentration of agricultural land use is seen in Vazharmangalam and Mangalam North wards.

6.3.6 Transportation Land Use

The area covered by transportation network comes to 2.74 % of the Municipal area. The total length of roads in the Municipality comes to 163.62 km and the road density is 4.87 km/sq km. The study area is served by public transport system consisting of both State-owned Kerala State Road Transport Corporation (KSRTC) and private buses. There is no town service as such but bus route operated by private sector ply through most of the town roads. The long-distance services are provided by KSRTC buses operating from the KSRTC bus station located near the MC road. The private buses are operated from the private bus stand situated near the municipal office. This is very near to the railway station. The spatial distribution of transport facilities is shown inFigure 6:15.

6.3.7 Recreational Landuse

The recreational facilities include stadium, open air theatre, community halls, public libraries and cinema halls. But there is no stadium or open-air theatre in the Municipality at present. But there is a proposal for stadium in the Municipality which is under construction.

6.3.8 Park and open spaces

Of the total land area, only 0.14% constitutes park and open space in the town at present.

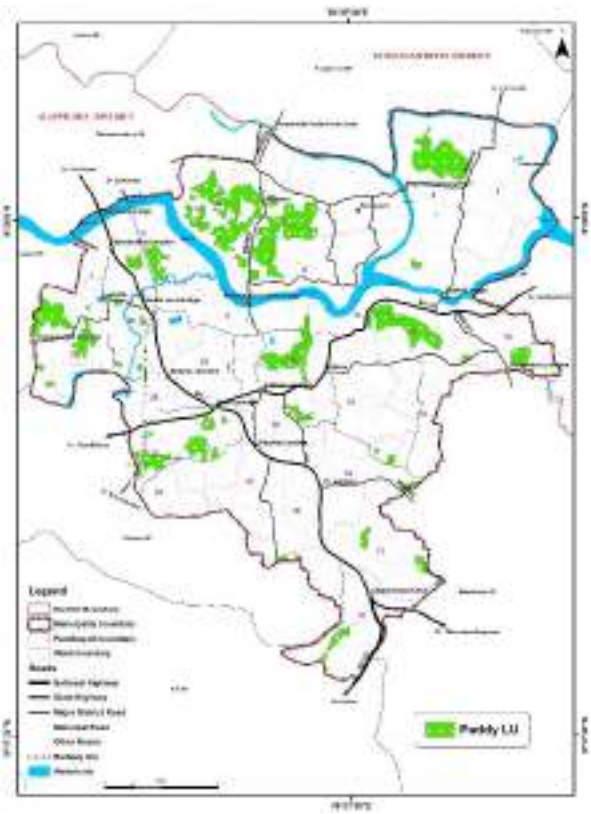

Figure 6:11 Spatial distribution of Paddy fields

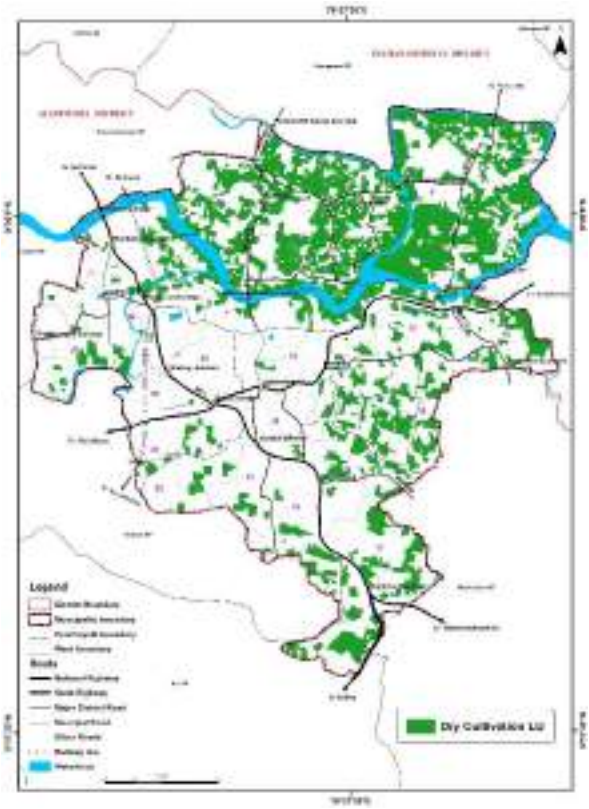

Figure 6:12 Spatial distribution of Dry cultivation



Figure 6:13 Concentration pattern of Paddy fields



Figure 6:14 Concentration pattern of Dry cultivation

Source: Land use survey 2019



Figure 6:15 Spatial distribution of Transportation facilities

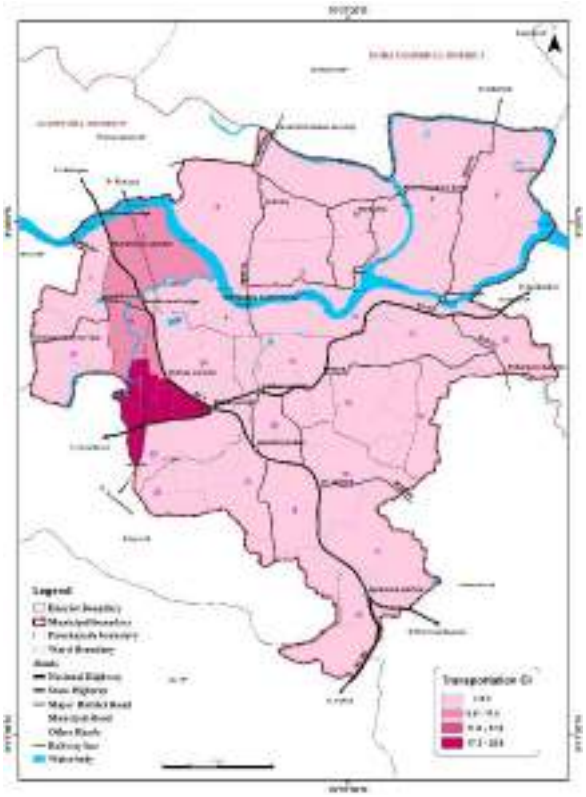

Figure 6:16 Concentration pattern of Transportation land use
Source: Land use survey 2019

6.4 Categorization of Residential Land Use

The residential area in Kerala is generally in the category of mixed landuse. Generally, two types of mixed land use category are there in Kerala context. Predominant land use is agricultural but residences are also seen there. The residential area with dry crop cultivation can be divided in to four, based on the land holding size.

1. Pucca residential area

The extent of the holding here is less than 25 cents which makes the agricultural activity nearly impossible.

2. Residential cum agricultural area

In this category, the extent of the land holding is in between 25 cents and 50 cents. Hence agricultural activity is also a source of income.

3. Residential area with predominance in agricultural activity

In this category the extent of land holding is between 50 to 70 cents. Agricultural activity is an important source of income.

4. Residential area with fully agricultural area

In this category, the extent of land holding is above 70 cents. From this land a family can generate income for their livelihood.

If we examine the residential land use of Chengannur Municipality, 54 % of the residential land comes under the category of residential cum agricultural area. (This means that average land holding of this category of landuses is in between 25 to 50 cents). Balance residential area falls in pucca residential category (In this category the extent of land holding is below 25 cents). The categorization is shown in Figure 6:17.

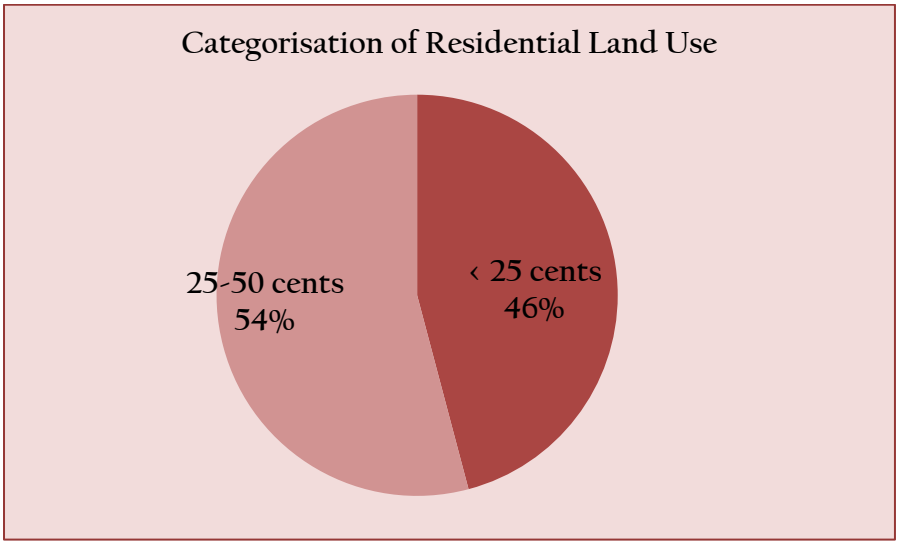

Figure 6:17 Percentage of categorisation of residential land use

In Chengannur Municipality, 54 % of the land is in residential cum agricultural use. This means that more than half of the residential land in Chengannur Municipality has potential for dry land cultivation.

6.5 Inference

From the analysis of land use, it is observed that more than 45 % 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. There is no major industry in the town and the industrial land use constitutes only 0.35 % of the municipal area. On analyzing the residential land use of Chengannur Municipality, it is seen that majority of the residential land comes under the category of residential cum agricultural area. This means that more than half of the residential land in Municipality has potential for dry land cultivation.

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, it also helps improvement in 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 Places of Tourist interest

A. Chegannur Mahadeva Temple

Chengannur Mahadevar Temple is one of the oldest and famous temples, situated in Alappuzha district. It is a sprawling temple complex with a circular Sanctum. Lord Shiva and Parvathi Devi are the main investitures of this temple. Differing from other temples, there are two main Shrines in this temple. Lord Shiva facing East and Devi facing West. The main shrine is a conical copper plated one. Devi's main Idol is made with an alloy of five metals (Panchaloham). The Shivalingam, is covered with a gold plate bearing an image of Ardhanareeswara - or the Shiva-Shakti manifestation of Shiva. The other sub-investitures of the temple are Ganapathi, Shasta (Lord Ayyappan), Chandikeswaran, Neelagrivan, Ganga, and Naagar. There is also a shrine of Sree Krishna nearby.



Figure 7:1 Chengannur Mahadeva Temple

The temple was constructed centuries back in accordance with an architectural design evolved by the famous Perunthachan. In the 18th Century the temple complex was damaged by fire and renovated later by Vanghipuzha Thampuran except the Kuthambalam (Performance Hall). This could not be restored to its original position as it had been designed and constructed by Perunthachan. The structure of the Kuthambalam originally constructed by Perunthachan was in such a manner that the shadow of the performer would not fall on the stage if all the lamps were lit on each of the post of the Kuthambalam. The mukhamandapam in front of the temple and other mandapams in this temple are full of exquisite woodwork.

Compared to other temples, this temple has a peculiarity of its own, quite distinct from other temples. The interesting belief and festival of this Temple is Triputharattu which is considered as a symbol of fertility. This festival is connected with a menstruation ceremony, which is observed periodically in the temple. That is why this temple is also considered as Shakthi Peedam.

B. Pandavan Para

Pandavan Para, one of the major tourist attractions in Chengannur, has derived its name from the Pandavas of Mahabharatha. It is believed by the locals that Pandavas stayed inside the cave during the time of their exile. Also known as the rock of Pandavas, it is also an ideal picnic spot. This is situated at a distance of 1 km from Chengannur bazaar. It can be accessed by taking a walk up the hill. Along the trails visitors can enjoy beautiful views from several vantage points. There is a pool of water in Pandavan Para which does not dry up.



Figure 7:2 Pandavan Para

C. Varattar

The nine-kilometre long Varattar, a natural flush escape of floodwater between the rivers Pampa and Manimala, has its origin from the Pampa at Puthukkulangara near Chengannur. The river meanders through Meppuram, Thaimaravumkara, Thalayar, Nannad and Thriuvanavandoor, before it merges with the Manimala at Vaalathode near Eramallikkara in Alappuzha district.



Figure 7:3 Varattar

The once prolific river is almost dry, leaving heavily weeded small patches of water and narrow streams at certain points. The Pampa River bed has been drastically lowered due to indiscriminate sand-mining, blocking the natural water flow between the Varattar and the Pampa.

The Legislative Committee on Environment chaired by George J. Mathew had inspected the Varattar river bed in 2002 to verify the large-scale encroachment. To its astonishment, the panel observed that almost two-thirds of the Varattar was encroached upon by the local population for cultivating tapioca, rice, vegetables, fodder grass, etc. Concrete residential buildings too had come up on the river bed at certain points.

In its report submitted to the Government on June 26, 2002, the Assembly panel had recommended rejuvenation of the Varattar, saying that it could be a boon to the water-scarce

river basin. The committee had also recommended the Government to take necessary steps for the eviction of all the encroachments on the Varattar, besides cancellation of the 'possession certificates' or 'title deeds' issued to the encroachers, if any.

The 'Varatte aar' ('let the river come' in Malayalam) campaign is a unique experiment in water conservation and environment management efforts, where the will, resources and power of the people is effectively utilized for rejuvenation of an almost dead river. Transparency and accountability were ensured, and a concurrent social audit was initiated along with the processes.



Figure 7:4 Rejuvenation of Varattar

The vision for the programme was provided by the Haritha Keralam (Green Kerala) Mission, headed by the Chief Minister as Chairperson and Dr. T. N. Seema, Vice Chairperson, and includes ministers and experts from various fields.

The campaign kicked off on May 29, 2017, with a walk along the banks of the dilapidated river, in which ministers of the state, MLAs, and people's representatives from the local bodies participated, along with an enthusiastic crowd, who wished to see the river run its course once again. The civil works started after a walk with the participation of various groups including MGNREGS workers, Kudumbashree activists, students, local self-government institutions, and various others. Unscientifically constructed man-made structures along the river's path were removed after building consensus through local-level consultations. All financial resources were pooled without any financial assistance from the state government, and the daily accounts were recorded and presented in the WhatsApp group created specifically for the coordination of the campaign activities.

D. Old Syrian Church

It is believed that the church was built about 1700 years ago. The structure of the church building certifies that it is very old. The story is that long ago a hermit priest came to Chengannur and began a worship place at this spot.



Figure 7:5 Old Syrian church

Till AD 1580, Nazranis and Knanaya people were worshipping together in this church. Then the Knanaya people who escaped the persecution in Cochin and surrounding area, also joined with those at Chengannur. Later the Knanaya people had built their own church and moved out. During reformation two groups were formed in the

Malankara Church. Those who supported Patriarch of Antioch were known as Bava kakshi and those who supported Malankara Metropolitan, the Metran kakshi. These two factions quarreled in this church and there was a court case. The court found that the clergy from both parties had letters from Mathews Mar Athanasius Metropolitan the then Malankara Metropolitans, and so ordered that the two parties should come to an agreement to share the church between them, on a weekly basis. Thus now the Chengannur Pazhaya Pally is co-owned by the Indian Orthodox Church and the Mar Thoma Church.

Architectural style is a blend of 18th Century Christian and Hindu temple architecture and something fast disappearing from Kerala landscape. Its gopuravathil, nadapanthal, kalluvilakku and doors adorned with carved figurines including a Hanuman holding a baton. This is indicative of communal and religious harmony exhibited by the localities in yesteryears.

The Pazhaya Suriyani Pally in Chengannur and the Cheriya Pally (St. Marys Orthodox Church) in Kottayam are unique with the same architectural splendor.

The Church is famous for the Aval Nercha (offering of sweetened rice flakes) held on every Maundy Thursday, for the last four centuries.



Figure 7:6 Pazhaya Suriyani Pally

The aval nercha custom is said to have an uninterrupted history of not less than 400 years. It was the patronage of the then rural chieftain of Vanjippuzha Palace, attached to the erstwhile kingdom of Venad who ruled Chengannur in the 16th century, which made it a popular event in the region.

E. Puthencavu St. Mary's Orthodox Cathedral

Puthencavu St. Mary's Orthodox Cathedral, a parish of Chengannur Diocese, is an ancient Pilgrimage centre of Malankara Orthodox Syrian Church founded by St. Thomas, one of the twelve Apostles of our Lord Jesus Christ, in AD 52.

Due to the torment and aggression of Tipu Sultan and Pandy Army, many Christians began to flee from ancient Christian centers like Niranam, Kuravilangadu, Nilackal and started to come and dwell at Kadampanadu, Kanjirapally, Chengannur and later to Puthencavu and its surrounding places. They joined the Chengannur Pazhaya Suriyani Pally (Old Syrian Church) to meet their sacramental needs. The families who stayed in the eastern part of Chengannur found



Figure 7:7 Puthencavu St Mary's Orthodox Cathedral

it difficult to access Chengannur when flooded heavily. They desired to have a place of worship at Puthencavu.

Puthencavu is situated in the banks of Pampa River. It was known trade centre, centuries ago. More Christians started to arrive at puthencavu for their trade prosperity. Thus, Puthencavu became a place where only Christians lived. The desire of having a place of worship in Puthencavu was made known to the Malankara Metropolitan Martha VI. A beautiful piece of land called 'Puthenkalakunnu' near the river bank was selected as the site for the worship place. H.G. Mar Dionysios the Great along with Mathu Tharakan went to Thiruvanthapuram and met the king Karthika Thirunnal who was pleased to allot the land for the place of worship. The first place of worship was built on the southern side of the existing church and now the same is situated in the Aramana building. According to some other versions, H.G. Mar Dionysius the Great purchased a plot of land belongs to Punnarattamatom on 26th Midhunam 968 ME, and constructed a place for worship and stayed there.

Puthencavu Cathedral is the only parish in Malankara Orthodox Syrian Church where three Metropolitans were laid to rest. This Parish hosted the historical Malankara Association in 1958, after the Supreme Court verdict and the two factions were united. Puthencavu Cathedral is the mother parish of several parishes in and around this place. At present the Cathedral has three chapels namely St Andrew's chapel, St John's chapel, St Gregorios chapel at Neervilakom. The Cathedral has 8 cross vaults (Kurisin Soudhams), an Auditorium, three halls, one Aramana.

F. Thrichittatt Maha Vishnu Temple



Figure 7:8 Thrichittatt Maha Vishnu Temple

This is a Hindu temple dedicated to Supreme God Vishnu and located in Chengannur. It is one of the five ancient shrines in the Chengannur area of Kerala, connected with the legend of Mahabharata, where the five Pandavas are believed to have built one temple each. Thiruchittattu temple, is considered to be one among the 108 most sacred place of worship, where Lord Vishnu himself resides.

The Temple is believed to have been built by Devas along the banks of Chittar, a tributary of Holy River Pampa, before mankind was born. The temple, was then renovated, by Yudhishthira in Dvapara Yuga. The temple is considered to be the primary temple among the five Mahavishnu Temples built by Pandavas.

It is believed that long before Yudhishthira renovated the temple, the Devas undertook pilgrimages to this spot many a time for the purpose of making special prayers and requests to the Lord to bless them so that they can ensure that the objective of harmony between the three world is fulfilled.In Dvapara Yuga, the Pandavas resided at present day Chengannur for a large duration of their exile, hence, after the passing of Lord Krishna, Sage Brighu persuaded the

Pandavas to consecrate four sacred temples in the vicinity, to the Lord, who was their guide and protector in Mahabharata.

The temple is built in Kerala style architecture, common in all temples in the South Indian state of Kerala in Eastern axis. The temple has no gateway tower and has an arch from the main road. A rectangular wall around the temple, called Kshetra-Madilluka pierced by the gateways, encloses all the shrines of the temple. The metal plated flagpost or Dwajasthambam is located axial to the temple tower leading to the central sanctum. Chuttuambalam is the outer pavilion within the temple walls. The central shrine and the associated hall are located in a rectangular structure called Nallambalam, which has pillared halls and corridors. Between the entrance of Nallambalam to the sanctum, there is a raised square platform called Namaskara Mandapa which has a pyramidal roof. Thevrapura, the kitchen used to cook offering to the deity is located on the left of Namaskara Mandapa from the entrance. Balithara is an altar is used for making ritualistic offering to demi-gods and the festive deities. The central shrine called Sreekovil houses the image of the presiding deity. It is on an elevated platform with a single door reached through five steps. As per Kerala rituals, only the main priest called Thantri and the second priest called Melshanthi alone can enter the Sree Kovil. The central shrine has a circular plan with the base built of granite, superstructure built of laterite and conical roof made of terrocata tile supported from inside by a wooden structure. The image of the presiding deity is 4 ft (1.2 m) tall. Krishna is in Vishvarupa pose, the one he depicted to Arjuna during the Mahabharatha war. In the second precinct, there are shrines of Sastha, Yakshi, Nagaraja and Erangavil Bhagavathy Balarama in the lower shrine.



Figure 7:9 Sanctum

The two major festivals celebrated in the temple are Vaikunta Ekadasi and Thiruvonam. From 1957, the festival of Gosala Krishna Temple at Thiruvanvandoor commences from Thrichittatt Maha Vishnu temple when 25 caparisoned elephants are paraded to the Thiruvanvandoor.

G. Palliyodam



Figure 7:10 Mundenkavu Palliyodam

The Paliyodams of Aranmula Parthasarathy temple, dedicated to Lord Krishna are Aranmula's unique snake boats. Which is revered as the divine vessel of the presiding deity in Sree Parthasarathy temple. A snake boat is about 103 feet in length. Each boat has about 4 helmsmen 100 rowers and 25 singers. These Palliyodams belong to different *Karas (lands)* on the banks of river Pamba .

The much-famed mega feast during the Ashtamirohini, the birthday of Lord Krishna known as Ashtami Rohini 'vallasadya', where 45 varieties of dishes is served. Each kara or enclave have their own Palliyodams, after a spectacular reception at the ghats of the temple banks, devotees who came in the Palliyodams will move around the temple, chanting vanchipattu, hymns praising Lord Krishna and then they are led into a hall where the humongous Vallasadhya awaits them. Even a second helping of the dishes are asked through 'Vanchipattu'.

Major palliyodams of Chengannur area are Edanadu Palliyodam, Mundenkavu Palliyodam and Mithrakadavu Palliyodam.

7.1.2 Sabrimala Pilgrimage

Chengannur acts as transit hub for the pilgrim tourists to Sabrimala, the major income generation for KSRTC Chengannur and Chengannur Railway Sation is during the Sabrimala season from November to January (Mandala-Makaravilakku festival).

Kerala State Road Transport Corporation usually operate special services from Chengannur Railway Station towards Pamba during Sabarimala Mandala-Makaravilakku festival season. This is done every year to reduce the passenger rush. Pampa is the nearest place to Sabarimala that can be accessed only by road. Sabarimala is about 5 kms away from Pamba and Chengannur is the nearest Railway Station to catch buses to Pamba. During the pilgrim season, there will be frequent bus services to Pamba from Chengannur Railway Station.

Chengannur – Pamba running time would be around 3 hours via Pathanamthitta, Vadasserikkara. KSRTC is operating special services and chain services on the Nilackkal-Pamba- Nilakkal corridor for Ayyappa devotees. Nowadays seat can be reserved through "Ente KSRTC" mobile app. KSRTC gets maximum collection of revenue especially during this festival season.

Table 7-1 shows collection details of the last three years wise KSRTC bus services of Chengannur depot exclusively for Sabarimala pilgrims. Hikes in revenue can be seen in the Mandala- Makaravilakku festival season (November to January). In the year 2018 total amount of collection received is Rs 5,24,93,080. During festival season it is Rs 4,02,10,989. It constitutes 76.60% of the total revenue of the year. In the year 2019 total amount of collection received is Rs 7,42,39,835. During festival season it is Rs 5,48,55,437. It constitutes 73.89 % of the total revenue. In the year 2020, because of the Covid out break and lock down total amount of collection received is only Rs 2,25,83,462. During festival season it is Rs 2,02,45,445. It constitutes 89.65 % of the total revenue.

Table 7-1 Details of Year wise KSRTC Revenue collection

Sl No	Year	Total Number of Service Operated	Amount of Collection Received (Rupees)
1	2018	5966	5,24,93,080
2	2019	6637	7,42,39,835
3	2020	1849	2,25,83,462

Source: KSRTC

Table 7-2 shows the details of railway passengers arrived and departed from Chengannur Railway station in different years. In the year 2018-19, total number of passengers arrived at Chengannur railway station is 619741, Of which 287853 passengers arrived during Mandala- Makaravilakku festival season (November to January). Total number of passengers departed at Chengannur railway station is 578916, Of which 251441 passengers departed during November to January season. Total amount of train ticket fare collected for the year 2018-19 is Rs 75,78,84,148. For the Mandala-Makaravilakku season time, total ticket fare collected is Rs 34,00,25.667. This clearly indicates that nearly 45% of the revenue from railway ticket fare comes during the Sabarimala Mandala- Makaravilakku season time. Similarly, for the year 2019-20, Total number of passengers arrived at Chengannur railway station is 669066, of which 316558 passengers arrived during Mandala- Makaravilakku festival season (November to January). Total number of passengers departed at Chengannur railway station is 633915, of which 287390 passengers departed during November to January season. Total amount of train ticket fare collected for the year 2018-19 is Rs 83,51,41,388. For the Mandala-Makaravilakku season time, total ticket fare collected is Rs 38,51,33,867. This clearly indicates that more than 45% of the revenue from railway ticket fare comes during the Sabarimala Mandala- Makaravilakku season time. In the year 2020-21 (Up to March 1st), because of the Covid Out break and lock-down number of passengers arrived at Chengannur railway station is very less compared to previous years.

Table 7-2 Passengers arrival and departure from Chengannur Railway Station

SL No	Year	Total Number of Passengers Arrived for the year	Total Number of Passengers Departed for the year	Total amount of Ticket Charges received for the year	Number of Passengers arrived During the period from November to January	Number of Passengers departed During the period from November to January	Total amount of ticket charges received during the period from November to January
1	2018-19	619741	578916	757884148	287853	251441	340025667
2	2019-20	669066	633915	835141388	316558	287390	385133867
3	2020-21 (Up to 1st March 2021)	110609	116968	87211213	69398	68928	59483094

Source: Southern Railway

Vendors usually take temporary licence from the Municipality for a 3-month period during Mandala- Makaravilakku festival time and make temporary shops in the Municipality premises. Government is sanctioning 25 lakhs per annum to the Municipality for the purpose of preparation towards Mandala- Makaravilakku pilgrimage. There are 25 cleaning staffs and 6 securities are appointed during the festival season. The wages of these staffs are giving from the fund allocation. There are economic boom happening in the Chengannur Municipality during pilgrim season. Lot of pilgrims are coming in Mandala- Makaravilakku season time. Our master plan should cater the needs of people coming in the Municipality. Provision for basic facilities for the pilgrims like parking area, comfort stations, shopping complexes, toilets, clock rooms, lodge facilities should be considered. Economic activity is peak in Chengannur during festival season.

7.1.3 Availability of tourism infrastructure

There is no permanent tourist information centre in Chengannur Municipality. But during Sabarimala season there will be information counters at Municipal Office, Railway Station and KSRTC Bus station. A temporary KSRTC stand with service to Pampa is set up during the Sabimala season near the railway station. There are no restaurants or hotels run by KTDC/DTPC in the town. There are other private hotels in Municipality for staying with basic facilities for the travellers.

7.1.4 Problems and potentials

The Municipality has immense potential for development of tourism sector with a clean and beautiful environment. The town has water frontage which is ideal for development of water sports and other related activities. The town lacks in tourist infrastructure. The marketing efforts are minimal. A two-pronged strategy of development of tourist sites along with adequate marketing efforts shall boost the sector to a great extent in the town. Facilities have to be provided to the pilgrims during the Sabrimala season.

7.1.5 Inference

Chengannur Municipality has a great scope for tourism with the available natural and traditional sites. Number of people are coming to Chengannur during Sabarimala Mandala-Makaravilakku season time, and this makes Chengannur as an Edathavalam of Sabarimala and the pilgrim's hospitality and facilities must be catered for. This potential can be tapped through proper planning without harming the environment and local residences.

7.2 TRADE & COMMERCE

7.2.1 Existing scenario

Commercial facilities are seen mainly in the town centre and as ribbon development along the major transport corridors in Chengannur Municipality. Only around 26.17 ha (2 % of the total area of the Municipality) is under commercial land use. The commercially developed area comprises of Municipal and Railway Jn, Angadickal, ITI Jn, Mundankavu, Bethel Jn and Puthenkavu. 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 Chengannur Municipality most of the commercial nodes are characterised by inadequate space for efficient circulation of pedestrian and vehicular traffic.

7.2.2 Important Commercial Centres and Nodes

Commercial nodes are located along the straight stretch of road. The nodes are characterised 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 Chengannur Municipality are Municipal and Railway Jn, Angadickal, ITI Jn, Mundankavu, Bethel Jn and Puthenkavu. Important nodes and their hierarchy in Chengannur Municipality are shown in Table 7-3.

Table 7-3 Hierarchy of nodes

Sl No	Category of commercial node/centre*	Hierarchy
1	Bethel jn.	1st order
2	Mundankavu	2nd order
3	ITI Jn.	2nd order
4	Municipal Jn. and Railway Jn.	3rd order
5	Angadickal	3rd order
6	Christian College Jn.	4rth order

7.2.3 Street vendors / Informal Sector

Street Vendors are a common sight in many towns. 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 103 street vendors throughout Chengannur Municipality. Majority of them are Vegetables, fruits, fish, toys, baby items, teashop, coconut, groundnut, ornaments, Helmet etc.

Higher concentration is seen in

- *Hospital Jn*
- *Angadickal Jn*
- *Mundankavu*

Tendency of Street vendors is to settle in areas where there is constant movement of people, especially near bus terminals. Table 7-4 shows the details of street vendors in Chengannur Municipality.



Figure 7:11 Street vendors in the Municipality

Table 7-4 Details of street vendors in the Municipality

Sl No	Area of concentration of informal sector activities	Type of activity – fruits and vegetables, garments, tea and snacks, home appliances, books etc	Extent of informal sector activity in each area (no of shops / cart), no of street Vendors	Labour force (man, women, children separately) in informal sector		
				M	W	C
1	Nandavanam	Vegetables and fruits	10	8	2	-
2	Mundankavu	Vegetables, fruits and Helmet	16	14	2	-

3	Puthenkavu	Vegetables, fish, fruits and ground nut	12	12	-	-
4	Hatchery Jn.	Vegetables and fruits	6	6	-	-
5	Hospital Jn.	Vegetables, fruits, toys and Baby items	18	12	6	-
6	ITI Jn.	fruits	5	5	-	-
7	College Jn.	Vegetable, tea, coconut	3	6	-	-
8	Angadickal Jn.	Vegetable, fish and ground nut	18	12	6	-
9	Bethel Jn.	Vegetable, fish, and ground nut	6	4	2	-
10	Municipality Jn., Railway Jn., Private Bus stand	Ornaments, toys, fruits, vegetables	9	8	1	-

7.2.4 Markets

The main market complex in Chengannur town is situated at Bethel Jn. It is a municipal market. Various shops are functioning in this complex. This market needs renovation.



Figure 7:12 Existing Market Scenario

Present market cannot carry the increasing pressure and thus needs upgradation. The market operates every day from morning to evening. Wholesale and retail trade is happening here and sells vegetable, fish, meat. The improper organization of spaces and haphazard development has created congestion and havoc in the place.

7.2.5 Spatial distribution

Figure 7:13 shows the spatial distribution of commercial centers and nodes. The map shows that the commercial facilities are distributed along the major transport corridors.

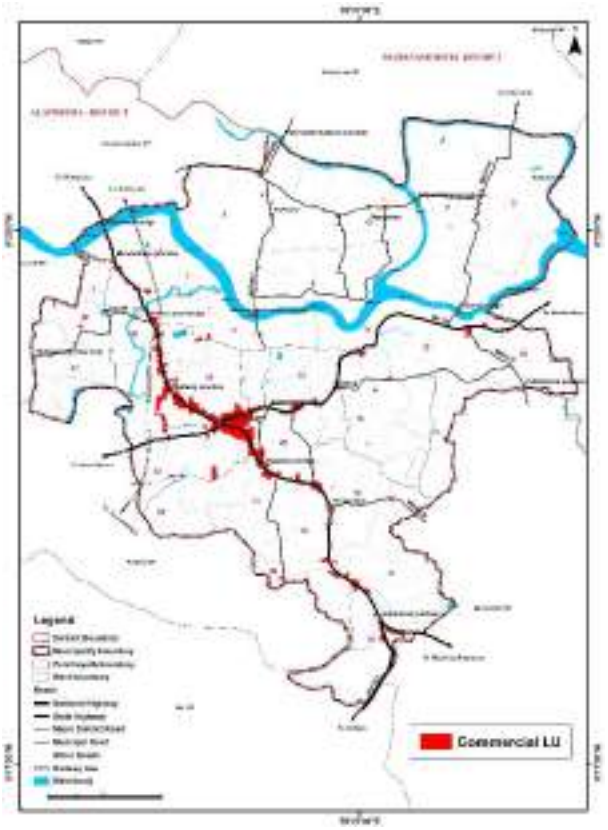

Figure 7:13 Spatial distribution of Commercial area

7.2.6 Problems and Potentials

Chengannur Municipality is a second order settlement in the district. The town therefore has to cater the higher order requirements of a wider service area, covering immediate surrounding Gram Panchayats of Pandanad, Thiruvanvandoor, Ala, Puliyoor

and Mulakkuzha with a service area of 81.75 sq.km and the service population as per 2001 census is 113625 (District Urbanisation Report, Alappuzha, 2011).

Commercial facilities are seen mainly in the town centre and as ribbon development along the major transport corridors. Problems faced by the town are insufficient space for parking and for loading & unloading. Market area which is the main centre for vegetables, fruits and fish commodities is very congested. The primary issue identified is the lack of proper waste disposal from these markets. The impetus given to the trade and commerce by NRI remittances in the Municipality is not evident to the full extent due to lack of proper facilities like shopping malls, adequate parking space etc.

7.2.7 Inference

Chengannur Municipality is a second order settlement in the district. The town therefore has to cater the higher order requirements of a wider service area, covering immediate surrounding Gram Panchayats of Pandanad, Thiruvanvandoor, Ala, Puliyoor and Mulakkuzha, with a service area of 81.75 Sq. km and the service population as per 2001 census is 113625. 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 also to cater the higher order commercial requirements of its service area.

7.3 AGRICULTURE

7.3.1 Area under cultivation

Agricultural land use covers about 35.18 % of municipal area. Rubber and mixed crops are the most important crop in the Municipality. Other agricultural activities include banana, tapioca, tuber crops, and arecanut to a very limited extent. Dry cultivation constitutes 27.4 % of the total municipal area. The spatial distribution of agricultural area is shown in Figure 7:14 and Figure 7:15. The agricultural activities are concentrated more in Vazharmangalam and Mangalam North wards. The paddy fields are mainly concentrated in Vazharmangalam ward, Mangalam north and south wards, Edanadu west, Puthenkavu west, Shasthamkulangara and Valiyapalli wards.

7.3.2 Crop productivity

The different crops under cultivation in Chengannur Municipality are Coconut, Rubber, Paddy, Tapioca, Tubers, Banana, Vegetables, Arecanut, Pepper, etc. The different crops and its productivity are shown in Table 7-5.

Figure 7:16 and Figure 7:17 shows the variation in agriculture produces with respect to time. Paddy production and area under cultivation has increased. In the case of coconut, thearea under cultivation remains the same but the production has decreased during 2019 and increasedby 2020 but this is still less than that of 2018.



Figure 7:14 Spatial distribution of Paddy fields

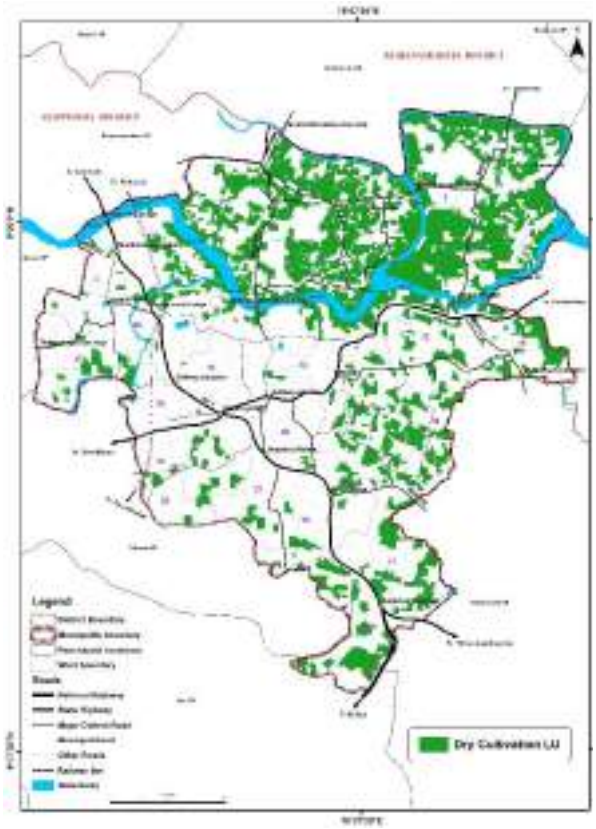

Figure 7:15 Spatial distribution of Dry Cultivation

Table 7-5 Important Crops and its Production

Type of crop	Area under cultivation (Ha)			Production (T)			Productivity (T/Ha)		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
Coconut	25	25	25	350	300	340	14	12	13.6
Paddy	10	10	38	150	150	570	15	15	15
Rubber	10	10	10	0.4	0.4	0.4	0.04	0.04	0.04
Vegetables	5	5	5	50	50	50	10	10	10
Tapioca	5	5	5	300	300	300	60	60	60
Tubers	5	5	5	187	187	187	37.4	37.4	37.4
Banana	5	5	5	100	100	100	20	20	20
Arecanut	2	2	2	175	175	170	87.5	87.5	85
Pepper	1	1	1	5	5	5	5	5	5
Pulses	0.4	0.4	0.6	0.5	0.5	0.5	1.25	1.25	0.8
Ginger	0.4	0.4	0.5	8	8	8	20	20	16
Turmeric	0.4	0.4	0.4	8	8	8	20	20	20

7.3.3 Problems and potentials

The irrigation facilities in the Municipality are minimal. 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.

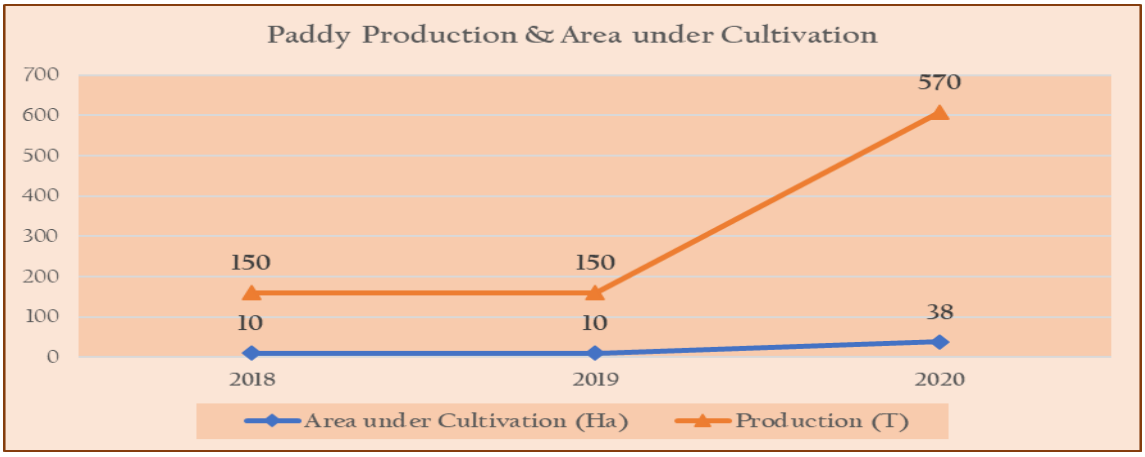

Figure 7:16 Paddy production of Chengannur Municipality

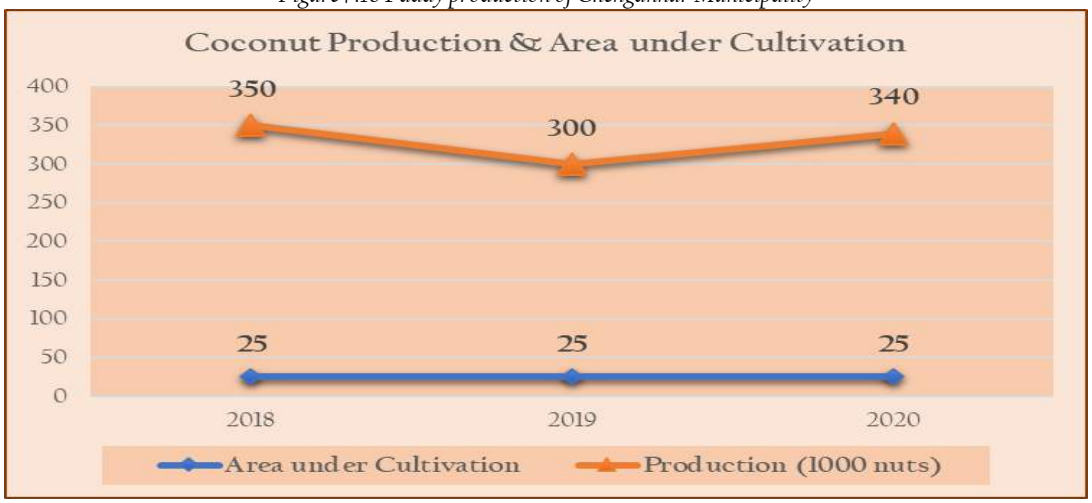

Figure 7:17 Coconut Production of Chengannur Municipality

7.3.4 Inference

Coconut, Rubber, paddy and mixed crops are the major cultivation in the Municipality. Agriculture produces 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 unavailability of labourers. The Sasthampuram market is the main market within the Municipality that sells the agricultural products.

7.4 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 a prominent and one of the fastest growing sectors of rural economy.

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.

7.4.1 Population

The main livestock in Chengannur Municipality are cattle, buffaloes, goat, hen and duck. Livestock population is shown in Figure 7:18.

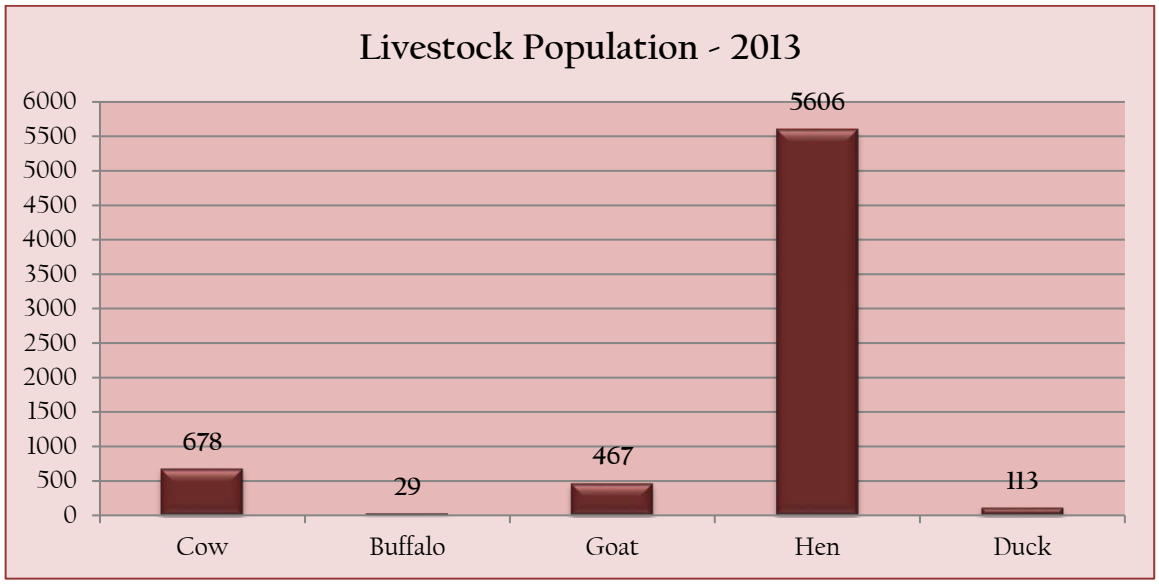

Figure 7:18 Livestock population

7.4.2 Production

A. Meat

Even though the livestock population is showing a decline, produces from livestock does not follow such a trend. Eating habits of people have changed and there is an increase in demand for meat products. There is no authorized slaughter house in Chengannur Municipality. There are few numbers of unauthorized slaughter houses in the Municipality, which are very unhygienic; there is no adequate facility for water supply and for collection and disposal of waste.

B. Milk

There are only 2 Dairy Farms with a total of 21 cattle in Chengannur Municipality. There is a milk co-operative society at Thittamel but it is not working at present. The demand for milk is at constant rise and as per the data obtained the availability of milk per month is 19980 litres only. Milk demand for the population is is 176000 litres. Milk production in the Municipality is less than 12% of the consumption.

7.4.3 Physical Infrastructure

There is an Intensive Cattle Development Centre (ICDC) sub-Centre at Edanadu, a Veterinary Polyclinic near Mahadeva Temple and a mobile veterinary hospital in the Municipality. There is no poultry farm in the Municipality. But there is hatchery available in the town with about 10,000 hens with a production of 1,65,000 eggs per month.

Table 7-6 Details of hatchery

Ward No.	Name of Ward/Place	Name of hatchery	No. of hens	No. of eggs produced per month
19	Hatchery ward	Central Hatchery	10360	166606

Table 7-7 Detaills of Dairy farm

Ward No.	Name of Ward/Place	Name of Dairy Farm	No. of Cattle	Quantity of Milk produced per day
7	Mangalam	Reji	8	92 lit/day
23	Bethel	Radhakrishnan	10 cow, 3 Buffalo	130 lit/day

Table 7-8 Details of Dairy Outlets and collection centres

Ward No.	Name of Ward/Place	Type of outlets and collection centres	Average Qty collected per Month (Liters)
23	Thittamel	Milk Co-operative societies	Not Functional

7.4.4 Problems and potentials

The municipal area with its large extent of dry cultivation area, availability of water, rising demand for livestock produces etc. has good potential for development of this sector. However, the infrastructure facilities available in the sector are minimal and needs enhancement.

7.4.5 Inference

Animal Husbandry sector is weak in Chengannur Municipality. However, there is a possibility for developing the sector with creation of adequate infrastructure in the sector. In poultry sector efforts may be made 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.

7.5 INDUSTRY

7.5.1 Existing Industrial Scenerio

Industrial land use constitutes only 0.36% of the total municipal area. There is no large scale and medium scale industries in Chengannur Municipality. There are only 9 small scale industrial units in the Municipality.

The small-scale industries are further classified into Agro based, Electronics based, Automobiles, Wood based, Engineering based, Printing & Photostats, Garment making,

Electrical based, Jewelry designing, Rubber based, building materials, Leather based, Chemical and Others. The number of units in each class is given in Figure 7:19.

Small scale industries in the municipalities are in Agro based, Textiles, Electronics and other classes. Agro based industries include bakeries and textile include tailoring units.

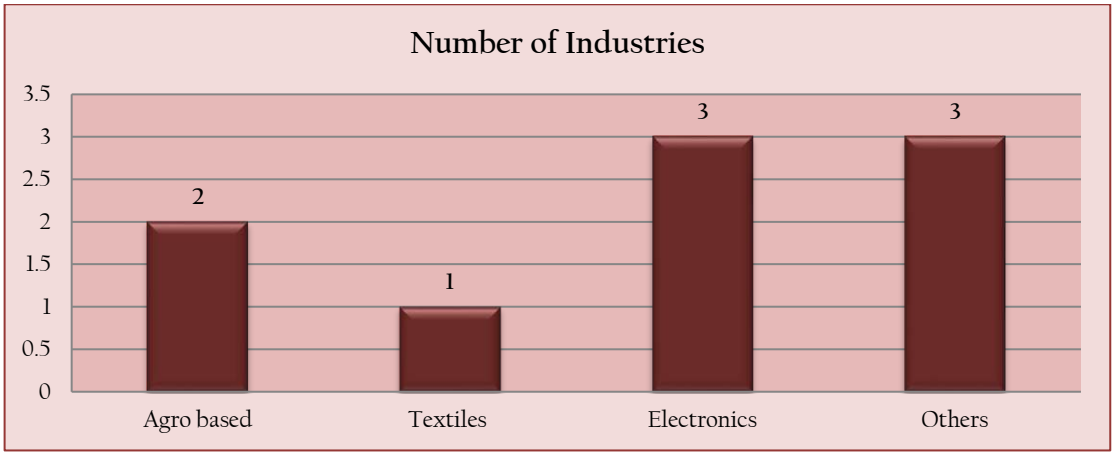

Figure 7:19 Industries in various categories

7.5.2 Industrial production

The industrial production is limited to food products and coir products. Value addition or diversified productions are limited.

7.5.3 Spatial distribution

Figure 7:20 shows the spatial distribution of industrial land use in the town. The concentration of industrial land use is high in Mundenkavu ward. The high concentration in this ward is explained by the presence of industrial estate in this ward. 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 7:20 Spatial distribution of Industrial Land use

7.5.4 Problems and Potentials

The Municipality has a large number of people working outside the country. The major problem experienced by the town in this sector is the lack of entrepreneurship due to a wide spread culture of migration to Middle East in search of employment. 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.

Industrial and Commercial Policy, 2018 of the Government of Kerala envisages to transform Kerala into a vibrant investment destination with an effervescent entrepreneurial society through inclusive, eco-friendly and sustainable economic growth with the creation of employment opportunities with reasonable wages. Kerala aims to become one of the top 10 ranking states in the country as far as Ease of Doing Business is concerned. 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 for which Chengannur Municipality has to play major role.

Efforts to regain the status of the town as a trading centre of agricultural produces will open out chances of value addition units.

7.5.5 Inference

The existing industrial base of the town is not very strong, mainly due to lack of entrepreneurship and cultural orientation towards out migration to Middle East and European countries for employment. However, the town has potential for growth in house hold industrial units which are a need of the hour in view of the anticipated changes in the employment pattern in the Middle East and elsewhere. Efforts to regain the status of the town as a trading centre of agricultural produces will open out chances of value addition units.

7.6 FISHERIES

The Municipality has no coast line and hence fishery is not an important sector of economy of the Municipality. Even though the Municipality has rivers flowing through it, the fishing sector is not prominent. From the local resource group employment data, only 89 people were engaged in fisheries from the Municipality.

8 TRAFFIC AND TRANSPORTATION

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. This chapter details out the traffic and transportation of Chengannur Municipality.

8.1 Introduction

Traffic and transportation are of prime importance in the economic activity of an urban settlement and improvements in the interactions that the settlement has with the neighbouring towns and the settlements within the region may contribute to the development of the urban settlement.

Chengannur is well-connected by road and rail. State Highway 1 (SH-1), popularly known as the MC Road, passes through the heart of the town and connects Chengannur to Thiruvananthapuram and Kottayam. The Chengannur - Kottayam stretch of the MC Road is also part of the NH 220 which stretches between Kollam and Theni. Another major road is the State Highway 10, the Mavelikara – Kozhenchery road, which connects Chengannur to Mavelikkara and Sabarimala. Besides these two roads, there are also many arterial roads running across the length and breadth of the town.

Kerala State Road Transport Corporation has a depot at Chengannur which is one among the 29 major depots in the state. The Municipal Private Bus stand is located in front of the railway station. Private buses leave this stand heading to various places in Alappuzha, Pathanamthitta and Kollam districts.

Chengannur Railway Station is a major railway station in Thiruvananthapuram railway division of the Southern Railway Zone. It caters to the needs of two districts, viz. Alappuzha and Pathanamthitta. Recently, the station has been declared as "The Gateway to Sabarimala". Two new lines are proposed from Chengannur: one to Thiruvananthapuram via Kottarakkara and the other to Sabarimala via Pathanamthitta.

The nearest Airports are Thiruvananthapuram International Airport and Nedumbassery International Airport which are at a distance of 116km and 127km from Chengannur respectively.

8.2 Characteristics of transport network

8.2.1 Roads

A. Existing Road network

The road network pattern within Chengannur town resembles a composite pattern similar to radial as well as grid iron. The stretch from Hospital junction to Vellavoor junction and Business India Ground to Railway underpass forms the CBD region of the town.

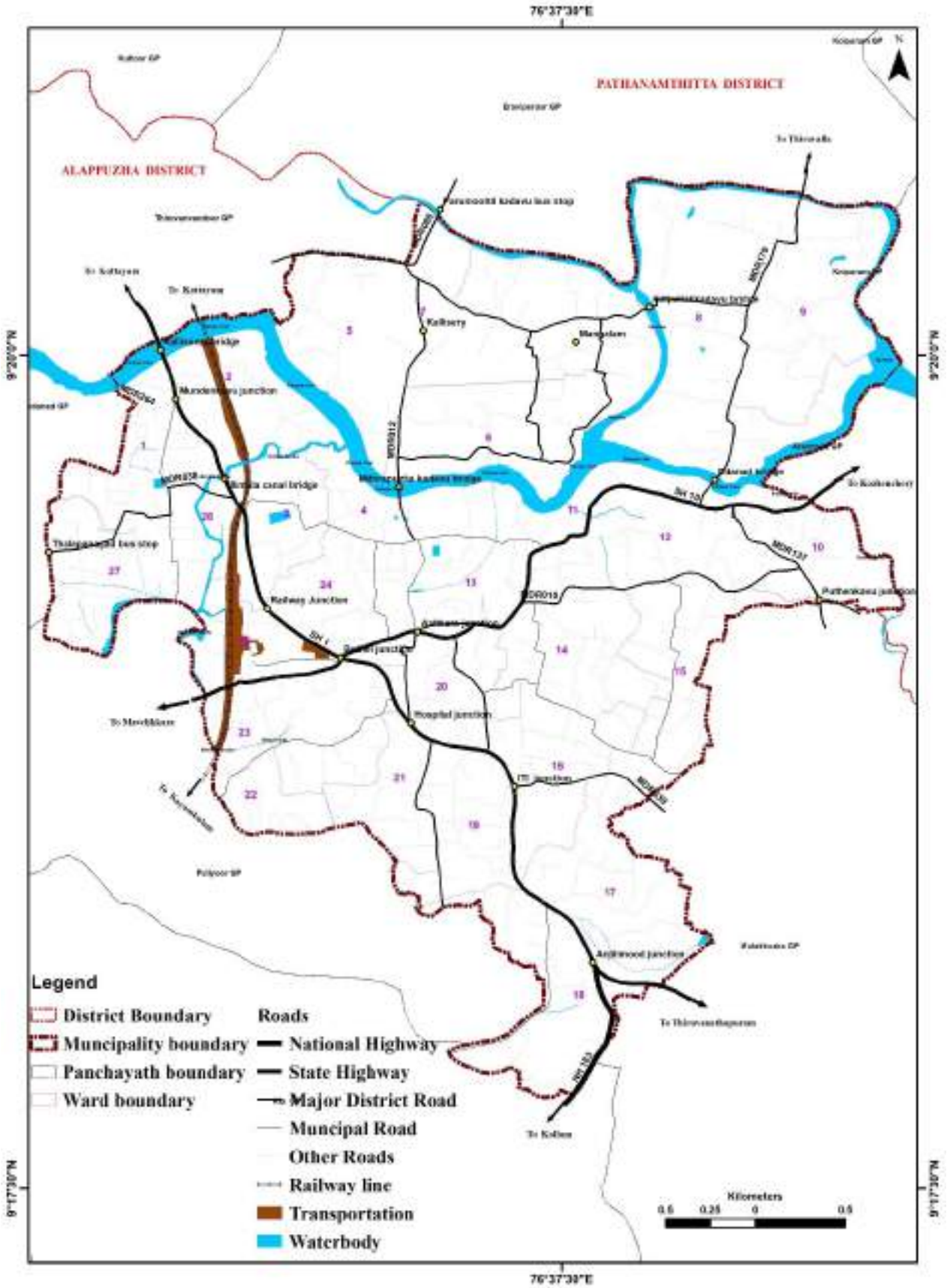

Figure 8:1 Road Network of Chengannur Municipality

The MC Road passes through the centre of Chengannur Municipality and runs for a distance of 4.75 km within the Municipality boundary, the two ends being Anjilimood and Erapuzha Bridge. The carriageway width of the road varies along its length and is catering to two-lane width. The road (upto Engineering College Junction) was upgraded with the Kerala State Transport Project (KSTP) to standard two-lane. The pavement of the road is provided with bituminous surfacing and is in good condition. This road section includes four culverts and one bridge of span 32m (Puthentheruvupadi Bridge). The major intersections in this road are Anjilimood junction, ITI junction, Hospital junction, Bethel junction, Vellavoor junction, Puthentheruvupadi junction and Mundancavu junction. The land use along the stretch is predominated with commercial activities, along with residential and slight agricultural areas. Street lightings are properly provided and the road has been provided with central line as well as edge line markings upto Engineering College junction.

The Mavelikkara–Kozhenchery State Highway (SH 10) also passes through Chengannur Municipality. The road runs for a distance of 4.35 km from Perissery junction to Puthenkavu, in which the Vellavoor – Bethel section overlaps with the MC road. The pavement of the road is provided with bituminous surfacing and is in poor condition upto Vellavoor. The section from Bethel to Puthenkavu has a fair to good surfacing and is provided with road markings. The land use along this road is mixed consisting of residential, agricultural and commercial.

Other major roads in Chengannur Municipality are Puthencavu–Edanadu road, Chengannur –Kidanganoor road, Venmony - Chengannur Road, Chengannur - Parumala Road, Mithrapuzha–Kuttikattupadi road, Sabarimala Road and Suriyani Church Road. All the roads are black topped and the surface condition varies from poor to fair.

The road density in the Municipality comes to 9.82 km per sq.km which is higher compared to other similar towns in the state. The major traffic carriers are the MC road and Mavelikkara – Kozhenchery SH.

B. Transport Terminals

The town has two bus terminals. One is owned by KSRTC and is exclusively used by them and is located on the side of MC road. This terminal mainly caters to the inter district operations as well as intra district operations.

The other bus terminal is located opposite to railway station caters to all the private buses passing through and operated from the town. The bus stand attracts through traffic to the centre of the town adding to congestion and thus is ill located. The present area available is only 7000 sqm. The number of buses operating is high. It is of utmost importance to propose a new bus terminal for the mofussil services, including that of Sabarimala trips.



Figure 8:2 KSRTC Bus Terminal

C. Bottlenecks and Missing links

The major bottlenecks in the road network are Puthentheruvupadi Bridge, Erapuzha Bridge and the two railway underpasses near Temple junction and Railway Station. Heavy traffic congestion is felt at Vellavoor junction, Bethel junction, Engineering College Junction and Railway Station premises. The inflow of Sabarimala pilgrims is so high that the link from Private Bus Stand to Vellavoor behaves like a pedestrian mall. Adding to this is the location of KSRTC stand on the MC road near Vellavoor and the market location near Bethel junction, where loading / unloading of goods vehicle also occurs. The Taluk office, Taluk Hospital and the Engineering College are also located inside the CBD region, adding to more and more traffic related issues.

Alternative links to divert the by passable traffic passing through the CBD area would help to reduce the inter mixing of intra-town and inter-town traffic on roads within the central part of the town.

The bridge over Edakaddu thodu is shown in Figure 8:3, which is prone to bottle neck issues. This bridge is in the municipal boundary, and is the linkage towards Pathanamthitta. There are proposals for a new wider bridge, which is still on papers only.



Figure 8:3 Bottle neck traffic on the bridge

D. Other aspects

The road coverage is reasonably good within the Municipality but the lesser width is a major problem. The draft transport policy for the state realizes this bottle neck in the case of urban roads and prescribes advance action to widen the existing arterial and sub-arterial roads to 4/6 lane standards with provision for pedestrian walking and crossing facilities, cycle tracks and off-street parking. The road system in Chengannur which has been developed based on a need-based approach has to be ordered based on hierarchy of roads considering their importance and their role to carry traffic. Based on such an approach it is necessary to prepare a Road Network Plan, which would not only show the regional and local level importance of roads, but would also point out the need for new linkages, which have to be developed and the probable traffic volume which can be diverted to each of these roads.

8.2.2 Railways

Chengannur railway station is inside Chengannur town. All the passenger trains and some express trains have halt at Chengannur railway station. The station is the nearest railhead to Sabarimala and hence hosts thousands of Sabarimala pilgrims during festival seasons. Adequate facilities need to be provided for the pilgrims with respect to their waiting and travel. There is heavy need of crowd management as the pilgrims walk in crowds and blocks the entire traffic along the SBI – Vellavoor link of SH 10.

Chengannur Railway Station is a major railway station in Thiruvananthapuram railway division of the Southern Railway Zone. It caters to the needs of two districts, viz. Alappuzha

and Pathanamthitta. By rail, Chengannur is well connected to major cities in India like Delhi, Mumbai, Chennai, Kolkata, Bangalore, Hyderabad, Pune, Mangalore, Bhopal, Guwahati, Nagpur, Jammu and other major cities of the country. Recently, the station has been declared as "The Gateway to Sabarimala". The rail line between Chengannur and Thiruvananthapuram has been doubled and electrified. Two new lines are proposed from Chengannur: one to Thiruvananthapuram *via* Kottarakkara and the other to Sabarimala via Pathanamthitta. Reservations, goods booking facilities, retiring rooms etc. are the services available here.





Figure 8:4 Chengannur Railway Station

8.3 Existing Traffic Characteristics

The Town & Country Planning Department has entrusted the study on existing traffic characteristics of Chengannur town to NATPAC. The following are the excerpts from the traffic study report of NATPAC conducted in 2014.

8.3.1 Vehicle Population

The growth of motor vehicles in Alappuzha district during the period from 2008 to 2013 is given in Table 8-1. It can be seen that the vehicle population in Alappuzha district has grown by more than 1.6 times during those five years.

Table 8-2 shows the number of newly registered vehicles in Alappuzha district for the year 2013.

Table 8-1 Growth of Motor Vehicles in Alappuzha and their Index (Base 2002 = 100)

Growth of Motor Vehicles in Alappuzha and Their Index (Base 2002 = 100)			
Year	Item	Alappuzha	Kerala
2008-09	No. of Motor Vehicles	337804	4907495
	Index	242	
2009-10	No. of Motor Vehicles	374512	5397652
	Index	268	
2010-11	No. of Motor Vehicles	421246	6072019
	Index	302	
2011-12	No. of Motor Vehicles	478641	6870354
	Index	342	
2012-13	No. of Motor Vehicles	531940	8042541
	Index	380	

Source NATPAC Report 2014

Table 8-2 Newly registered vehicles in Alappuzha district-2013

Sl. No.	Classification of Vehicles	No. of Vehicles
1	Multiaxled Articulated Vehicles	3
2	Trucks and Lorries	514
3	Four wheelers	1517
4	Three wheelers	538
5	Stage carriage	461
6	Contract carriage	212
7	Private service vehicle	4
8	Other buses	73
9	Motor cabs	1184
10	Maxi cabs/Taxi	0
11	Other taxis	80
12	LMV 3 seater	3216
13	LMV 4-6 seater	0
14	Motor cycle hire	0
15	Scooter	752
16	Mopeds	1568
17	Motor cycles (› or ‹ 95cc)	49933
18	Cars	9094
19	Jeep	172
20	Omni buses	0
21	Tractors	26
22	Trailors	2
23	Others	504
Grand Total		**69853**

Source NATPAC Report 2014

8.3.2 Traffic V-C studies

The map of Chengannur town showing the density of traffic on various homogeneous sections of the roads is shown in Figure 8:5.

The following road sections were found to be overloaded more than their carrying capacity:

The traffic volume in passenger car units (PCU) varied from a high of 34,111 to a low of 21,348 on M C road. High traffic volume of about 34,111 was observed between E C junction and Bethel junction. On Mavelikkara – Kozhenchery State Highway, the traffic volume ranged from 11,053 on Bethel – Althara to 17,390 on Perissery – SBI junction.

Capacity utilization of the road stretches was measured by volume-to-capacity ratio (V/C Ratio). It is the ratio of volume of traffic plying on the road stretch to the capacity of the road stretch. For working out the capacity of different road sections, the information compiled during the road inventory surveys was compared with the specifications of IRC- 106-1990. While working out the capacities due consideration was given to carriage - way width, junctions, parking, lateral clearance, shoulder, surface condition etc.

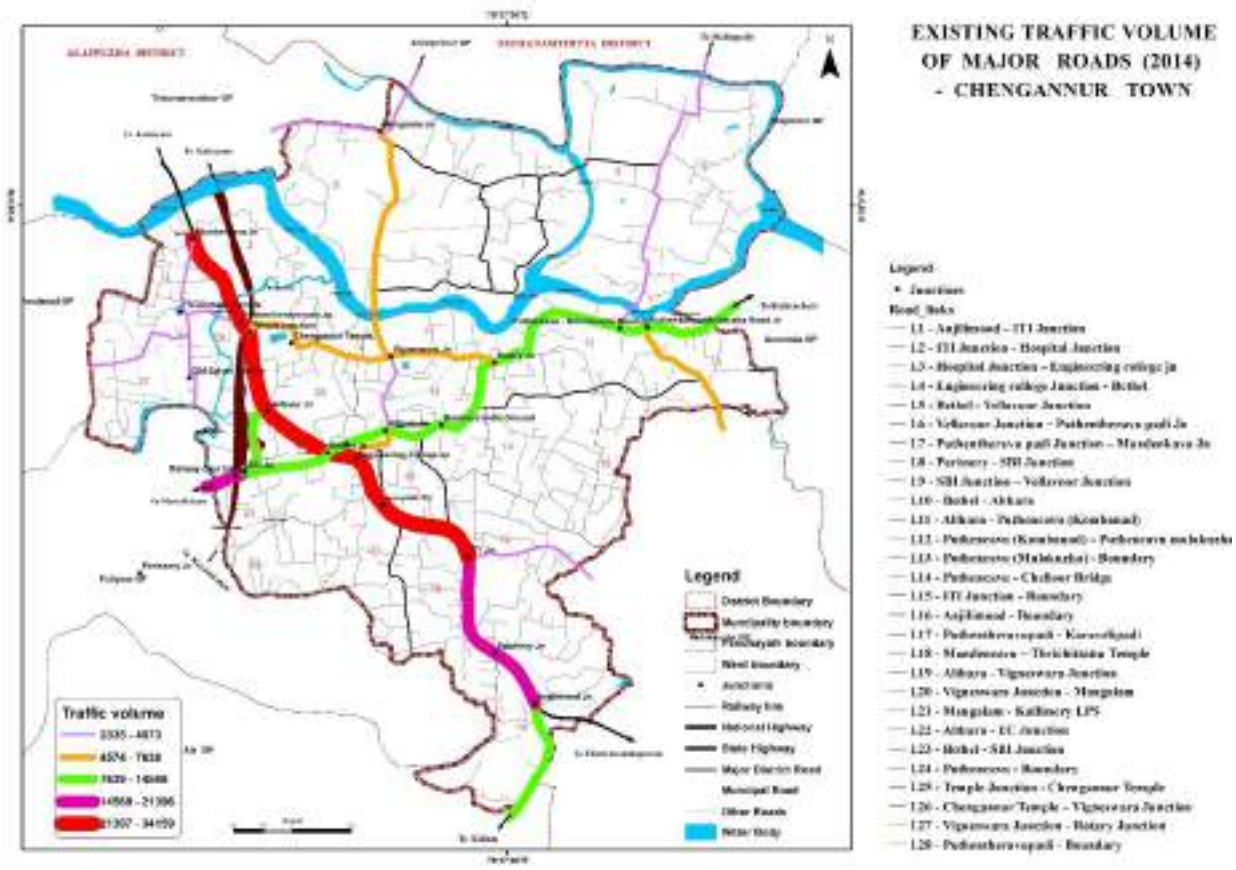

Figure 8:5 Existing traffic volume on major Roads

Source NATPAC Report 2014

Table 8-3 Road sections with V/C ratio >1

Sl. No.	Name of Road Section	Volume-Capacity Ratio
	MC Road	
1	Anjilimood – ITI Junction	1.42
2	ITI Junction - Hospital Junction	2.01
3	Hospital Junction – EC Jn	1.97
4	EC Junction - Bethel	2.27
5	Bethel - Vellavoor Junction	2.22
6	Vellavoor Junction – Puthentheruvupadi Junction	1.94
7	Puthentheruvupadi Junction - Erapuzha	1.74
	Mavelikara - Kozhenchery State Highway (SH 10)	
8	Perissery - SBI Junction	1.16

The traffic volume observed at different road stretches were compared with the capacity of the road sections, to calculate the volume – capacity ratio (V/C ratio) of different road sections within the city. Major road stretches where the V/C ratio exceeds 1 are given in Table 8-3 and Figure 8:6.

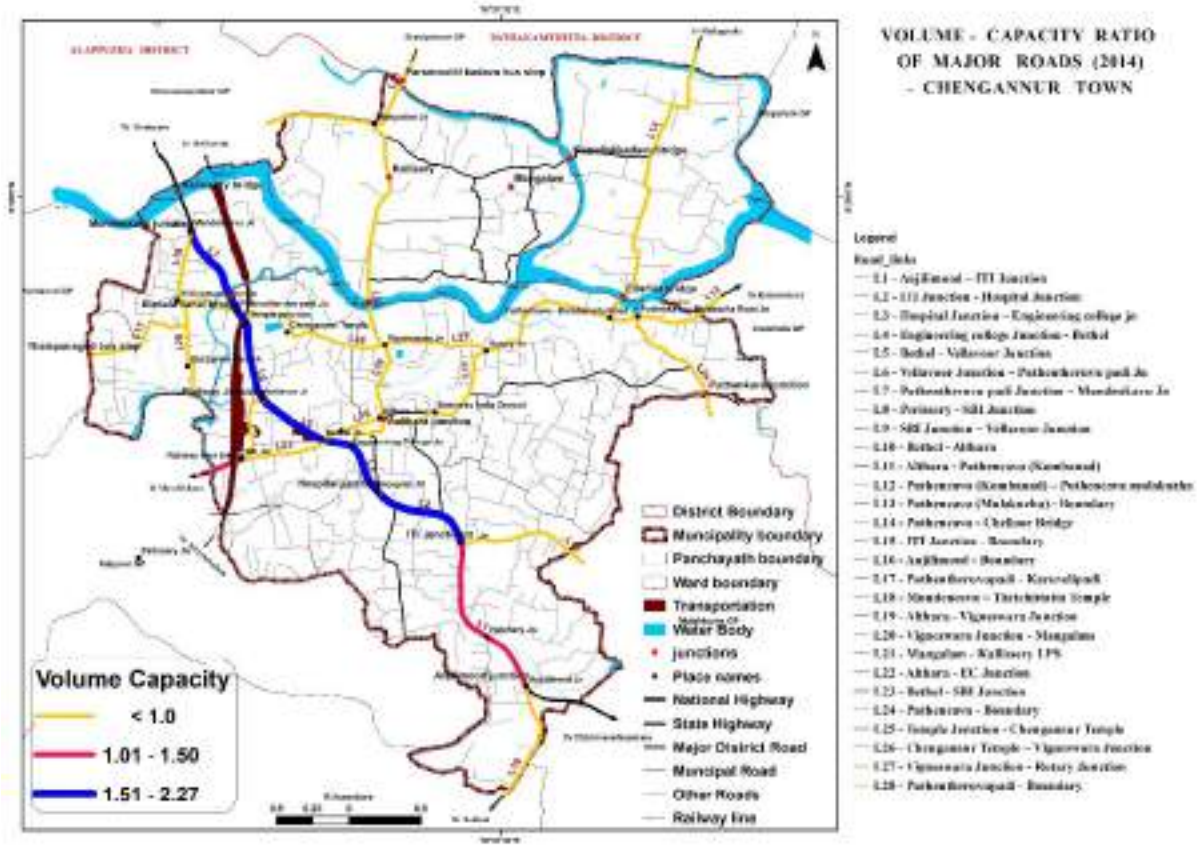

Figure 8:6 Road sections with V/C ratio >1

8.3.3 Speed and delay studies

From the speed and delay survey conducted in MC Road, with a total length of 4.75 km, it was noted that the journey speed was 24.75 kmph and running speed was 34.13 kmph. The section for survey was taken from Anjilimood to Erapuzha Bridge, the two end points, inside the Municipality. The reasons for the delay are attributed to various particulars like congestion, intersection and narrow bridges at Puthentheruvupadi and Erapuzha.

In Mavelikkara–Kozhenchery (SH 10) Road, over a length of 4.35 km, the delay was caused by the presence of intersections, pedestrian crossing, bus stops and signals. The average journey time was 661 seconds. The journey speed was noted as 23.69 kmph while the running speed was 28.47 kmph.

For Sabarimala Road with a length of 1.81 km, the journey speed and running speed was 24.68 kmph and 25.65 kmph respectively, whereas in Parumala Road, the journey speed was 25.57 kmph while the running speed was 30.67 kmph.

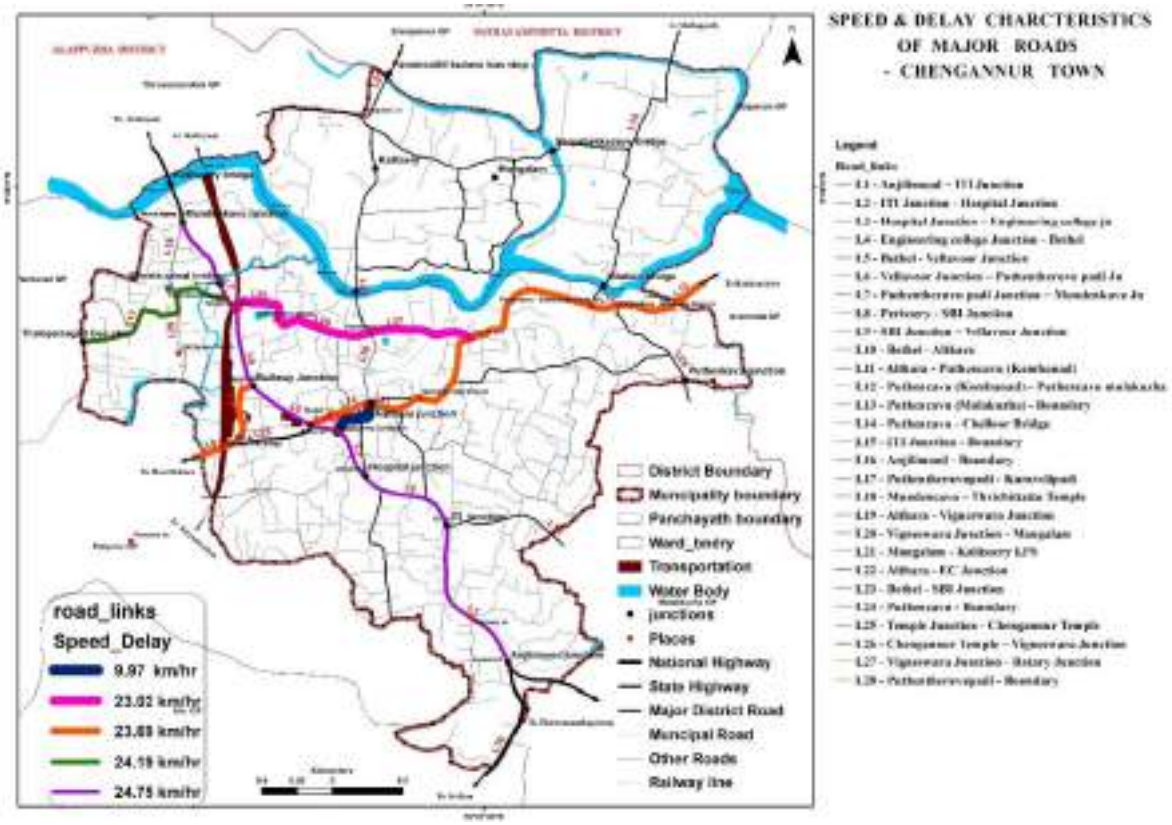

Figure 8:7 Journey Speed in Major Road Sections

Table 8-4 Speed and Delay Characteristics of Major Roads in Chengannur Study Area

Sl. No.	Road Name	Length (km)	Average journey time (seconds)	Delay (seconds)	Speed (km/ Hr)		Delay Cause
					With delay	Without delay	
1	MC Road	4.75	691	190	24.75	34.13	Intersection, Bus stop, Pedestrian, Narrow bridge
2	Mavelikara-Kozhenchery	4.35	661	111	23.69	28.47	Intersection, Pedestrian, Bus stop
3	Sabarimala Road	1.81	283	41	23.02	26.93	Intersection, Congestion
4	Althara-Oneway	0.36	130	89	9.97	31.61	Intersection, Bus Stop
5	Parumala Road	1.25	186	94	24.19	48.91	Intersection, Bus Stop

8.3.4 Turning movement at intersections

Based on the reconnaissance survey, turning movement surveys at 11 major intersections in the study area were conducted to ascertain the peak hour demands. The observations are given in Table 8-5.

It could be seen that the Bethel Junction witnessed the maximum peak hour traffic flow of 3,115 PCU. Engineering College junction had a peak hour traffic of 2,979 PCU, while Vellavoor junction had a peak hour traffic of 2,743 PCU followed by Hospital junction with a peak hour traffic of 2,644 PCU. For other intersections, the peak hour traffic flow varied between 609 to 1,956 PCU.

Table 8-5 Peak hour traffic flow at major intersections in Chengannur town

Sl. No.	Name of Intersection	Intersecting Roads	No. of Arms	Peak Hour	Peak Hour Volume (PCU)
1	Puthentheruvupadi Junction	MC Road and Parumala Road	3	10.45 to 11.45	1,951
2	Vellavoor Junction	MC Road and SH 10	4	10.45 to 11.45	2,743
3	Engineering College Junction	MC Road, Engineering College Road and Althara One-way road	4	10.45 to 11.46	2,979
4	Bethel Junction	MC Road, SH 10and Bethel Road	4	16:15 to 17:15	3,115
5	Hospital Junction	MC Road and Hospital Road	3	5.15 to 6.15	2,644
6	Anjilimoodu Junction	MC Road and Venmony Road	3	5.15 to 6.15	1,956
7	Althara Junction	SH 10, Althara One-way Road, Vigneswara Road and Business India Road	5	9.00 to 10.00	1,319
8	Puthencavu (Kombanad Road Junction)	SH 10 and Kombanad Road	3	8.45 to 9.45	1,117
9	Puthencavu (Mulakuzha Road Junction)	SH 10 and Mulakuzha Road	3	4.45 to 5.45	1,097
10	Vigneswara Temple Junction I	Sabarimala Road and Mithrapuzha Road	4	9.00 to 10.00	609
11	Vigneswara Temple Junction II	Sabarimala Road and Mithrapuzha Road	4	8.45 to 9.45	688

8.3.5 Pedestrian survey

Pedestrian surveys were conducted at major locations where the pedestrian lateral and cross movements were found to be high. Locations selected for pedestrian survey and peak hour pedestrian demand is shown in Table 8-6 and Table 8-7.

Table 8-6 Peak hour pedestrian cross movements

Sl. No.	Name of Location	Peak Time	No. of Pedestrians		
			Up	Down	Total
1	KSRTC	16.15 - 17.15	134	281	415
2	Railway Station	17.00 - 18.00	353	452	805
3	Market Road	15.30 - 16.30	98	83	181
4	Bethel Junction	8.45 - 9.45	504	51	555
5	Vellavoor Junction	10.00 - 11.00	715	280	995
6	Mammen Memorial Hospital	9.30 - 10.30	102	77	179
7	Bethel - Junction	8.15 - 9.15	133	218	351

Analysis of pedestrian lateral movement at major activity/traffic generation areas has shown that a maximum of 1152 pedestrian movement occurred at KSRTC stand followed by 1076 pedestrian movements at Railway Station. A high volume of 995 pedestrian movements occurred at Vellavoor Junction in the cross direction. Safe passage of pedestrians is an urgently felt necessity in Chengannur town.

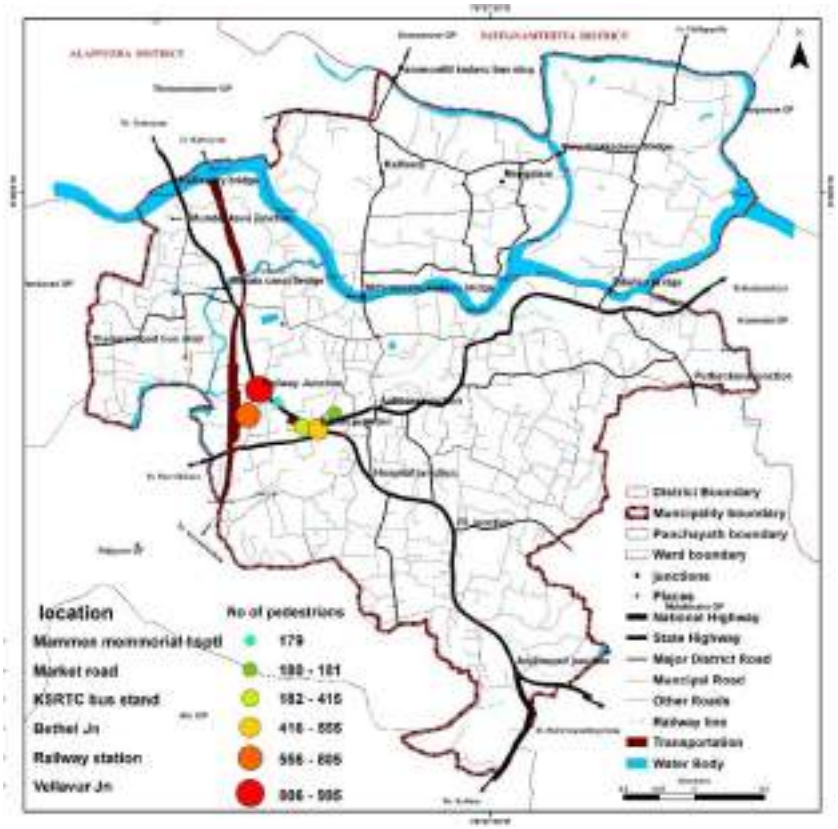

Figure 8:8 Pedestrian Cross Movements

Table 8-7 Peak hour pedestrian lateral movements

Sl. No.	Name of Location	Peak Time	No. of Pedestrians		
			Up	Down	Total
1	KSRTC	15.45 - 16.45	705	447	1152
2	Railway Station	15.15 - 16.15	598	478	1076
3	market Road	16.30 - 17.30	409	435	844
4	Bethel - Pandalam arm	10.00 - 11.00	177	98	275
5	Vellavoor	10.00 - 11.00	520	526	1046
6	Mammen Memorial Hospital	9.00 - 10.00	411	264	675
7	Bethel - Junction	8.15 - 9.15	246	269	515

8.3.6 Junctions

The main junctions in Chengannur Municipality are

- Bethel junction
- Althara junction
- Vellavoor junction
- Engineering College junction
- Hospital junction
- Anjilimood junction
- Puthencavu Junction
- Vigneswara junction
- Puthentheruvupady Junction

The major intersections in the Chengannur CBD area house many commercial establishments and also avenues of business and commerce. Besides that, the bus stand is situated very near to the MC road and the market is situated in between Bethel and Althara junction. Adequate junction improvement needs to be done for Bethel junction, where the junction geometries are of very poor nature, which makes the maneuvering of vehicles very difficult. Similar is the situation in Vellavoor junction, Engineering College junction and Hospital junction. During the peak periods, especially in the evening, the situation becomes even worse causing traffic block at these junctions.

8.3.7 O.D Survey

The objective of this survey is to determine the origin and destination of external-external, external-internal and internal-external passenger and goods movements across the external cordons. An analysis of these traffic movements will give the proportion of bye-passable traffic along with the major external interaction areas.

For a meaningful analysis of O-D survey data, the study region was divided into 4 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 20 traffic zones, which include the immediate surrounding areas and adjoining districts.

Base year inter-city travel characteristics of passenger and goods movements were obtained by conducting Origin-Destination survey of a sample number of motor vehicles passing through major outer cordon locations on roads and of passengers alighting and boarding at the railway station located within Chengannur town.

A. O-D of Passenger Trips

In Chengannur, a total of 2,81,433 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 81,012 trips constituting 28.79 per cent of the total trips. About 3.38% of trips were generated from the remaining area of Chengannur Municipality and the balance Alappuzha district generated 21.83% of the trips. Trips generated from other districts were 1,26,560 and that from other states were 2,910.

An analysis of inter-town trip attractions revealed that the CBD area attracted 1,08,997 inter-town passenger trips. The remaining Chengannur Municipality area attracted about 3.12% of total trips and the balance of Alappuzha district attracted nearly 45,596 trips. Trip attractions by other districts amounted to 1.12 lakhs. The number of trips attracted to other states was 5725. The desire lines of inter – town passenger trips are shown in Figure 8:9.

Distribution of inter-city daily passenger trips according to mode of travel & purpose of trip and mode of travel & occupation of trip makers is given in

Table 8-8 and Table 8-9.

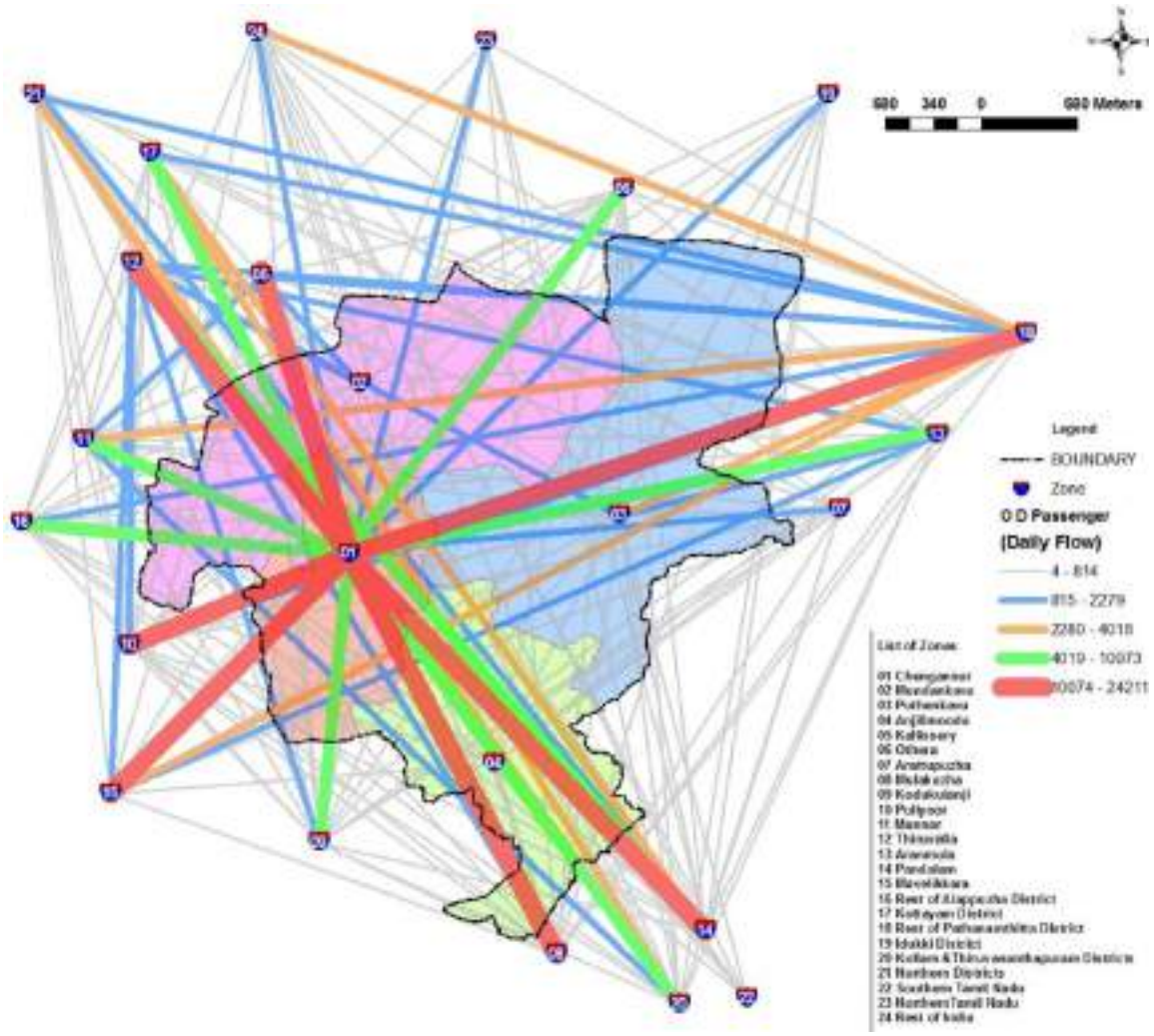

Figure 8:9 Desire lines of inter- town passenger trips in Chengannur

Table 8-8 Distribution of Inter-Town Daily Passenger Trips according to mode of travel & purpose of trip

Distribution of Inter-town Daily Passenger Trips According to Mode of Travel and Purpose of Trip

Sl. No.	Type of Vehicle	Purpose of Trip							Total	Per cent
		Work	Personal	Shopping	Recreation	Social	Education	Back home		
1	Bus	53,174	35,472	12,878	3,031	25,181	7,048	22,667	159,450	56.66
2	Mini-bus	6,936	4,627	1,680	395	3,285	919	2,957	20,800	7.39
3	Car	12,109	9,701	2,271	1,151	8,514	1,257	6,023	41,026	14.58
4	Auto	3,840	3,647	1,675	91	2,771	589	2,489	15,100	5.37
5	Two wheeler	15,571	7,679	3,688	555	3,641	2,332	4,925	38,390	13.64
6	Train	2,268	1,443	31	49	988	716	1,171	6,667	2.37
Total		93,899	62,568	22,223	5,272	44,379	12,861	40,231	281,433	100
Per cent		33.36	22.23	7.9	1.87	15.77	4.57	14.3	100	

Table 8-9 Distribution of inter-city daily passenger trips according to mode of travel & occupation of trip

Distribution of Inter-town Daily Passenger Trips According to Mode of Travel and Occupation of Trip Maker									
Sl. No.	Occupation of Trip Makers	Type of Vehicle						Total	Percent
		Bus	Mini-bus	Car	Auto	Two wheeler	Train		
1	Government service	18,167	2,370	4,675	718	5,376	1,535	32,841	11.67
2	Private service	24,481	3,193	5,320	1,902	7,290	1,486	43,672	15.52
3	Industry	202	26	10	-	109	50	397	0.14
4	Business	24,165	3,152	8,860	1,186	4,279	700	42,342	15.05
5	Professional	6,371	831	1,826	586	1,364	112	11,090	3.94
6	Cultivator	1,821	237	402	202	476	47	3,185	1.13
7	Casual labourer	26,494	3,456	5,308	3,972	6,425	273	45,928	16.32
8	Retired	12,479	1,628	4,400	557	2,440	104	21,608	7.68
9	Unemployed	10,036	1,309	3,547	876	1,526	369	17,663	6.28
10	House wife	8,002	1,044	1,792	897	2,054	145	13,934	4.95
11	Student	11,297	1,474	1,489	3,215	1,993	737	20,205	7.18
12	Others	12,069	1,574	2,017	513	4,624	1,084	21,881	7.77
13	Gulf	3,867	504	1,382	476	435	25	6,689	2.38
Total		159,451	20,798	41,028	15,100	38,391	6,667	281,435	100

A. O-D of Goods Movement

Inter-town movement of goods to the tune of 15,562 tonnes was carried out over the study region. The major traffic generator of goods traffic within the study region was the CBD area with 3,306 tonnes (21.24%) most of them bound for other Districts within the State. A total of 1,320 tonnes of goods traffic was generated from remaining Alappuzha area. Goods generated from other districts formed 63.02% of the total volume, while the goods generated from other states was to the tune of 706 tonnes.

In the case of goods traffic attraction, CBD area had the dominant share with 2947 tonnes. Among the external zones, 23.54% of the goods traffic terminated in Alappuzha District, while 54.5% constituted the goods volume to other districts. Goods bound to other states were 318.3tonnes constituting 2.05% of the total volume. The desire lines of inter- town goods traffic are shown in Figure 8:10.

8.3.8 Modal split

A. Modal split of Passenger Traffic

The inter-town passenger transport in Chengannur is met mostly by road based KSRTC buses, private buses, and a host of personalized vehicles like two-wheelers and four-

wheelers. Chengannur railway station is situated inside the Municipality and hence there is a proportional usage of trains as well.

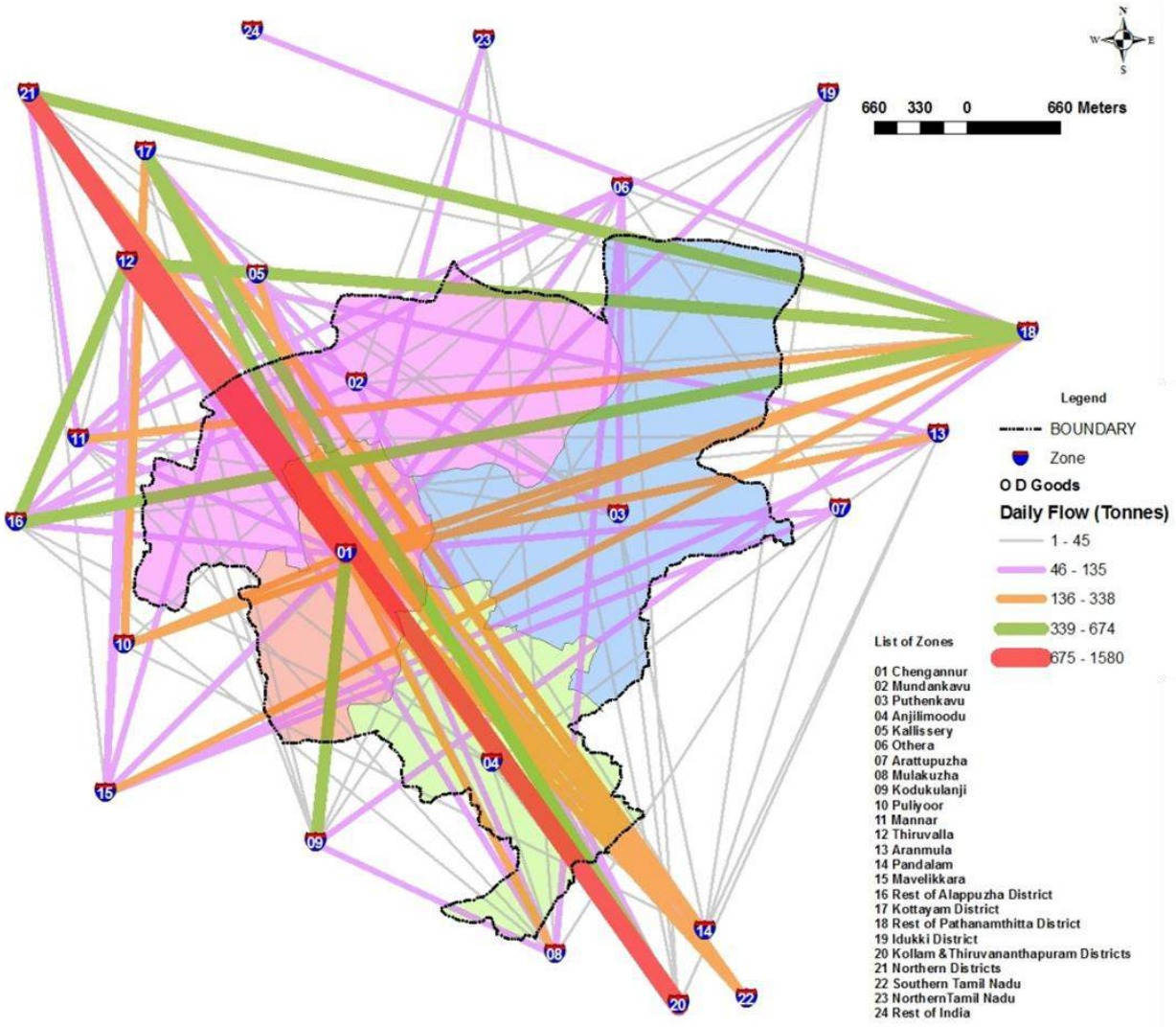

Figure 8:10 Desire lines of inter- town goods traffic in Chengannur

Source NATPAC Report 2014

An analysis of the O-D survey data collected from outer cordon survey locations revealed that an estimated 2,81,433 inter-town passenger trips were performed in the study region on a reference day consisting of 1,59,450 bus passenger trips, 20,800 mini-bus trips, 41,026 car trips, 38,390 two-wheeler trips, 15,100 auto trips and 6,667 train trips. Table 8-10 gives the modal split of inter-city passenger traffic in Chengannur town. Figure 8:11 presents the same in a pie diagram.

Table 8-10 Modal split of inter-city daily passenger trips in Chengannur town

Modal Split of Inter-town Daily Passenger Trips in Chengannur			
Sl. No.	Mode of Travel	No. of Passengers	% of Passengers
1	Train	6,667	2.37
2	Bus	159,450	56.66
3	Mini-bus	20,800	7.39
4	Car	41,026	14.58
5	Autorikshaw	15,100	5.37
6	Two-wheeler	38,390	13.64
Total		281,433	100

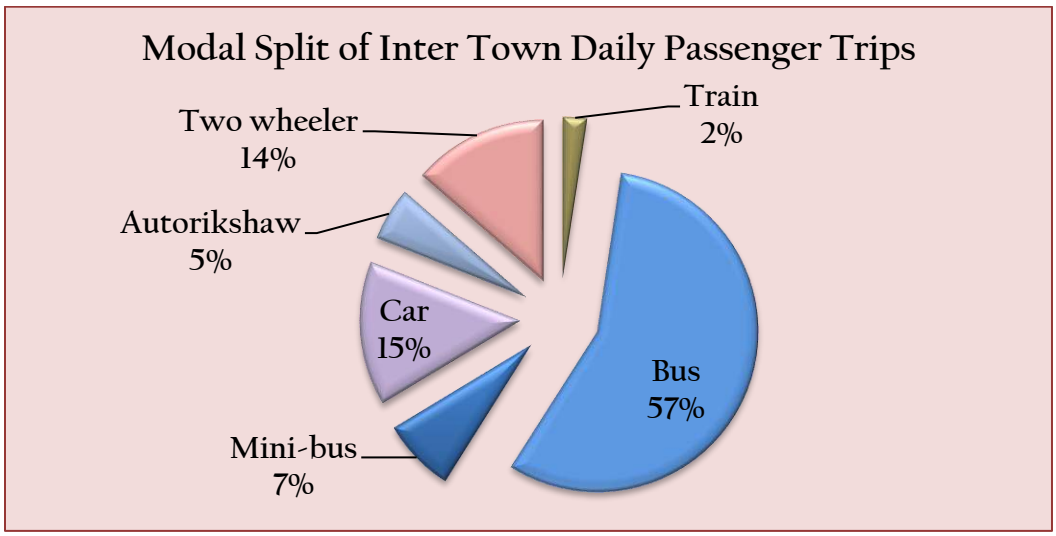

Figure 8:11 Modal split of inter-city daily passenger trips in Chengannur town

The number of passengers travelling by bus is more. It could be inferred that public transport had a significant role in meeting the inter-city passenger demand.

Table 8-11 Pattern of inter-town Daily passenger trips (in percentage)

Type	Internal – internal (%)	Internal – External(%)	External – Internal (%)	External-External (%)
Bus	0	32.06	41.89	26.05
Mini Bus	0	31.90	42.98	25.12
Car	0	28.31	34.26	37.43
Auto	0	44.27	42.27	13.46
Two wheeler	0	32.18	50.66	17.16
Train	0	31.53	32.19	36.28
Total	**0**	**32.16**	**41.85**	**25.99**

The bypassable traffic for passenger trips is almost 26% of the total daily passenger trips of the town.

B. Modal split of goods traffic

A total of 9153 goods vehicles were found to be involved in carrying goods traffic to and from the study region, consisting of 4654 trucks, 3457 mini-trucks and 1042 goods autos. The quantum of goods handled by the goods vehicles was to the tune of 15,562tonnes. Trucks carried the maximum volume of goods traffic (77.67%) followed by mini-trucks (19.84%). The remaining 2.49 per cent of goods traffic was handled by goods autos Table 8-12 gives the modal split of inter-city daily goods traffic in Chengannur town. The bypassable traffic for goods traffic trips is more than 56% of the total daily goods traffic of the town.

Table 8-12 Pattern of Inter-Town daily goods traffic (in Percentage)

Type	Internal – internal (%)	Internal – External (%)	External – Internal (%)	External-External (%)
Truck	0	23.6	20	56.4
Mini Truck	0	23	18.5	58.5
Goods Auto	0	41.7	28.4	29.9
Total	0	24	19.9	56.1

8.3.9 Purpose of Trip

In Chengannur, almost 33% of the total inter-town passenger movements were performed for work related purpose. An estimated 62,568 inter-town passenger trips were performed for personal purpose, which constituted almost 22.23% of the total inter-town passenger movements. This was followed by 44,379 social trips, 40,231 back home trips, 22,223 shopping trips, 12,861 educational trips and 5,272 recreational trips. Table 8-13 presents distribution of inter-town passenger trip for different purposes according to mode of travel. Figure 8:12 illustrates the same with pie diagram.

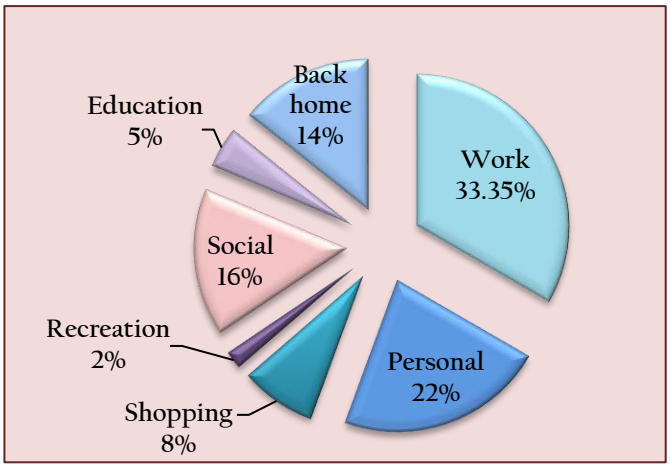

Figure 8:12 Distribution of inter-town daily passenger trips according to purpose of trip

Table 8-13 Distribution of Inter-town Daily Passenger Trips According to Mode of Travel and Purpose

Distribution of Inter-town Daily Passenger Trips According to Mode of Travel and Purpose of Trip

Sl. No.	Type of Vehicle	Purpose of Trip							Total	Per cent
		Work	Personal	Shopping	Recreation	Social	Education	Back home		
1	Bus	53,174	35,472	12,878	3,031	25,181	7,048	22,667	159,450	56.66
2	Mini-bus	6,936	4,627	1,680	395	3,285	919	2,957	20,800	7.39
3	Car	12,109	9,701	2,271	1,151	8,514	1,257	6,023	41,026	14.58
4	Auto	3,840	3,647	1,675	91	2,771	589	2,489	15,100	5.37
5	Two wheeler	15,571	7,679	3,688	555	3,641	2,332	4,925	38,390	13.64
6	Train	2,268	1,443	31	49	988	716	1,171	6,667	2.37
Total		93,899	62,568	22,223	5,272	44,379	12,861	40,231	281,433	100
Per cent		33.36	22.23	7.9	1.87	15.77	4.57	14.3	100	

8.3.10 Freight transport

Out of the 15,562 tonnes of inter-town goods traffic observed through outer cordon survey stations, maximum volume of 11,333 tonnes movements were observed in the case of construction materials which amounted to 73 per cent, followed by Agricultural products with 10.3 percent, miscellaneous items with 5 per cent, Industrial goods with 4.5 per cent, petroleum products with 4 percent and food grains with 3.3 percent. The major items transported are Earth, Gravel, Sand & clay, Timber & Bamboo and Granite & rubbles.

8.3.11 Parking survey

Parking surveys were carried out on major road sections of Chengannur study area to obtain the peak parking demand and parking duration of various categories of vehicles on these road sections. Table 8-14 Shows peak parking accumulation observed on major corridors.

Table 8-14 Parking accumulation of different road sections in Chengannur town

Sl. No.	Road Section/Location	Peak Parking Time	Type of Vehicle								Total (No)	Total (ECS)
			Bus	Mini Bus	Car	Passenger auto	Two-Wheeler	Truck	Mini Truck	Goods auto		
1	Hospital-EC Junction	11:15	0	0	52	28	211	0	7	4	302	137
2	EC-Bethel Junction	11:30	0	0	22	5	135	0	0	0	162	54
3	Bethel-Vellavoor Junction	12:15	1	0	30	46	98	0	2	4	181	105
4	Vellavoor-Puthentheruvupadi	11:30	0	0	21	9	124	1	4	12	171	75
5	Railway Underpass - Vellavoor	3:15	1	1	36	9	55	0	2	0	104	63
6	Bethel-Market Althara	4:00	0	0	16	35	129	0	3	10	193	92
7	Althara-EC Junction	3:45	0	0	17	11	63	0	2	2	95	45
8	Hospital Road	11:00	0	0	35	4	92	0	0	3	134	60
9	Bethel Road	12:00	0	0	6	7	25	0	1	1	40	21
10	Railway Station		0	0	84	9	185	0	0	0	278	130
11	Chengannur Temple		3	0	19	3	18	0	0	2	45	34
12	Bus stand Area		0	0	7	0	48	0	1	0	56	18

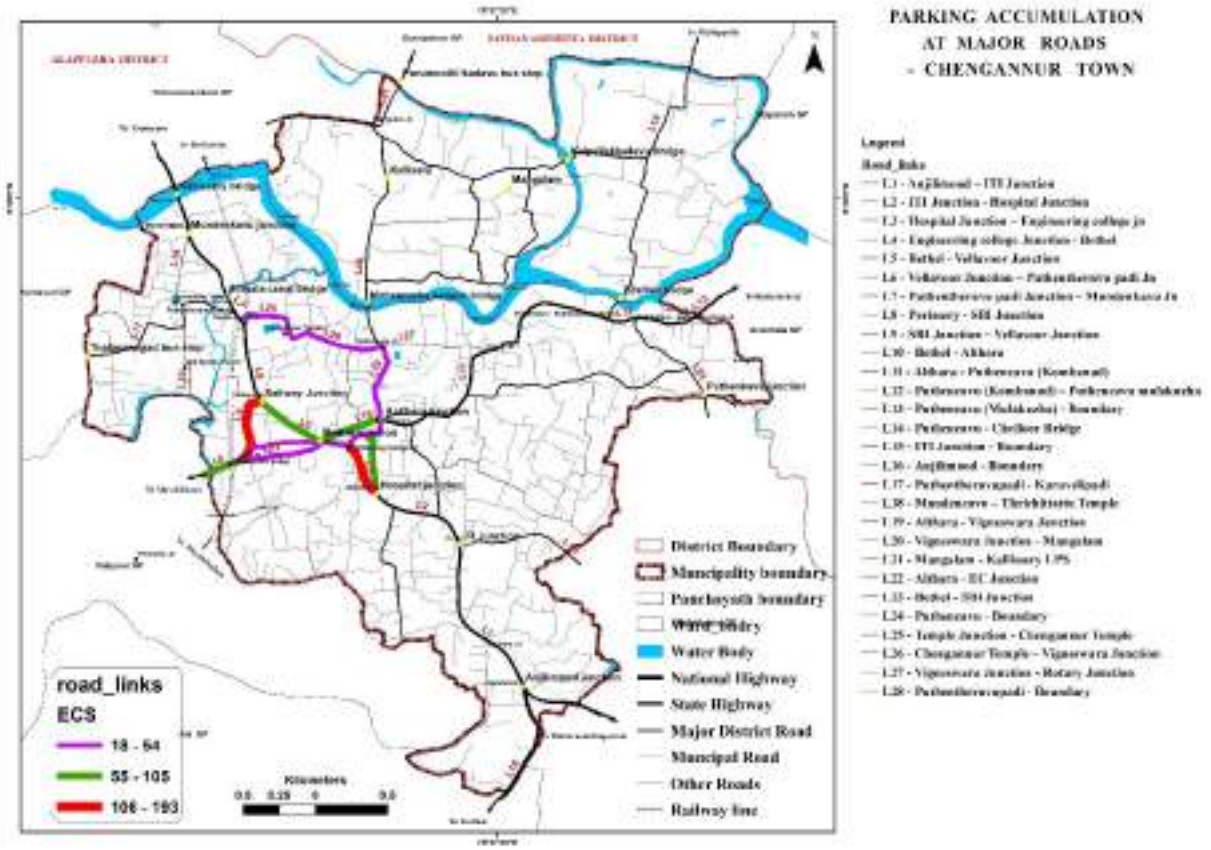

Figure 8:13 Parking Accummulation in Major Road Sections

Of the 12 corridors where parking accumulation survey was conducted, it was found that the Hospital Jn to Engineering College Jn had the highest parking accumulation of 302

vehicles parked at 11.15 A.M on a normal working day. 211 of these vehicles were found to be two wheelers, followed by 52 cars, 28 passenger autos, 7 mini trucks and 4 goods auto. Railway station had peak parking accumulation of 278, 193 vehicles on Bethel – market - Althara, followed by 181 vehicles on Bethel – Vellavoor Jn, 171 vehicles between Vellavoor - Puthentheruvupadi and 162 vehicles in the road section, Engineering College Jn to Bethel Jn.

Majority of the vehicles parked at the selected parking corridors were found to be for short duration of less than 30 minutes. About 33 per cent of the vehicles parked on the parking corridors in most of the locations were found to be parked for duration less than 30 minutes. About 24 per cent vehicles were parked for period of more than two hours. In few locations, about 18 per cent of vehicles were parked for a period ranging between one and a half hour and two hours.

8.3.12 Major corridors

Chengannur is well-connected by road and rail. State Highway 1 (SH 1), popularly known as the M C Road, passes through the heart of the town and connects Chengannur to Thiruvananthapuram and Kottayam. The Chengannur - Kottayam stretch of the MC Road is also part of the NH 220 which stretches between Kollam and Theni. Another major road is the State Highway 10, the Mavelikara – Kozhenchery road, which connects Chengannur to Mavelikkara and Sabarimala. Besides these two roads, there are also many arterial roads running across the length and breadth of the town. Other major roads in Chengannur Municipality are Puthencavu–Edanadu road, Chengannur –Kidanganoor road, Venmony - Chengannur Road, Chengannur - Parumala Road, Mithrapuzha–Kuttikattupadi road, Sabarimala Road and Suriyani Church Road.

8.4 Parking facilities

Facilities for parking of private vehicles as well as public carriers are vital for the smooth functioning of the traffic system of any town. In most of our towns commercial buildings have come up without adequate parking facilities due to various reasons. The vehicles coming to these commercial centers are forced to park in the public roads seriously reducing the carrying capacity of these roads. The draft transport policy for the state states that "For existing buildings /commercial complexes built without providing adequate parking space, such parking facilities will be built off-street by the local bodies at suitable locations and costs from the building owners." Further the policy outlines the initiatives required by the government by saying "Open and multi-storied parking facilities will be constructed by the government at important terminals, market centres multi-modal logistic centres to promote inter-modal."

In Chengannur town there are no designated parking spaces for private vehicles. So, the vehicle owners park on the road on a first come first basis creating chaos. The narrowness of the town roads does not allow on street parking without affecting traffic flow. However, there are some designated areas for public carriers. Taxi stand is available at Railway Station. There are a number of auto stands in the Municipality.

8.5 Identification of gaps in network

The major gaps in the traffic and transportation system of Chengannur town are identified as follows: -

- The details of the roadway elements such as right of way, number of lanes, channelization, intersection etc. the existing conditions are far from satisfactory. In most cases the entire right of way is utilized as carriage way leaving no space for pedestrian movement.
- The width of the road is quite inadequate for segregating the mixed traffic. Higher percentage of cycle traffic in central area.
- Vehicles are parked along the major roads for want of off-street parking space; whereas the narrowness of the town roads do not allow on street parking without affecting traffic flow.
- Highly conflicting traffic movement at the Engineering College junction, Bethel Junction and Vellavoor junction.
- Heavy pedestrian movement in the railway station premises as well as along the MC road sections in the CBD.
- Inter-mixing of intra-town and inter-town traffic on the major road corridor.
- Unorganized on-street parking in the absence of proper parking lots.
- Movement of inter-town bus traffic due to the location of KSRTC as well as private-bus stations within the central area of the town.
- Encroachment of right-of-way by hawkers at all the major roads.
- Absence of adequate design for major junctions along the major roads.
- Narrow cross structures like the Puthentheruvupadi Bridge, Erapuzha Bridge and the two railway underpasses near Temple junction and Railway Station.
- Presence of market near the CBD area.

8.6 Inference

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 MC road passing through the town is overcrowded. The situation in the State Highway is also not different. 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 centres is another issue to be tackled. The number of passengers travelling by bus is more. It could be inferred that 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 curb parking affecting the carrying capacity of the roads. A proper truck terminal is needed for the development of trade and commerce in the town.

9 PHYSICAL INFRASTRUCTURE

The physical infrastructure of the Municipality like water supply, drainage, sewerage, solid waste management and energy are discussed in this chapter.

9.1 WATER SUPPLY

9.1.1 Existing water supply system

Majority of the municipal population depends on domestic wells and municipal water supply for drinking purpose. Major source of Municipal water supply scheme in Chengannur Municipality is Pampa River. According to socio economic survey and census data, the various sources of water were identified as in Figure 9:1 and Figure 9:2 respectively.

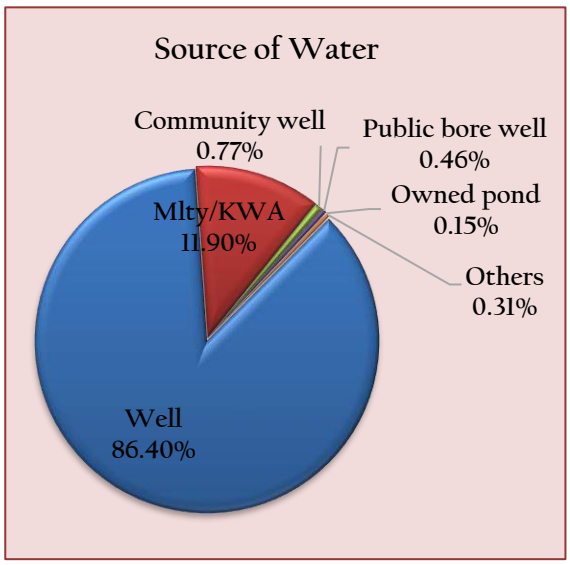

Figure 9:1 Source of Water as per Socio economic survey

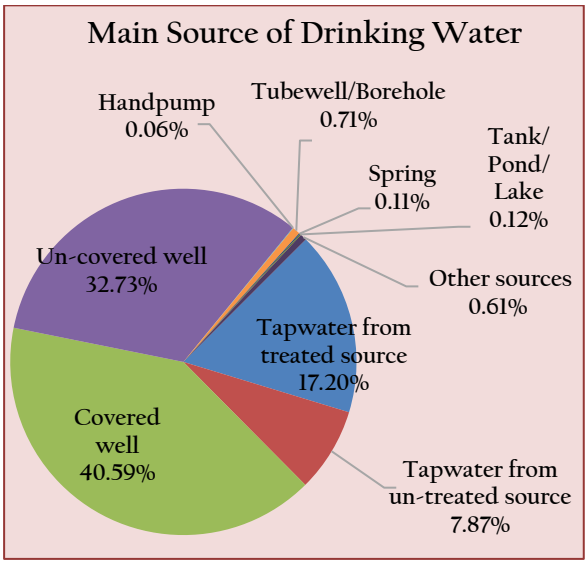

Figure 9:2 Main Source of Drinking Water as per Census data

According to Water Authority, municipal water supply distribution depends on intake wells in Mithrapuzha kadavu and Konnamukk and treatment plants in Kunnathumal and Malayil. These wells cater to Chengannur Municipality. Total quantity of water supplied is 4.75 MLD. There are about 2961 domestic connections, 275 non domestic connection and 1 industrial connection. The domestic connections account to about 50% of the total number of households and 366 street taps are present. But as per the local enquiry and discussion with the councilors, it is learned that, there is acute scarcity in water supply in entire Municipality during summer season and in elevated areas through out the year.

9.1.2 Groundwater Scenario

The groundwater profile of the Municipality is generally good to moderate according to the LRIS data. Certain open wells are not fit for drinking after the 2018 floods. The groundwater profile was moderate before flood 2018 but drastically depleted (4-10m) post flood. This was due to deposition of impermeable clay. These clay deposits must be cleared off to improve water permeability and increase the Ground water level in the area.

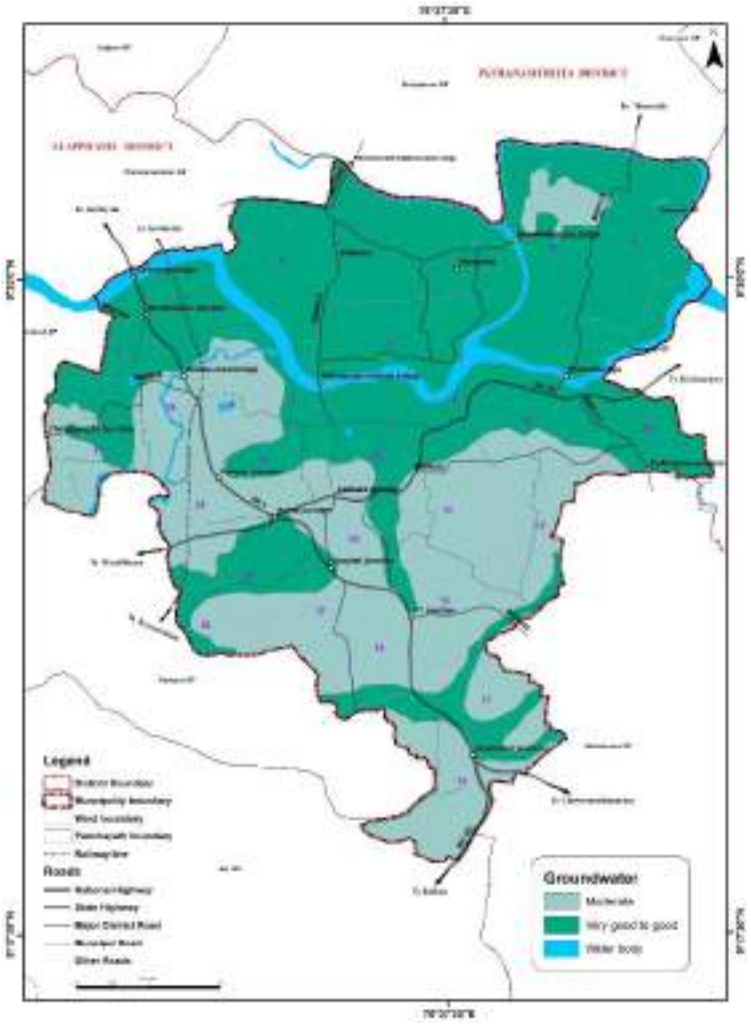

Figure 9:3 Groundwater profile of the municipality

Source: LRIS

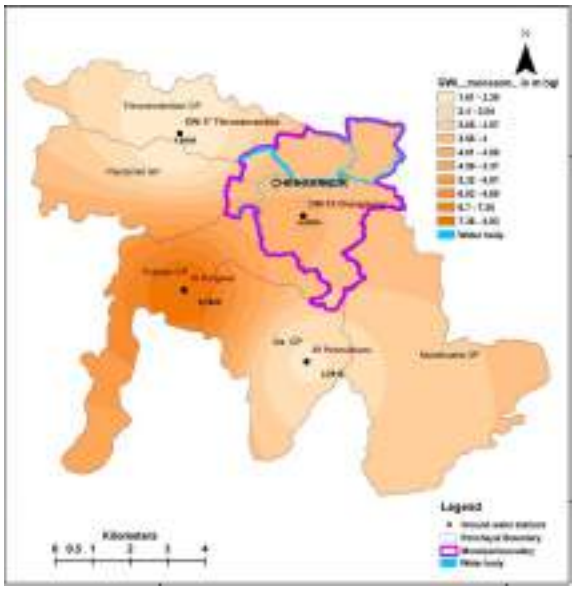

Figure 9:4 Groundwater level during Monsoon Season 2020

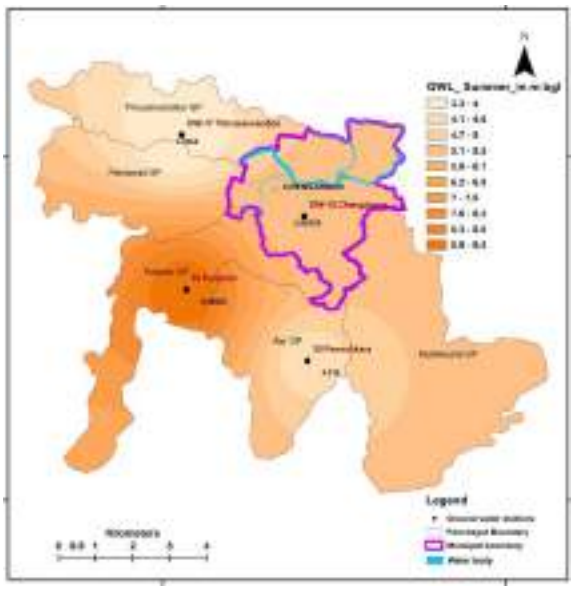

Figure 9:5 Groundwater level during Summer Season 2020

Source: Groundwater Department

9.1.3 Scarcity

Shortages in water supply do exist in some wards of Chengannur Municipality. According to the data collected in the socio-economic survey about 73.5% of the houses are not facing water shortage. The nature of scarcity as per socio economic survey is shown in Figure 9:6. Most of the houses have water sources within their yard.

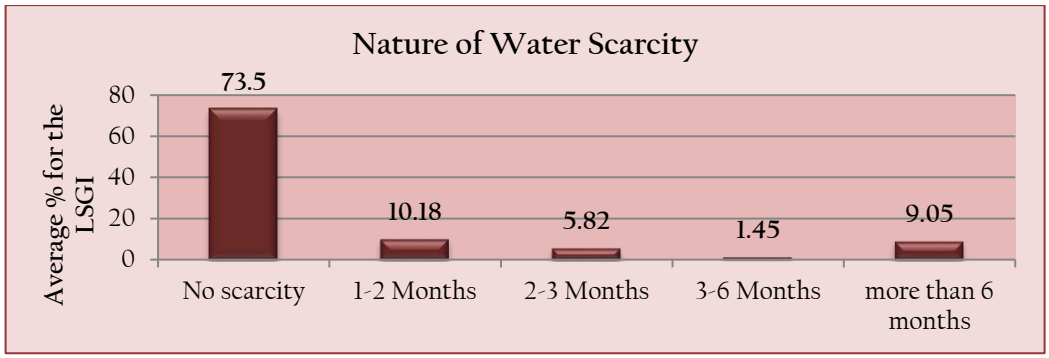

Figure 9:6 Nature of Water Scarcity

Source: Socio Economic Survey

The population of Chengannur town was 23,466 in 2011. Required quantity according to census 2011 is 3.16 MLD (with 135lpcd). Taking into consideration the future growth prospects, it can be assumed that the population of town may grow to 25000 by 2041. Assuming a per capita consumption of 135 lcpd, the total quantity of water to be pumped for a population of 25000 is approximately 3.375 MLD.

From the pilot household survey conducted in 2021, it was noted that there is a water scarcity problem in the Municipality. Higher elevated areas such as ward no. 23 have issues regarding the municipal water supply scheme. The open wells in certain areas are not fit for drinking after the 2018 flood. From the month of February itself, water sacristy issue starts in certain areas and the public purchase water from tanker water services for their needs.

9.1.4 Problems and potentials

As per socio-economic survey conducted the residents of the Municipality attached only 2.75% priority for the development to water supply, which indicates that people are satisfied by the present availability of water.

Higher elevated areas such as ward no. 23 have issues regarding the municipal water supply scheme. They receive the supply only once a week, and for places with a higher elevation it is difficult for the supply to reach their homes because of the low pressure in the supply lines. The ground water table level is low in certain areas and therefore open wells are not efficient in water supply and they depend completely on the government water lines.

Even though standards are met in majority of the area, the people's expectation regarding quantity and quality of water is high as experienced throughout the state. Major source of municipal water supply for Chengannur Municipality is Pampa River. Measures need to be undertaken to contain salinity intrusion at the intake source during the summer months. Salinity may affect the quality of water supplied through the scheme. The poor level of

sanitation in the town causes percolation of polluted waters into the sub soil polluting the underground resources. Therefore, open shallow wells cannot be continued in a big way as a source of water for long.

State level schemes must be initiated to ensure the proper adequate flow of drinking water to every household. The service connections and pipes are too old and with inadequate pressure to supply to the elevated areas regularly. The public water taps are being misused in certain areas, which causes a depletion of water force to other areas.

9.1.5 Inference

As per planning standards and data received from KWA, the quantity of water supplied is sufficient. According to the study, well is the main source of water. Ground water table level is low in certain areas open wells are not efficient in meeting water demands and they depend completely on the government water lines. Proper water supply schemes must be initiated to meet water demands especially during the summer season.

In addition, uninterrupted supply of potable water has to be ensured as part of efforts for improving the quality of life of the people. Proposals under water supply sector have to be evolved in this consideration. The existing water supply schemes in the area are inadequate and there is much scarcity for water throughout the year in areas of high elevation and especially in Sabarimala festival season as it needs to cater the demand of floating population too.

9.2 DRAINAGE

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.

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 collection of water to allow slow 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 getting fast depleted because of land conversions due to filling up of these low-lying land parcels for construction activities.

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



Figure 9:7 Clogged Drains, Vettuthodu

9.2.1 Existing drainage network

Only 40 % of the roads in Chengannur have side drains. The existing drains are also in a deteriorating stage- some of them are broken and blocked obstructing flow of water in the drains. These drains are constructed along the slope of the road not taking into consideration the alignment of any major canals. Most of these drains do not even end in any canals or water bodies. Such drains, which have not considered the final discharge of surface water, allow water to flow on to the roads and vacant low-lying plots.

The town had low density development. Therefore, many of the patches of paddy fields and low-lying land parcels absorbed land parcels absorbed storm water during monsoons. During the recent period, these privately owned properties are getting filled up and converted into building plots. In the process the natural drainage basins disappear and water stagnates on the roads.



Figure 9:8 Vettuthodu

Most of the commercial establishments have outlets to the let off sullage and waste water into these drains. Disposal of rubbish and garbage through these outlets clog these drains. This becomes a problem during the rainy season when the drains overflow and the waste water is let out into the roads and other public spaces. Such flooding of roads and low-lying pockets within the town causes mosquitoes to breed in these water pools. Chance of occurrence of water borne diseases is high in the town.

The Vettuthodu channel passes through the town. The roadside drains combine with Vettuthodu in the municipal area causing pollution and clogging of drains and blocking the passage. At certain points near the town centre and KSRTC bus stand, the passage is covered using concrete slabs.

Table 9-1 Length of Existing drains

Sl. No.	Type of Drain	Length of Existing Drain
1	Covered	7.9 km
2	Uncovered	3 km

9.2.2 Identification of gaps in the network

The feeder drains and canals to the major thodu have either been blocked, enclosed into private properties with reduced capacities or have reduced capacity due to overgrown weeds. Urban Drainage Master Plan for the town has not been attempted. The town does not have an organized and planned system of road side drains. Many of the road side drains are not designed for taking storm water flowing into these drains. A cluster of drains without inter connectivity or a hierarchical pattern does not form a network. This should be made to a network by correcting the geometry of existing drains and adding the missing links.

9.2.3 Inference

The drainage network of the Municipality needs total revamping. There should be a planned provision of roadside drains for all the inner area roads. 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 natural drainage channel revival has to be taken in consideration.

9.3 SEWERAGE SYSTEM

Chengannur Municipality has no public sewerage system at present. The general practice in Chengannur town for disposal of sewage is to resort to septic tanks. However, many households still adopt soak pits, E.S.P type/two pit latrines etc. it is noticed that there are a few houses even without sanitary latrines particularly in the slums. The washings from the markets, hotels, commercial establishments and other public buildings are disposed directly into the road side drains. During rainy seasons, these drains overflow, spilling such sullage and sewage onto the roads and the open yards of nearby houses. A major share of this untreated waste water ends up in the canals causing foul smell and water pollution. Such polluted and stagnating water bodies form breeding beds for mosquitoes.

9.3.1 Existing treatment facilities

Socio economic survey of Chengannur Municipality shows that about 91.11% of people are using septic tank and 6.46% of the people depend on Pit latrine. About 86% of the town population depend on open well for drinking water. Sewage disposal through soak pit or pit latrines pollute subsoil water. The households do not have latrines resort to open defecation into the water bodies.

Sewerage system does not exist in the town. This affects especially the central area wards, since many of the houses and commercial establishments, offices, schools and hospitals discharge untreated effluent water from the septic tanks into the street side drains or in the adjacent open spaces. The waste water is disposed without any treatment. The untreated waste water either ends in the canals or in the underground water source causing epidemics.

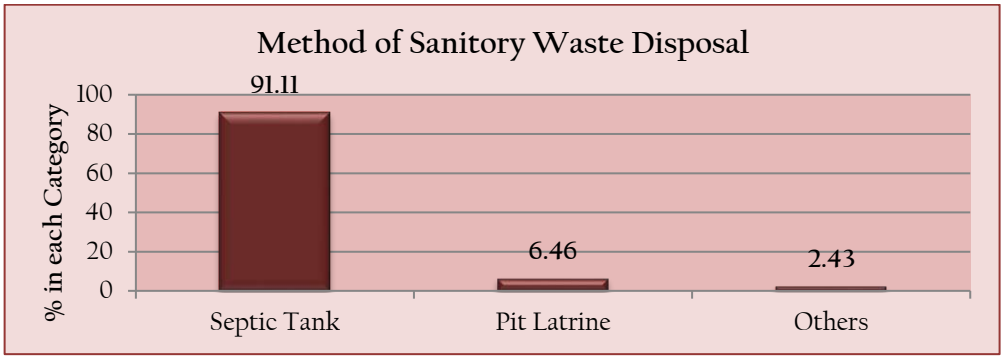

Figure 9:9 Method of sanitary Waste disposal

9.3.2 Inference

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 public sewerage system is needed.

9.4 SOLID WASTE DISPOSAL

An urban area is characterized by concentration of people and concentration of non-agricultural activities. In the process of its day-to-day activities the town generates large quantity of solid wastes. One of the important mandatory responsibilities of the local self-government is management of solid waste collection and disposal. Most of the towns and cities in Kerala suffer from the absence of adequately designed sustainable and sanitary solid waste management arrangements suited to the particular town or city. Chengannur is no exception to the above situation.

9.4.1 Generation and collection

Presently, Chengannur municipal area has an ill designed solid waste management system. Bio degradable wastes are not collected by the Municipality. Majority of the garbage produced in residential areas are dumped on the backyard or into open spaces or road side drains. Street sweepings are also limited to the commercial centre of the town. Solid waste collection fleet with the Municipality is inadequate and under maintained.

Only 5 bins are provided for the aerobic composting of waste. Most of the waste is left to decompose on road sides, drains, canals and open spaces and backyards of residences. Such a situation provides ideal breeding ground for pathogens, flies, rats and mosquitoes. The major concern is the problem of ground water pollution due to leachate from disposal site. There is an alarming increase in the presence of substances like plastics especially plastic carry bags, which are difficult to break down in the waste stream.

Non bio degradable wastes are collected from about 50% of houses by the Harithakarma sena once in 30 days. There is no mini MCF or RRF available in the town. An MCF with 450 sq. ft plinth area is available. Bailing machine is provided there.

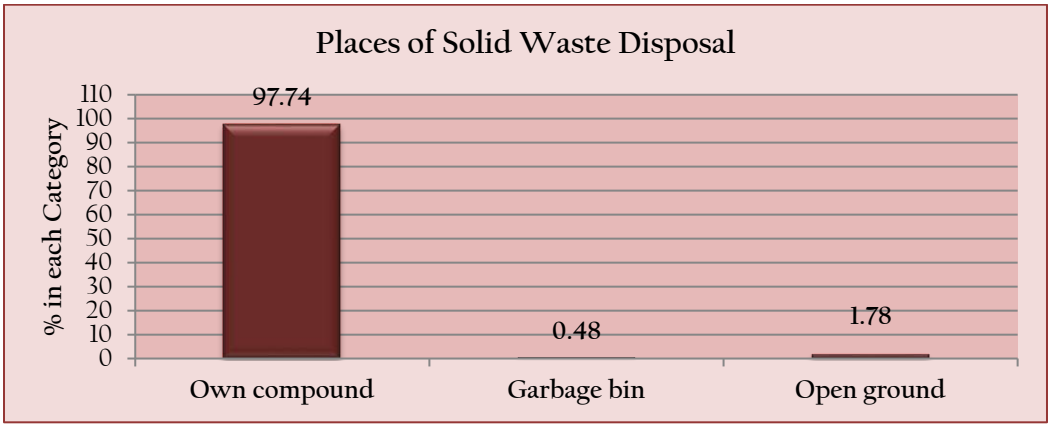

Figure 9:10 Place of solid waste disposal

97.74% of people are disposing the waste in their own compound and 0.48% in the garbage bins. Collection of waste generated is as important as its treatment, but not well attended to in the Municipality. The places of solid waste disposal identified by the socio-economic survey are shown in Figure 9:10.

9.4.2 Existing treatment facilities

The solid waste consists of both bio and non-bio degradable substances. There is no segregation of waste at source by residents.

The Municipality has started a different initiative for waste management through different funded projects. The Municipality has provided all the households with Bio Bin, Bio gas facilities to treat their biodegradable household waste. Non-biodegradable waste like plastic is collected by the Harithakarmasena and segregated. Plastic, glass, etc is collected and given for shredding to various agencies. Various waste segregation techniques like aerobic compost, plastic segregation unit and MCF is about to be implemented in the Municipality.



Figure 9:11 Distribution of Bio bins

The Municipality initiatives have just begun, and yet to reach the entire population. There is no arrangement for storage of waste at sources in a few parts of the Municipality. Individual generators use their own arrangements for storage of waste at source.

9.4.3 Inference

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. Most of the solid waste is disposed off on the private compounds of residents.

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 Energy consumption : source wise break up

The major energy consumption is the electrical energy generated from hydroelectric project. No other non-conventional energy is fed into the main grid. Petroleum products like diesel and petrol, biomass etc are also used.

9.5.2 Energy consumption : sector wise break up

Since the energy consumption is mostly electrical energy, the consumption of electricity by various categories is considered.

9.5.3 Electricity

The Kerala State Electricity Board is the single licensee responsible for power distribution in the Municipality. The details of number of power consumers in Chengannur Municipality are shown in Table 9-2.

Table 9-2 Details of power consumers in the Municipality

Category	2015-16	2016-17	2017-18	2018-19	2019-20
Domestic	6353	6462	6583	6679	6784
Commercial	2121	2205	2281	2350	2444
Agricultural	18	19	24	29	34
Industrial	25	25	27	31	34
Others	17	102	104	175	177

The number of power consumers is highest in domestic category, which is showing a constant increase from 2015-16 to 2019-20. The numbers of commercial, agricultural and industrial consumers have also increased. The trend in number of consumers is shown in Figure 9:12.

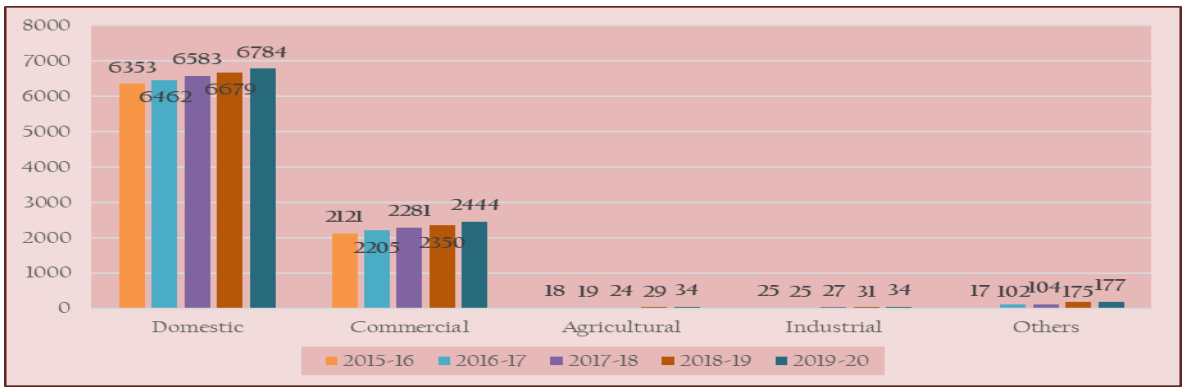

Figure 9:12 Variation in number of consumers

The figure shows that there is an increase in number of various categories of consumers. The power consumption details for various categories are shown in Table 9-3 and Figure 9:13.

Table 9-3 Consumption of power by various categories of users

Category	2015-16	2016-17	2017-18	2018-19	2019-20
Domestic	65378	62203	39503	73854	45066
Commercial	192340	46626	34837	73990	90737
Agricultural	47	1822	1327	1107	2877
Industrial	0	2687	4025	3695	6217
Others	42563	788	73003	2075	9844

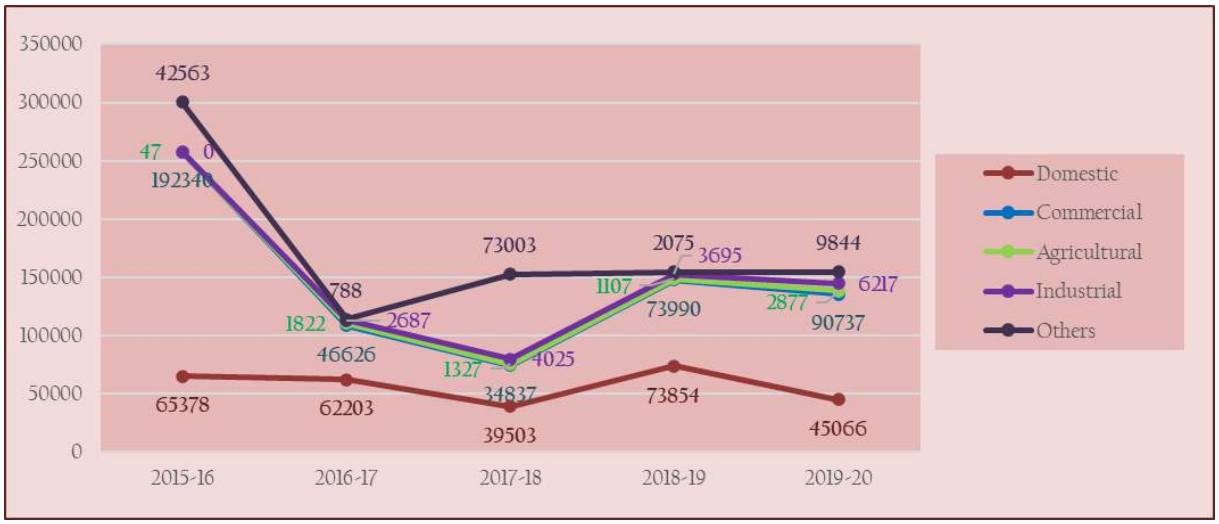

Figure 9:13 Variation in consumption of power by various categories of users

The distribution of power is only by overhead lines and underground lines are not used, causing various inconveniences in the town centre.

9.5.4 Petroleum

Petrol and Diesel are the major products considered. Almost 95% of the houses are using LPG.

9.5.5 Non-conventional 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 roof top solar water heaters.

9.5.6 Problems and potentials

Chengannur 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 non-conventional 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.

9.5.7 Inference

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

10.1EDUCATION

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 have become very eager in providing quality education to their offspring lately. Among the students in self-financing colleges both within the state and outside also the share of the district is considerable. The case is not different in Chengannur town also.

10.1.1 Existing facilities, students, teachers

The literacy rate of Chengannur Municipality is 97.82% as per census 2011 which is higher than the literacy rate of Alappuzha district, which is 95.72%. The literacy rate of Alappuzha, Cherthala, Kayamkulam and Mavelikkara municipalities are lower than that of Chengannur Municipality. In Chengannur Municipality the male literacy rate is 98.28% and female literacy rate is 97.36%.

Table 10-1 Literacy rate of towns in Alappuzha

Name of Municipality	Literacy Rate (2011)
Cherthala	97.02
Kayamkulam	94.81
Chengannur	97.82
Mavelikkara	96.90
Alappuzha	96.20

There are 20 schools in Chengannur Municipality, in which are 14 primary schools, 2 are High Schools, 3 are Higher Secondary schools and 1 is Vocational higher secondary school. The number and type of schools is given in Table 10-2.

Table 10-2 Number of schools in Chengannur

Sl. No	Type	Number
1	Primary	14
2	High School	2
3	Higher Secondary	3
4	Vocational Higher Secondary	1

The total number of students studying in 20 schools is 2731. The total population to be served within the age group of 0-15 is 3532. Total number of students in schools up to 10th standard is 2431. This means nearly 69% of the students depend on schools within the Municipality. Considering the nature of schools, majority of schools are under government ownership. Table 10-3 shows the total number of schools under each category.

Table 10-3 Number of schools in various categories

Sl. No	Type	Govt	Aided	Unaided	Total
1	Primary	7	5	2	14
2	High School	1	1		2
3	Higher Secondary	1	2		3
4	Vocational Higher Secondary	1			1

There are in total 10 schools under government ownership, 8 schools are aided and 2 are unaided.

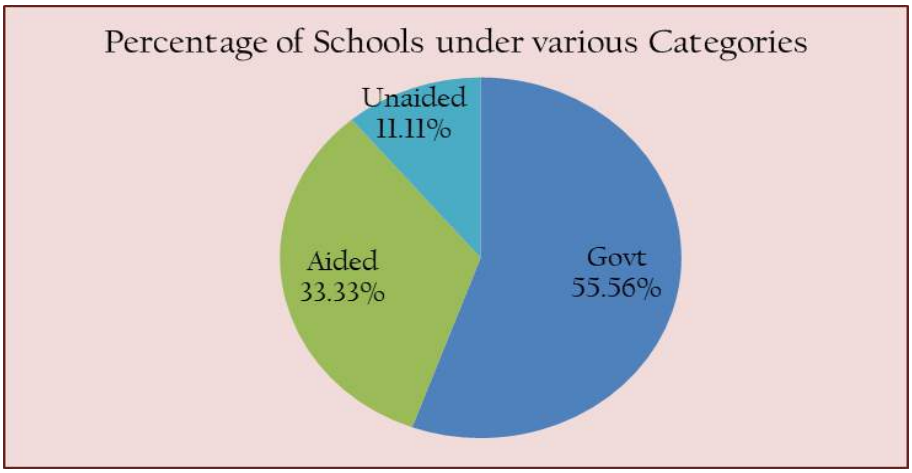

Figure 10:1 Percentage of schools under various categories

Table 10-4 List of schools in Chengannur Municipality

Sl. No.	School Name	Sl. No.	School Name
1	Govt. H S S Angadical South	11	J B S Mundankavu
2	Govt. Boys H S Chengannur	12	E A L P School Angadickal
3	Govt. Girls V H S S Chengannur	13	St. Marys L P School Kallisseri
4	St. Anne`s G H S S Chengannur	14	L P School Thalappanangadu
5	N S S H S Edanad	15	St. Thomas K G L P School Chengannur
6	M H S S Puthencavu	16	St. Anne`s E M L P School Chengannur
7	R L P School Chengannur	17	Govt. U P School Chengannur
8	J B S Edanad	18	Govt. U P School Puthencavu
9	J B S Keezhcherimel	19	M P U P School Puthencavu
10	J B S Mangalam	20	S C R V T T I Angadical

10.1.2 Higher and professional education

A. Colleges

There is one Arts & Science College, an Engineering College and 2 ITI in Chengannur Municipality. The Arts & Science College has PG courses. It has nearly 827 seats for B.A & B.Sc. and nearly 102 seats for PG courses.



Figure 10:2 Government ITI, Chengannur

Table 10-5 List of Colleges in Chengannur Municipality

Sl. No.	Name of College
1	College of Engineering, IHRD
2	Christian College Chengannur
3	Govt ITI for Women
4	Govt ITI , Chengannur

B. 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.

10.1.3 Comparison with Planning Standards

Threshold Population of a High School with student strength of 700-750 is 14000. In 2031 number of high schools needed = 75000/14000 = 1.79 schools with 700 strengths. That is schools with a capacity of 1253 (1.79 x 700) students are needed. Existing facility constitutes schools with a capacity of 1400 students as per secondary data. The existing high school facility is sufficient.

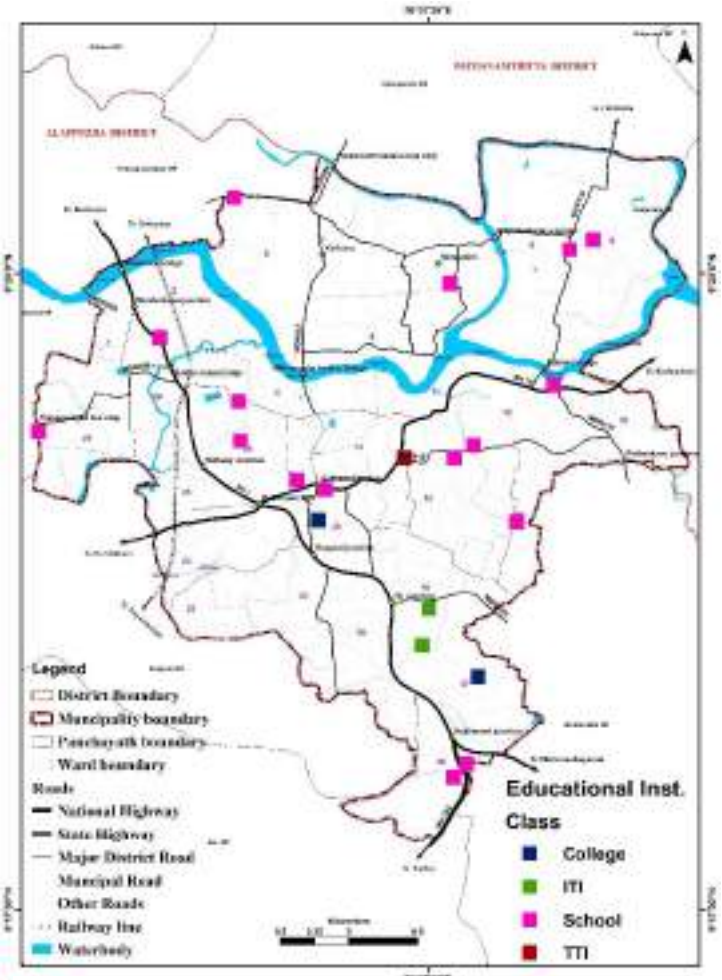

Figure 10:3 Educational Institutes of Chengannur Municipality

One Higher Secondary School with 8 divisions is needed for 14,000 populations as per standard. In 2031 number of higher secondary schools needed = 25000/14000 = 1.79 schools with 336 strengths. i.e., schools with a capacity of 602 (1.79 x 336) students is needed. As per secondary data there are schools with a capacity of 840 students in the town. The existing HSS facility is sufficient.

For 86,000 populations 1 college with 500 student's capacity is needed. 2 colleges with 1390 students are existing in the town as per secondary data. Polytechnic college with student strength 300 is needed. There is no polytechnic college available in the town as per the secondary data.

For 86,000 population 1 ITI/ITC with 300 student's capacity is needed. So, for a town like Chengannur, ITI/ITC with student strength 300 is needed. ITI with student strength 1100 is available in the town. For 1,20,000 population TTC with a strength of 120 is needed. There is no TTC available in the town as per the secondary data.

10.1.4 Problems and potentials

The conventional educational facilities in the town, especially at the school level are commensurate with the population of 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.

10.1.5 Inference

The literacy rate of Chengannur Municipality is high compared to the district. Most of the colleges are offering only conventional courses, and there is only one professional college or higher centers of learning in the Municipality.

10.2 HEALTH

10.2.1 General

Health is another sector the state of Kerala has achieved remarkable progress which is comparable to that of developed countries. However, at micro level certain problems like quality of services, reach and affordability do exist. Chengannur Municipality also follows the general pattern of development of health care institutions elsewhere in the state.



Figure 10:4 Govt Hospital Chengannur

10.2.2 Health Institutions

There are 3 government hospitals and 7 private hospitals in Chengannur Municipality. Government hospitals include Taluk headquarters hospital near IHRD Engineering College, Government Ayurveda Hospital near Althara junction and Government Home Hospital at Municipal Office junction. Most of the clinics are managed by the private sector.

There are 8 allopathic health institutions, 1 Ayurveda institutions and 1 homeopathic institution in the Municipality. Among the allopathic medical institutions, there is only one hospital under government ownership. There is no super specialty hospital in Chengannur Municipality. Hospitals in Thiruvalla as well as Kottayam have great influence on Chengannur.

The Government Ayurvedic Hospital is the only one institution practicing Ayurvedic system of medicine. Also, in homeopathic system of medicine there is only one institution. That is, Government Homeo hospital at Municipal Office junction. The details of hospitals, its location and category, number of beds and doctors, ownership are given in Table 10-6.

Table 10-6 Healthcare institutions in Chengannur Municipality

Allopathic system of medicine						
Sl. No	Name of Hospital	Location	Category *	Number of beds	Number of Doctors	Govt/Private /Cooperative society
1	Taluk Head Quarters Hospital	Near IHRD Engineering college	4	105	13	Govt.

2	Mammen Memorial Hospital	Near KSRTC	3	25	7	Private
3	Cheriyan Memorial Hospital	Near central Hatchery	3	35	4	Private
4	St. Andrews Mission Hospital		1	20	3	Private
5	Usha Nursing Home	Angadickal	1	18	2	Private
6	Pooppally Hospital		1	36	4	Private
7	Abraham Tharakan's Clinic		1	-	1	Private
8	Amballoor Clinic		1	-	1	Private
Ayurvedic system of medicine						
Sl No	Name of Hospital	Location	Category	Number of beds	Number of Doctors	Govt/Private/ Cooperative society
1	Govt.Ayurvedic hospital, Chengannur	Near Althara Jn.	2	10	2, 2 NRHM	Govt.
Homoeopathic system of medicine						
Sl No	Name of Hospital	Location	Category	Number of beds	Number of Doctors	Facilities for trauma care
1	Govt. Homoeo Dispensary	Ground floor of Municipal office	1	nil	1	nil

Category 1 – Clinics only OP
Category 2– Hospitals with 24 hrs service
Category 3 – Hospitals with single Operation theatre [Specify no. of operation theaters and category i.e. major/minor]
Category 4 – Hospitals with more than one OT
Category 5 – Hospitals with advanced diagnostic facilities like CT scan, EEG
Category 6 – Super specialty hospitals
Category 7 – Referral Hospital (Govt. Sector)

10.2.3 Comparison with planning standards

As per standards one PHC is required for a population of 20000 with 24 beds. The Taluk Hospital caters to this need also. As per standards one Nursing home, child welfare and maternity centre is required for a population of 45000 to 1 lakh. Chengannur Municipality has a population of 23466 as per 2011 census.

There are 7 private allopathic hospitals in Chengannur Municipality. Among the private hospitals 3 hospitals have bed strength more than 25. As per standards number of beds in private hospital for 1 lakh population is 40. Hence these hospitals are sufficient to serve the people in Chengannur Municipality.

10.2.4 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. Most of the hospitals are in private sector. Taluk hospital is the only government hospital with IP facility in the Municipality.

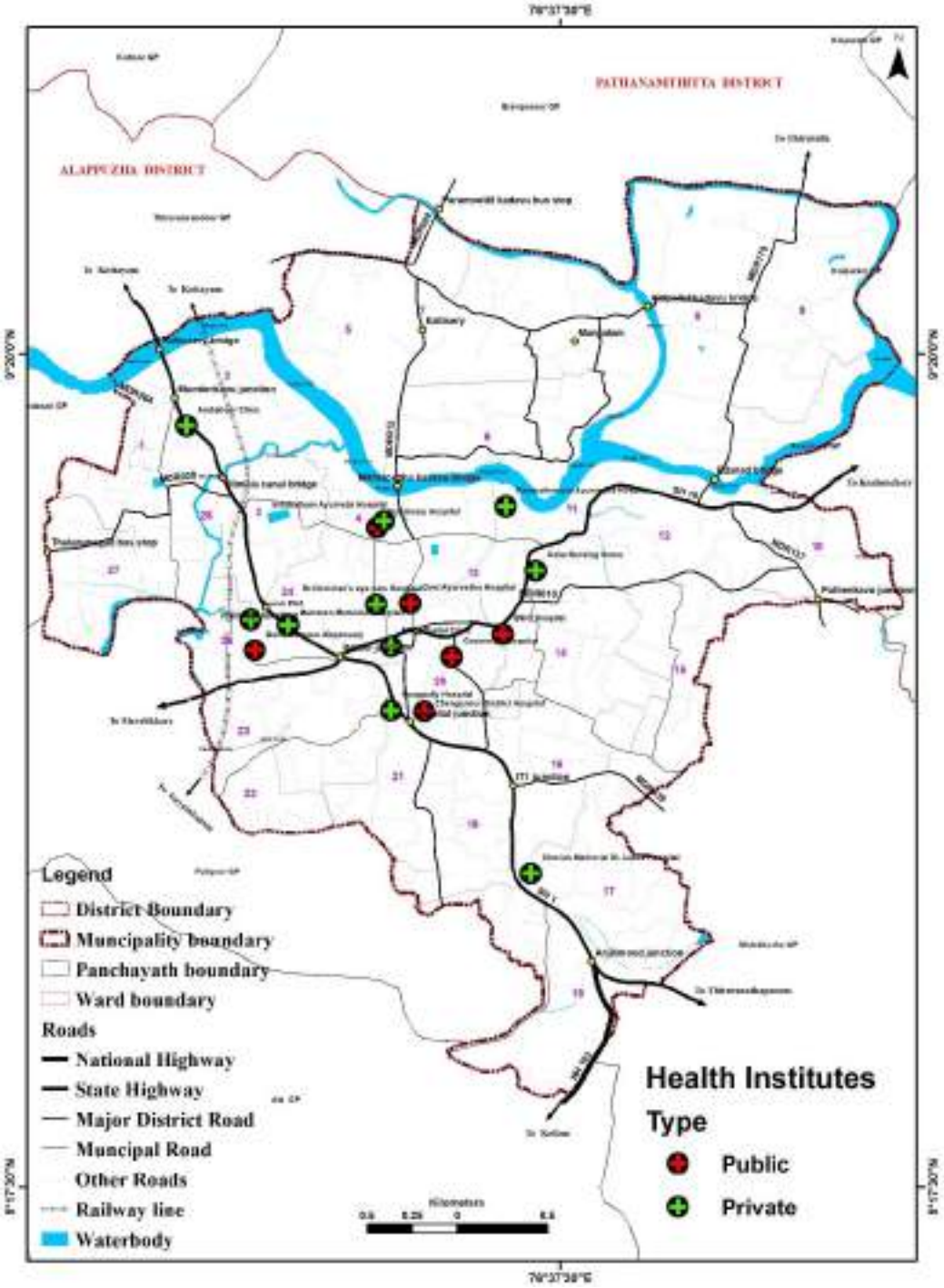

Figure 10:5 Health Institutions in Chengannur Municipality

10.2.5 Inference

There is no super specialty hospital in Chengannur Municipality. Hence the people have to depend on hospitals outside the Municipality. Major problem in the health sector is the inadequacy of facilities in the hospitals. Most of the hospitals are in private sector affecting the affordability of health care. The infrastructure facilities are to be upgraded in the hospitals for Ayurvedic and Homeopathic systems.

10.3 RECREATIONAL FACILITIES

10.3.1 Parks and open spaces

As per the land use classification, about 0.14% of the total land area belongs to open spaces and parks respectively, which is not sufficient as per URDPFI guidelines. But this area just an open ground. No recreational facilities available in the ground now.

10.3.2 Theatres and auditorium

There is no open-air theatre or Art Galleries in the Municipality. But there is one Cinema Theatre in the Town.

There are 21 Auditoriums in chengannur Municipality out of which 6 are having an average capacity of 1000 or more. They are Maruthi Auditorium (120), Giridheepam auditorium (1200), Marthoma Valiyapali Auditorium (1500), Kochupalli Auditorium (1500), Puthenkavu Palli Auditorium (2000) and Olivette Aramana Auditorium (1500).

10.3.3 Play grounds/stadia

There are no public play grounds or stadia available in the Municipality. Only available play grounds are the play grounds associated with the educational institutions. There is a stadium under construction within the Municipality, this space for the stadium is near marshy lands and is one among the first areas to be affected during the floods. This would cause issues to the locals in the future during monsoons if water retaining/infiltrating and drainage projects are not implemented alongside.

10.3.4 Pachathuruth Initiative

As the Municipality lacks open public recreational spaces, Pachathuruth was an initiative started by the Municipality for recreational purpose. This project was initiated with the help of Rotary Club and workers of the Mahatma Gandhi Rural Employment Scheme. The project was proposed at Edanadu Kallalipara and Angadickal Penniyathukadavu. The project also aims develop the agricultural sector thus bringing about the economic development for the Municipality.



Figure 10:6 Inauguration of Pachathuruth Scheme

10.3.5 Problems and potentials

The recreation facilities are limited in Chengannur Municipality. There are no parks, theatre, playground, stadium or Art galleries in the town. 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. The Pachathuruth scheme is now in a standstill due the pandemic and funding issues, revival of the project is needed.

10.3.6 Inference

The recreational facilities in the Municipality are not adequate to cater to the present population leave alone the target 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. There are no public open spaces or public play grounds or stadium in the town. Only one Cinema Theater functioning in the town. There is one municipal library in Railway Station ward. Chengannur badly lack a place for conducting cultural events and fairs.

10.4 OTHER CIVIC AMENITIES

10.4.1 Town hall

There are 3 community halls and 21 auditoriums in Chengannur Municipality. These are used for various public gatherings.

Table 10-7 Auditoriums in Chengannur Municipality

Sl. No	Name	Location/ Ward	Capacity
1	Maruthi Auditorium	Mahadeva temple	1200
2	Giridheepam auditorium	Christain college junc.	1200
3	Village garden inn	ITI junc.	500
4	NSS Auditorium	Mundenkavu	750
5	SNDP Auditorium	Hospital JN.	750
6	Suriyani Chruch Auditorium	Puthenthruvu	750
7	St. Ignitius Auditorium	Karuvellippadi	650
8	Marthoma Valiyapali Auditorium	Mundenkavu	1500
9	Kochupalli Auditorium	Puthenkavu	1500
10	Puthenkavu Palli Auditorium	Puthenkavu	2000
11	Olivette Aramana Auditorium	Aramana Jn	1500
12	Pentacoast mission Auditorium	Angadickal-Bhagavathypadi	750
13	Marthoma Auditorium	Edanadu	450
14	Navarathi Auditorium	Mahadeva Temple	800
15	Orthodox Church Auditorium	Edanadu	600
16	Orthodox Chruch Auditorium	Mangalam	450
17	Marthoma Auditorium	Mangalam	500
18	Citizen Club Auditorium	Netaji Jn	300
19	Rotary Club Auditorium	Arattukadavu Jn	250
20	YMCA Hall(mini)	Hospital Jn	350
21	Lions club Auditorium	Business India Jn	300

Table 10-8 Community Halls in Chengannur Municipality

Sl. No	Name	Location/ Ward	Extend/Capacity
1	Pandavan para community hall	Pandavan para	1000
2	Pulikunnu community hall	Hospital junction, pulikunnu	200
3	Municipality conference hall	Muncipality	600

As per URDPFI guidelines, Community halls and auditoriums must be of total area 2000sqms for 15000 persons. In case of Chengannur Municipality the existing facility can cater the needs of the people in the area. Table 10-7 and Table 10-8 shows the auditoriums and community halls in the Municipality, most of which are owned by religious managements.

10.4.2 Reading rooms and library

There is only one municipal library in Railway Station ward.

10.4.3 She-Lodge

In an initiative by the Kerala state government, "She Lodges" or women's only hostels are being set up all over the state. These will be managed and maintained by Kudumbashree. The first such she lodge was inaugurated in Chengannur Municipality near the private bus stand. State governments across the country have set up hostels catering to working women or youth travellers, but none to help female travellers. The She Lodge initiative remedies this gap by providing "secure, affordable" accommodation facilities.



Figure 10:7 Inaugration of She-Lodge

10.4.4 Crematoria and burial grounds

There is no crematorium owned by Municipality. But crematoria/burial grounds associated with churches are available in the town.

There are 14 burial grounds in Chengannur municipal area whichare associated with various churches. The details of the burial grounds are given in the Table 10-9.

Table 10-9 Burial grounds in Chengannur Municipality

Sl No	Name
1	St. Thomas Marthoma Church, Mangalam
2	Bethel Mar Gregorios Orthodox Aramana Church, Bethel
3	St. Thomas Evangelical Church, Puthenkavu
4	St. Thomas Catholic Church, Puthenkavu

5	IPC Worship Centre, Angadikal
6	St. George Orthodox Church, Mangalam
7	St. Andrews CSI Church
8	Trinity Marthoma Syrian Church, Thittamel
9	Marthomma Valiyapalli, Puthenkavu
10	Marthomma Mathilakom Asension Church, Puthenkavu
11	Salem Marthoma Church, Edanadu
12	St. Mary's Orthodox Syrian Church
13	St. Mary's Orthodox Syrian Church, Edanadu
14	St. Mary's Orthodox Cathedral, Puthenkavu

10.4.5 Inference

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

There are 27 wards in Chengannur Municipality. About 46% of the total land in the Municipality is under residential use. The details regarding the present condition of housing are dealt in this section.

10.5.1 Condition of houses

About 78% of houses in the Municipality is good in condition for living only 2% of houses is not liveable or in dilapidated condition as shown in Figure 10:8.

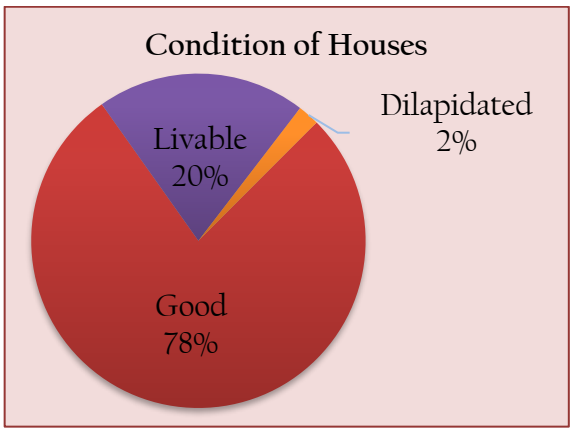

Figure 10:8 Condition of Houses

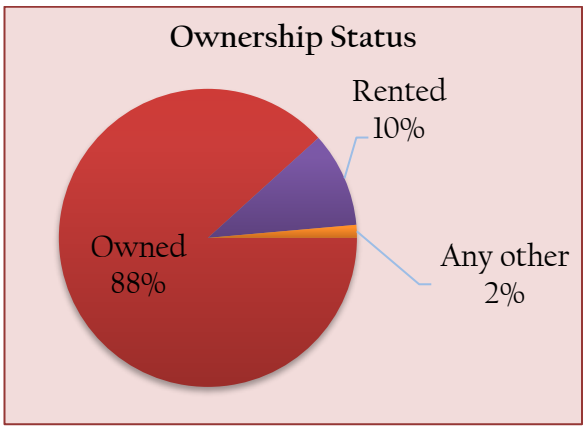

Figure 10:9 Ownership status of houses

Source: Socio Economic Survey

10.5.2 Ownership status

Most of the houses in the Municipality is owned by the residents. Figure 10:9 shows the ownership status of houses in Municipality.

10.5.3 Material of construction

A. Wall

Most of the houses in the Municipality are pucca houses with burnt brick as material of construction for wall. Figure 10:10 shows the variation in construction material of wall.

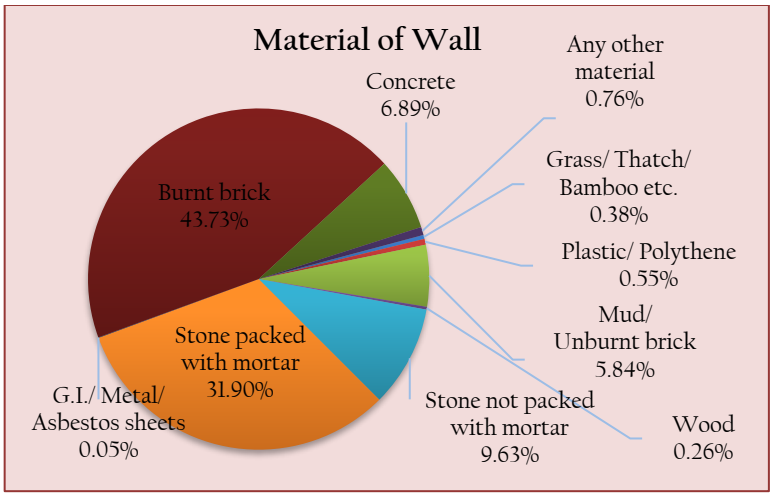

Figure 10:10 Materials used for walls

Source: Socio Economic Survey

B. Roof and Floor

The major construction materials used for buildings in the Municipality includes concrete on roof and cement on floors. Figure 10:11 and Figure 10:12 shows the percentage of materials used for construction of roof and floor respectively. Almost 70% of the total houses are liveable in good condition.

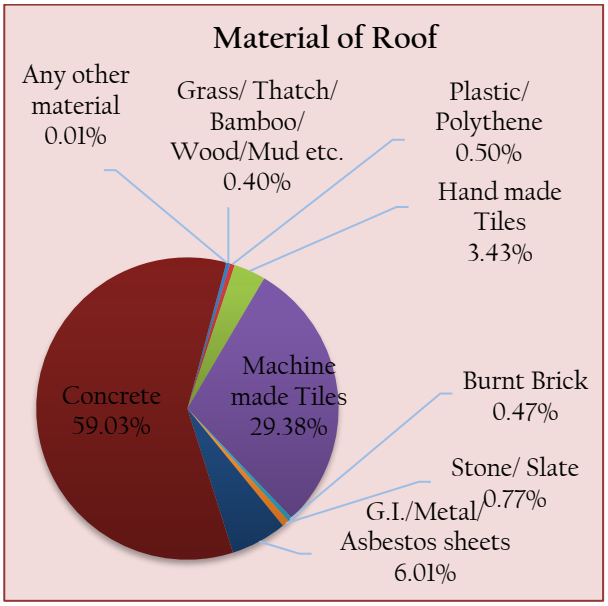

Figure 10:11 Materials used for roof

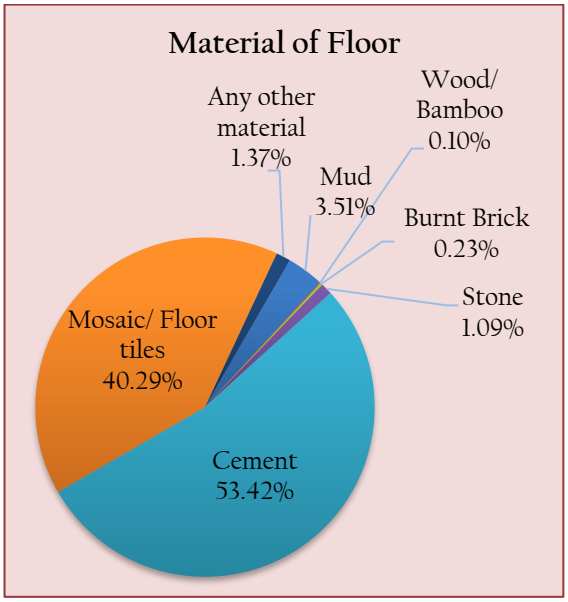

Figure 10:12 Materials used for Floor

Source: Socio Economic Survey

10.5.4 Housing stock and housing shortage

As per census 2011 there are 6278 households in Chengannur Municipality whereas the total number of houses in the Municipality is 9292. The plinth area detail of houses is given in

Figure 10:13. According to socio economic survey majority of houses have a plinth area of 20 - 50 sq.m.

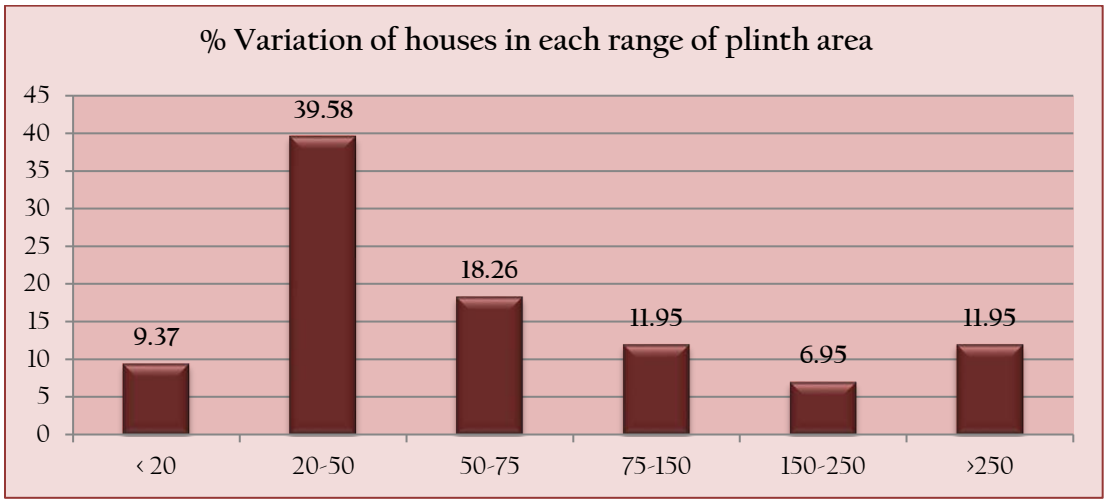

Figure 10:13 Houses in various ranges of plinth area

Source: Socio Economic Survey

The housing shortage is calculated by adding the number of kutcha houses to the difference between number of households and number of houses. According to the socio-economic survey total number of kutcha houses comes to 6.1% of the total number of houses. The number of kutcha houses which require replacement comes to approximately 567 according to the secondary data. The total number of houses in the Municipality is 9292 and the number of Households comes to 6278. There is no shortage of houses in the municipal area at present. But there is a need to replace the kutcha houses with pucca houses.

From socio economic survey, majority of houses are either pucca or moderate type. Kutcha houses are negligible in number. The percentage share of different type of buildings is given in Figure 10:14.

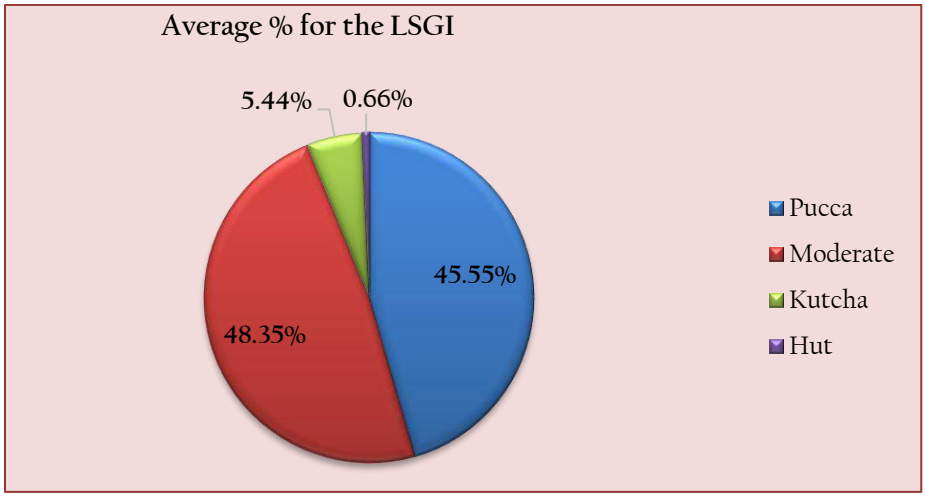

Figure 10:14 Percentage of various type of buildings

Source: Socio Economic Survey

The houses are classified as pucca and moderate depending on the type of roofing provided. Therefore, this does not reflect the actual structural stability of the building. The Kutcha buildings are those having cheap roofing, so they are houses that require replacement. The socio-economic survey indicates that people, at all levels, does not consider housing as a major problem in their town.

Further the survey reveals that most of the people have their own land for housing. This is shown in Figure 10:15.

Under PMAY housing project 188 beneficiaries are identified in the Municipality. 115 houses under this scheme have been completed.

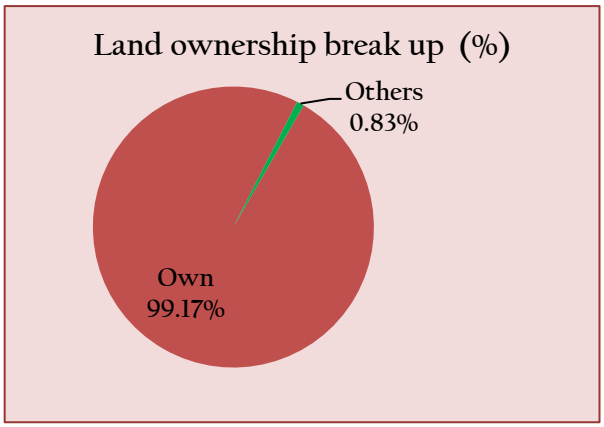

Figure 10:15 Percentage of land ownership break up

Source: Socio Economic Survey

10.5.5 Slums in the municipal area

Slum is an overcrowded poverty-stricken area having lack of open spaces and presence of unhealthy residential structures. Slums are characterized mainly by substandard housing structure. Construction quality is inadequate to withstand heavy rains, high winds or other local climate. Overcrowding is another characteristic of slums. Many dwellings are single room units with high occupancy rates. Each dwelling may be cohabited by multiple families. Lack of infrastructure development including non-availability of drinking water, poor sanitation facilities are the major concern in these areas.

As per the secondary data there are 10 slums in the municipal area. The details of slums are given the Table 10-10. Slums in the Chengannur Municipality are found to be better position compared to other slum areas of the state. Adequate facilities are provided in those slums.

There are about 251 households in the Municipality are living in slums. Out of the 229 houses in the slum, 34 are pucca houses and 191 are moderate houses. Only 4 houses are in kutcha condition.

Table 10-10 Details of slums in the Municipality

No.	Name of the Slum	Ward	listed/ non listed slum	Total area (Ha)	No of Houses	Housing category			No: of HHs
						Pucca	Moderate	Kutcha	
1	Pandavanpara	22	listed	0.8	35	3	32		36
2	Angadickal Thalakkodu pallathu	12	listed	0.2	9	6	3		13
3	Moolappadavu	20	listed	2.8	23		20	3	24
4	West of Railway station	27	listed	2	20	6	14		20
5	Poomalachal	18	listed	1.2	8	8			10
6	Angadickal South	17	listed	0.2	32		32		36

7	Angadickal Lakshamveedu	15	listed	0.12	22	6	16		24
8	Angadickal Amaroozhathil	15	listed	2.82	35	5	30		38
9	Pulikkunnu	20	listed	0.6	34		33	1	37
10	Angadickal Harijan Settelment Colony	14	listed	0.33	11		11		13

10.5.6 Categorisation of Slums

Data on the availability of infrastructure in each of the above colonies are also collected during the survey. The methodology adopted for identifying urban slums includes assigning weightage on basic amenities, density of population, number of scheduled caste/ scheduled tribe population and the structural condition of dwelling units in the area. The indication of backwardness, their minimum standard and weightage assigned are listed in Table 10-11.

Table 10-11 Indicators of Backwardness, their minimum standard/ benchmark and the weightage assigned

Sl No	Indicators of Backwardness	Minimum Standard /Bench mark	Maximum weightage when amenities are completely absent
A	Adequacy of basic amenities		
1	Inadequacy of latrine facilities	1 seated latrine for every 20 persons	10
2	Inadequacy of drainage system and exit for sullage and rain water		10
3	Inadequacy of access road		8
4	Inadequacy of water supply	1 tap point for every 100 persons	5
5	Inadequacy of street light	1 street light for every 30 metres	5
B	Density of population	100 persons/acre (250 persons / Hectare) gets 5 points and 1 point each for every additional 20 persons	20 maximum weightages when density reaches 300 persons per acre
C	SC/ST population	30 % or above	10 maximum weightages
D	Structural conditions of dwelling units	50 % or more huts or dilapidated structures	5 maximum weightages

The survey data collected for each of the settlements is analysed and presented in Table 10-12.

Table 10-12 Combined weightage of listed slums in the planning area

No	Name of Slum	Weightage according to facilities									Grade
		Latrine	Drainage	Access Road	Water Supply	Street Light	Population	SC/ST	Structural Condition	Total	
1	Pandavanpara	1.5	10	0	0	4.5	2.5	10	0	28.5	B
2	Angadickal Thalakkodu Pallathu	2.5	10	0	2.5	5	4.5	10	0	34.5	C
3	Moolappadavu	2	10	8	2.5	5	0	3	0	30.5	C

4	West of Railway station	2.5	10	0	5	5	0	10	0	32.5	C
5	Poomalachal	1.5	10	0	5	5	0	10	0	31.5	C
6	Angadickal South	2	10	0	5	5	20	10	0	52	D
7	Angadickal Lakshamveedu	1	10	0	2	5	20	10	0	48	D
8	Angadickal Amaroozhathil	2	10	0	3	5	0	10	0	30	C
9	Pulikkunnu	8.5	10	0	0	4	12	10	0	44.5	D
10	Angadickal-Harijan Settlement Colony	2.5	10	0	5	4.5	0	10	0	32	C

Grade A: Grade A colonies are comparatively well developed among other colonies. Most of the basic infrastructure is available in this area. With less financial support, these colonies will become as normal housing areas. No colonies in the planning area are identified as grade A.

Grade B: Colonies with combined weightage varying from 20-29 are categorized as grade B colonies. The colonies identified in the grade B is Pandavanpara Colony.

Grade C: Combined weightage ranging between 30 and 39 is categorized as grade C colonies. These colonies are slightly improved colonies compared to pucca slums. However severe problems on basic infrastructure, relatively high density and social backwardness exist in these colonies. Grade C colonies in the planning area are Angadickal Thalakkodu Pallathu, Moolappadavu, West of Railway Station, Poomalachal, Angadickal Amaroozhathil and Angadickal Harijan Settlement Colony.

Grade D: Colonies with combined weightage of 40 or above is categorized as Grade D which can be considered as pucca slums. The colonies identified to be of Grade D are Angadickal South, Angadickal Lakshamveedu and Pulikkunu.

In Angadickal South colony (D Grade) the major problems include high density of population and inadequacy of infrastructure facilities like drainage and water supply. Street lights are also not available in this colony. In Angadickal Lakshamveedu colony (D Grade) high density of population and absence of facilities like drainage and street lights are the major problems. In Pulikkunnu colony (D Grade) lack of drainage facilities and sanitation, absence of street lights etc are the problems.

In Angadickal Thalakkottu Pallathu colony (C Grade) inadequacy of drainage facilites and street lights are the major problems. Lack of infrastructure facilities like drainage, water supply and street lights are the main problems in West of Railway Station, Angadickal Harijan Settlement and Poomalachal colonies (C Grade). In Moolappadavu colony (C Grade) absence of internal access roads and inadequacy of facilities like drainage and street lights are the problems. In Angadickal Amaroozhathil colony (C Grade) the problems include lack of drainage and street lights.

In Padavanpara colony (B Grade) drainage facility is absent. Street lights are also not available in the colony.

10.5.7 Spatial distribution

Slums in the planning area are found in Kodiyattukara ward, Puthenkavu West ward, Valiyapalli ward, Angadickal South ward, College ward, Moolappadavu ward, Malayil ward and Angadickal ward. Two slums are located in Moolappadavu ward and Malayil ward.

10.5.8 Problems and potentials

Almost 46% 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 in habitation pattern.

10.5.9 Inference

In Chengannur Municipal area the housing sector as such do not show any serious problems. Only 6.1% of the houses in the Municipality are kutcha/huts. 93.9% of houses are in pucca or in moderate condition. 99% of people reside in their own land. Only 1% of people live in rented or lease buildings. There is no shortage of houses in the municipal area at present. But there is a need to replace the 567 kutcha houses with pucca houses. This can be covered by the housing projects by government for the economically weaker sections. But in slums and other backward settlements, infrastructural facilities are lacking. There are 10 listed slums in Chengannur. In all the above human settlements 251 families are residing. Lack of drinking water facilities, lack of sanitation facilities and absence of internal roads are major problems.

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 are discussed.

11.1 Social Backwardness and Poverty

Backwardness is a lack of progress by a person or group to some perceived culture norm of advancement, such as for example traditional societies relative to modern scientific and technologically advanced industrialized societies. Social backwardness leads to educational backwardness and economic backwardness. They are mutually contributing to each other and are intertwined with low occupations in the Indian society.

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 the 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 Chengannur Municipality, 1655 households are categorized as BPL families spreading over many wards of the Municipality. Table 11-2 shows the ward wise number of BPL HHs. The BPL families are more in Pandavanpara ward (115), Malayil ward (93), Mangalam North ward (88), Angadikkal south ward (88). BPL household is more concentrated on ward 7, 8 and 22 of the Municipality, where slums are located.

Table 11-2 Ward wise number of BPL card house holds

WARD No.	Ward Name	Bpl Card Holders No	Ward No.	Ward Name	Bpl Card Holders No
1	Mundankavu	53	15	Malayil	93
2	Kodiyattukara	53	16	ITI	53
3	Temple ward	75	17	College	69
4	Mithrapuzha	41	18	Angadickal South	88
5	Vazharmangalam	59	19	Hatchery	74
6	Mangalam South	50	20	Moolappadavu	72
7	Mangalam North	88	21	Thittamel	75
8	Edanadu West	81	22	Pandavanpara	115

9	Edanadu East	62	**23**	Bethel	42
10	Puthenkavu East	45	**24**	Town	46
11	Arattukadavu	50	**25**	Railway Station	51
12	Puthenkavu West	42	**26**	Vandimala	29
13	Sasthamkulangara	49	**27**	Valiya Palli	58
14	Angadickal	42	**TOTAL**		**1655**

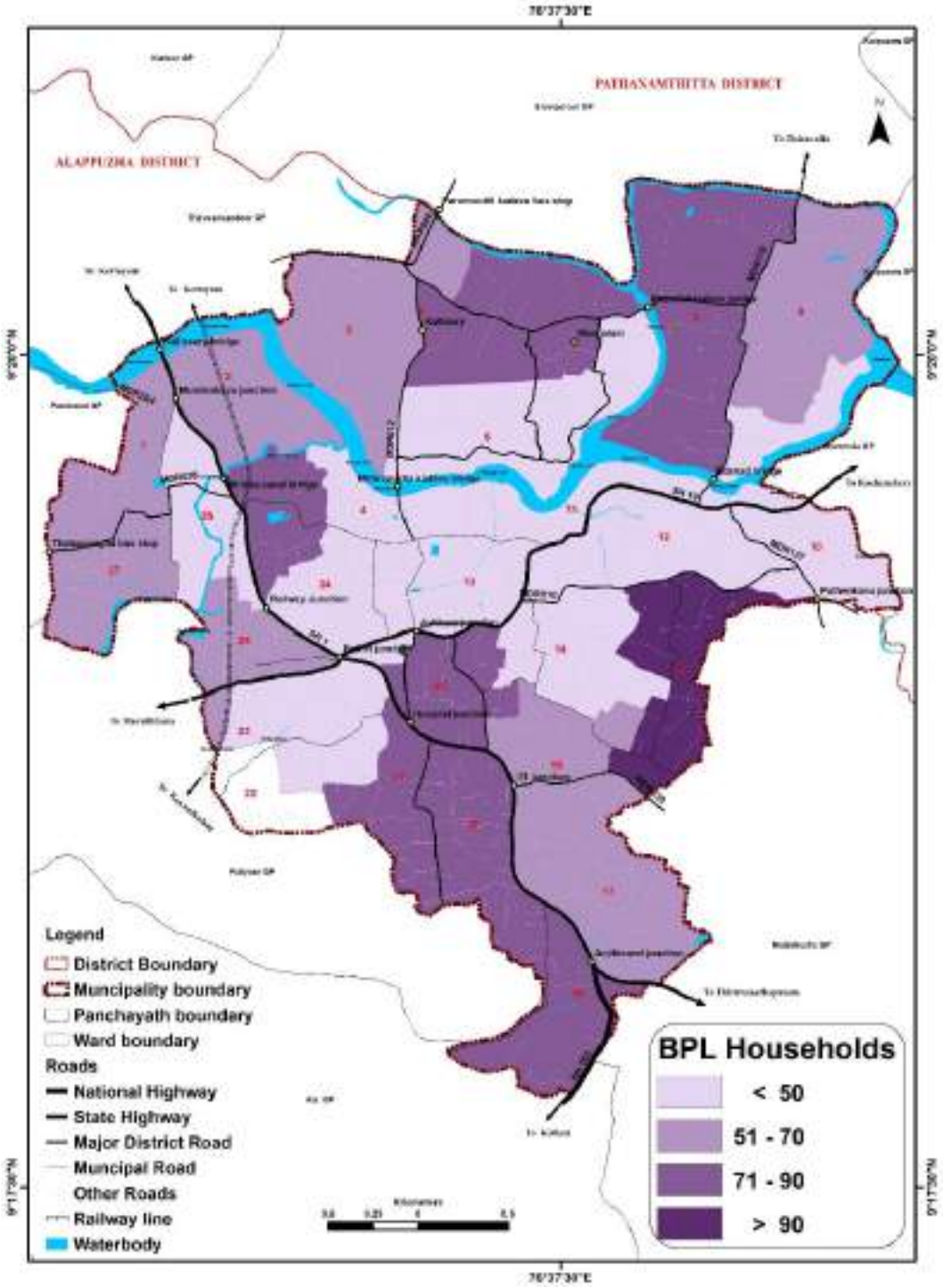

Figure 11:1 Concentration of BPL Household

Source: Taluk Supply Office Chengannur

11.1.2 Details of Colonies

Socially and economically back ward people usually living in groups and devoid of modern amenities often. Low-income people living either authorized or unauthorized as groups referred as colonies & slums. Table 11-3 shows the details of colonies in the Chengannur Municipality. As per Nammal Namukkayi durantha nivarana asoothrana rekha 2020, there are 24 colonies are present in the Municipality. Figure 11:2 is the representation of the detail of colony wise number of families and family members.

Table 11-3 Details of Colonies in Chengannur Municipality

Sl No	Ward no	Name of Colony	Number of Family	Number of family Members
1	1	Devathara Colony	5	18
2	5	Puthenyuzhathil Colony	11	38
3	6	Vettukattil Colony	5	20
4	6	Valiyathara sanketham	5	18
5	7	Velattuthara Colony	18	88
6	7	Unmanathara sanketham	7	20
7	8	Muloor laksham veedu colony	6	28
8	8	Udhikkana sanketham	7	34
9	9	Velan Colony Near temple	9	42
10	12	Kattil Colony	5	20
11	14	Channathilyuzhathil Colony	6	37
12	14	Kuttiyil Colony	5	20
13	15	Amariyuzham Colony	25	133
14	15	Kizhavaramodi Colony	9	51
15	17	Kappimala colony	15	79
16	18	Chettiyanmodi sanketham	10	53
17	19	Thondippara colony	15	52
18	20	Pulikkunnu Colony	45	178
19	21	Chakrapaniyuzhathil Colony	7	31
20	22	Pandavanpara Colony	76	279
21	22	Valiyakulathumbattu Colony	6	22
22	23	Priyadarshini Colony	24	91
23	24	Pathiyamparambil Colony	8	33
24	27	Thazhamthara Colony	13	49
Total			**342**	**1434**

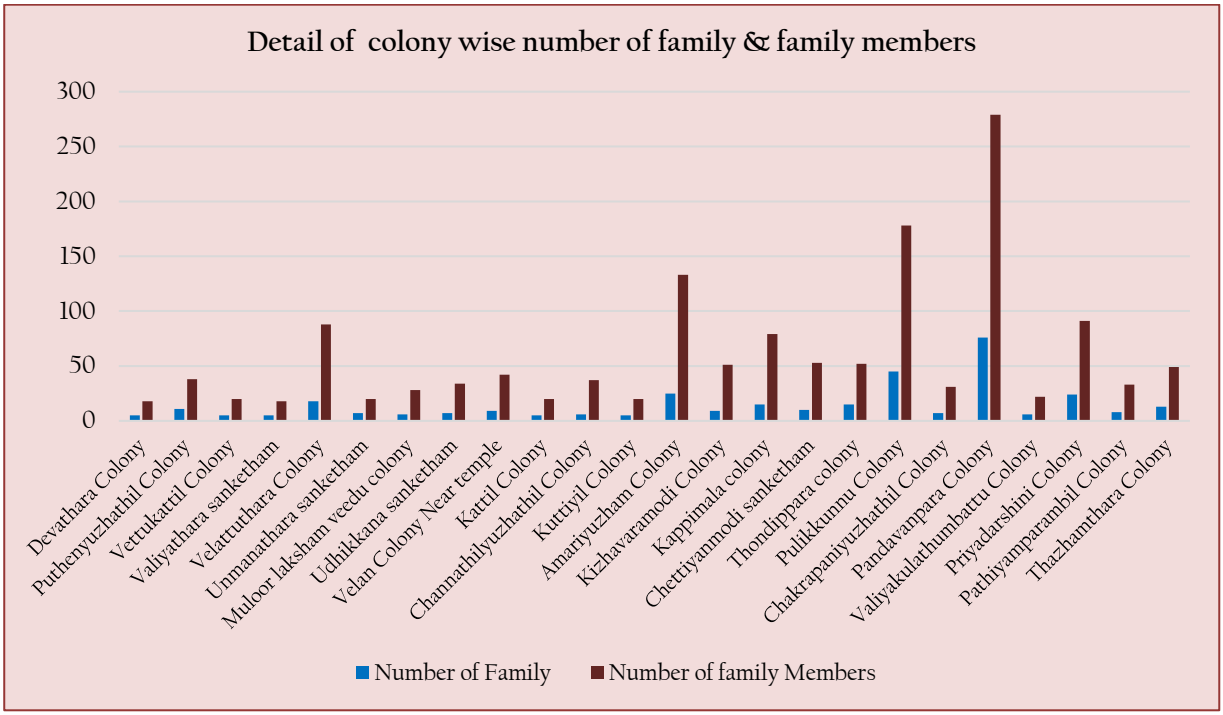

Figure 11:2 Detail of Colony wise number of family & family members
Source: Nammal Namukkayi Durantha Nivarana Asoothrana Rekha 2020

11.1.3 SC/ST Population Index

According to 2011 Census SC population constitutes nearly 11.03 % of the total population in the Municipality whereas ST population is very low (nearly 0.32 %) in the Chengannur Municipality. Percentage of SC population of the Alappuzha district is 9.45. More SC Population is concentrated in Pandavanpara ward & Town ward. ST population is more in Arattukadavu ward. Figure 11:3 and Figure 11:4 shows the details of SC population & ST population in the Municipality.

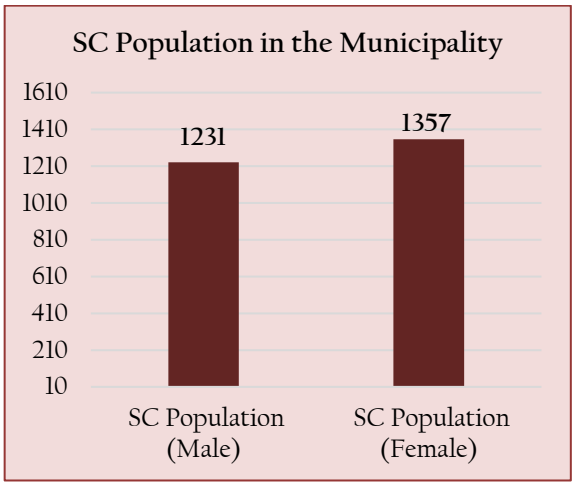

Figure 11:3 Details of SC Population in the Municipality

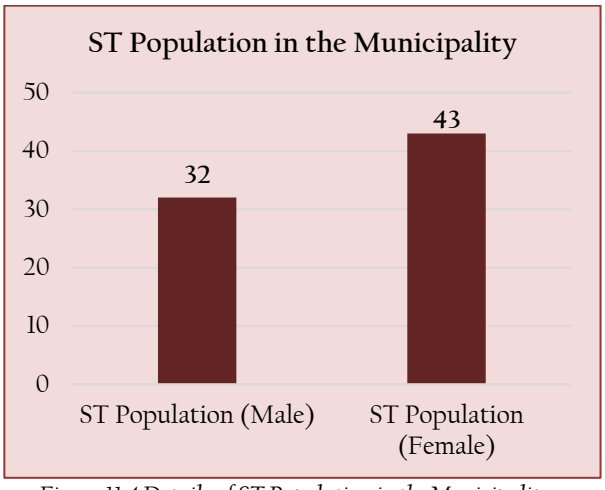

Figure 11:4 Details of ST Population in the Municipality
Source: 2011 Census data

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. As per Nammal Namukkayi durantha nivarana asoothrana rekha 2020, there are 41 differently abled peoples in the Municipality. Of which 23 are females and 18 are males which is shown in **Error! Reference source not found.**. I n the total population, there are 2642 elderly people are living in the Municipality. Of which 1150 are males and 1492 are females.

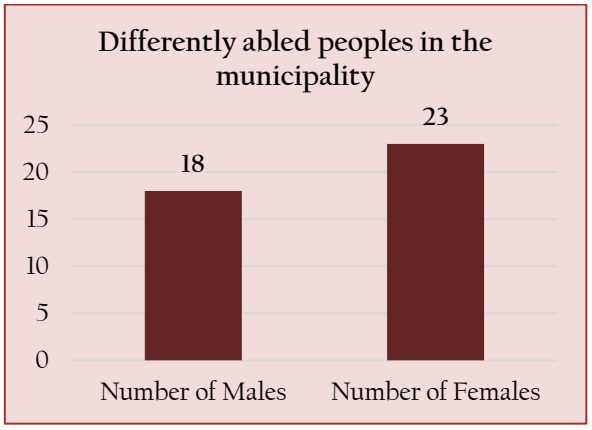

Figure 11:5 Differently abled peoples in the Municipality

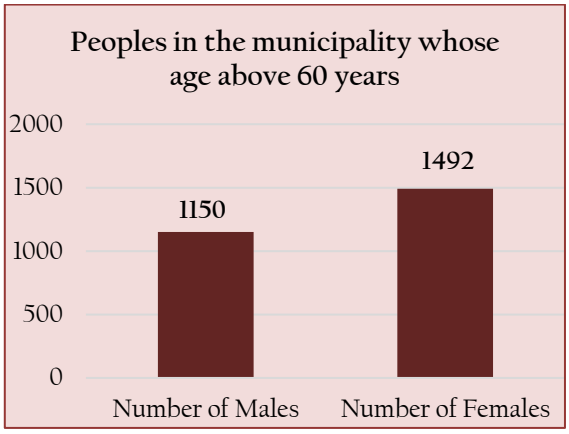

Figure 11:6 Peoples in the Municipality whose age above 60 years

Source: Nammal Namukkayi Durantha Nivarana Asoothrana Rekha 2020

As per the census data 2011, population of boys of age group 0 to 6 years is 834 and girl's population is about 858. It is represented in Figure 11:6. In the total population of 23466, 1692 are in the age group 0 to 6 years. This constitutes 7.21% of the total population.

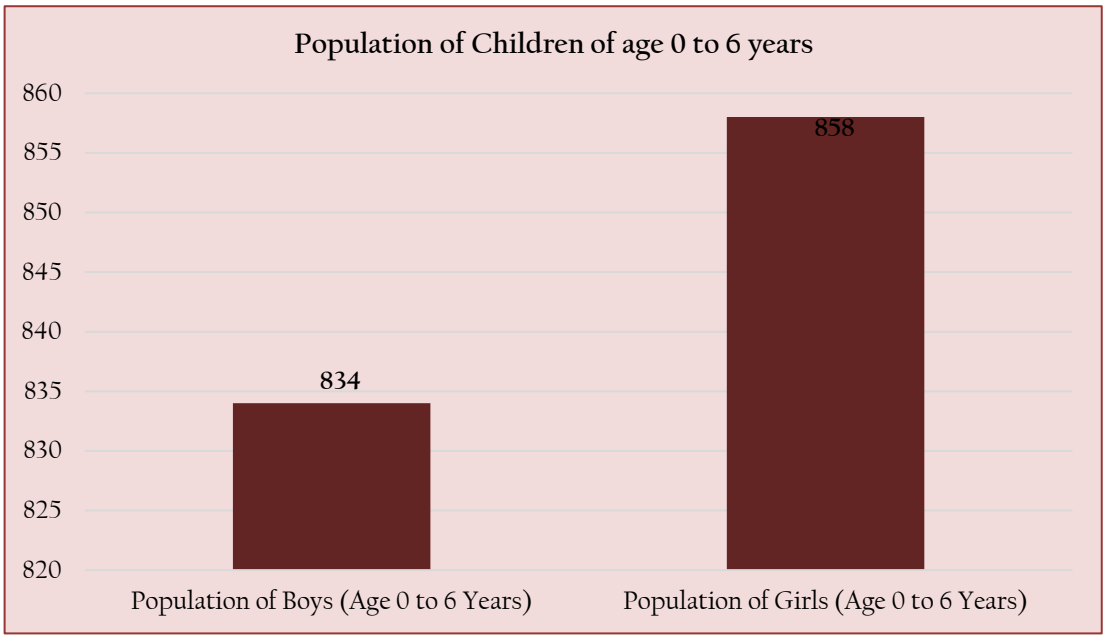

Figure 11:7 Details of Population of children of age 0 to 6 years

Source: 2011 Census data

11.3 Women and Child Development

For the modern developed world, the development strategy of women& child always seeks special attention. In Kerala population of women is more than half of the total population. Literacy rate of women is higher in Kerala state. Government had taken many proposals for bringing women into the main stream. For the welfare and advancement of women life, labour enterprises and special labour 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.

Absence of proper accommodation facilities is the major problem being faced by the working women. There is only one 'She Lodge' at the town near the private bus stand. Immediate steps have to be taken to provide accommodation facilities and measures to ensure their safety has to be taken care of. Another problem is the lack of basic facilities like toilets at public places.

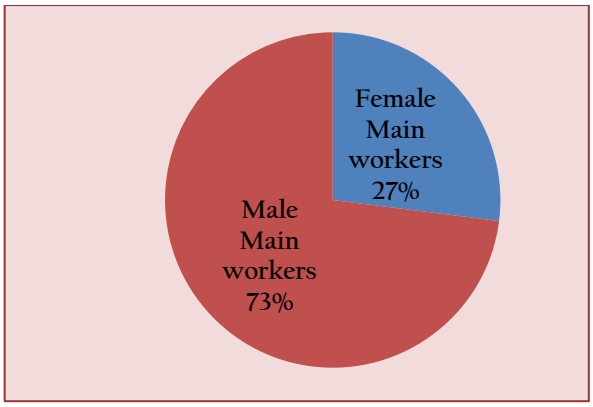

Figure 11:8 Percentage of Main workers

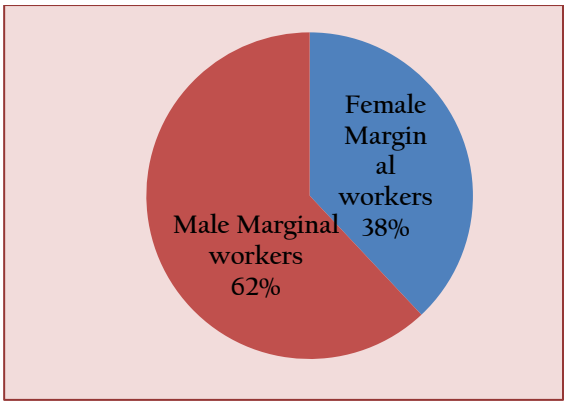

Figure 11:9 Percentage of Marginal workers

Source: 2011 Census data

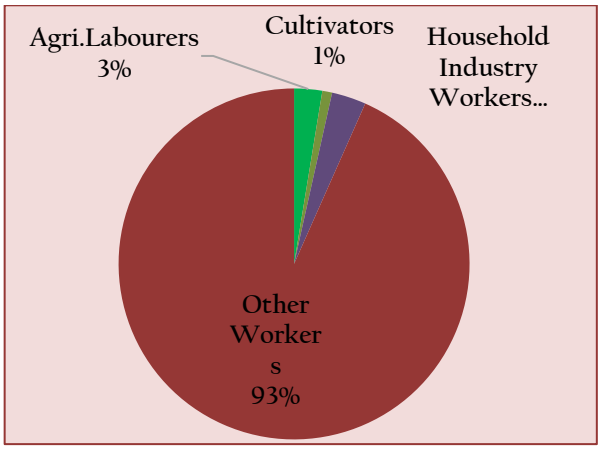

Figure 11:10 Classification of Female Main workers

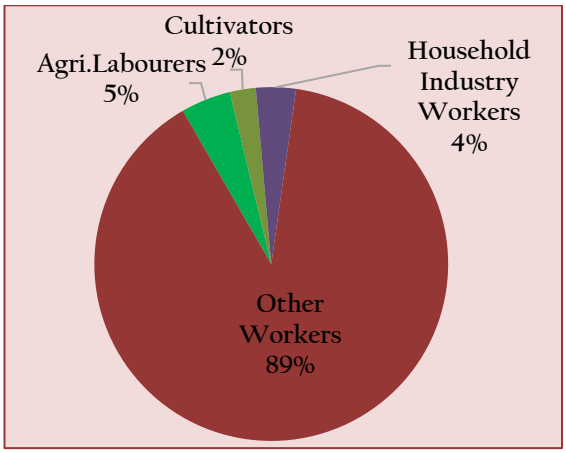

Figure 11:11 Classification of Female Marginal workers

Source: 2011 Census data

Figure 11:8 shows the percentage of main workers in the Chengannur Municipality. Female main workers constitute 27% of the total main worker's category. Figure 11:9 is the representation of percentage of marginal workers in the Municipality. Female marginal

workers constitute 38% of the total marginal worker's category. As per census 2011, different categories of female main workers are shown in Figure 11:10 and Figure 11:11 shows the classification of female marginal workers. Female workers are working in provisional stores, petrol bunks, teaching field, agricultural field, housekeeping works, textile shops and government offices.

11.3.1 ICDS Programmes

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 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. As per Nammal Namukkayi durantha nivarana asoothrana rekha, there are a total of 22 anganwadis within the Municipality, of which 32% of anganawadis working on its own building and 68% working on rented building. Table 11-4 shows the list of anganawadis in the Municipality. Figure 11:12 shows the status of anganawadi buildings. There are no anganawadis in ward no 6,11,14,19,20,23,26. There are two anganawadis in ward no 3.

Table 11-4 Details of Anganawadis

Sl No	Ward No	Name of Anganawadi	Own Building/Rented Building	
1	1	Mundenkavu	Own Building	
2	2	Kodiyattukara		Rented Building
3	3	Lakassery Kunnathumala		Rented Building
4	4	Town LPS, GPS Keezcherymel	Own Building	
5	5	Mithrapuzha	Own Building	
6	7	Vazharmangalam	Own Building	
7	8	Edanaadu		Rented Building
8	9	JBS Edanaadu		Rented Building
9	10	AKG Padi Puthenkavu		Rented Building
10	12	JBS Puthenkavu		Rented Building
11	13	Shasthamkulangara		Rented Building
12	15	Angadikkal Malayil School		Rented Building
13	16	Moolapadavu ITI Junction		Rented Building
14	17	Kappimala		Rented Building
15	18	Kanjirathummoodu		Rented Building
16	21	Noottavanpara	Own Building	
17	22	Pandavanpara		Rented Building
18	24	Shasthampuram	Own Building	
19	25	Thrpallur Railway Back side	Own Building	
20	3	Chinmaya School Back side		Rented Building
21	21	Thittamel		Rented Building
22	27	Karuvelippadi		Rented Building

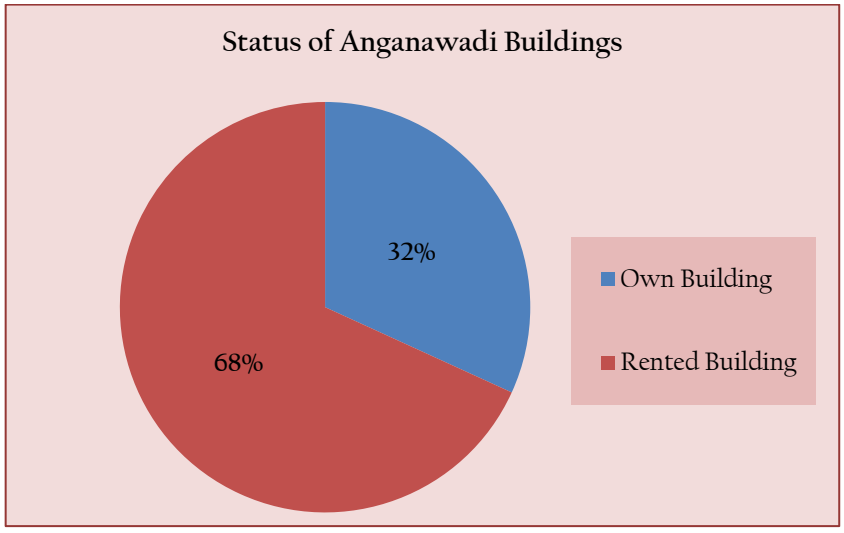

Figure 11:12 Status of Anganawadi buildings
Source: Nammal Namukkayi Durantha Nivarana Asoothrana Rekha 2020

11.4 Disaster Risk on the Special Concern Areas

During 2018 flood, almost all colonies, slums etc. were affected. Living share of Municipality population are NRIs who have migrated for the employment & study purpose. Parents of these NRIs who are senior citizens are in the society and included in the special concern categories of the Municipality. These were a group which faced the severity of the 2018 flood. When the water level rose up to 3metre, many of them were not in a position to climb upstairs for rescue. Rescue team got information regarding these trapped people from the messages shared by their children and relatives through social medias. SC population is more in the ward of Pandavanpara and Town ward. There were two rescue camps at Pandavanpara during 2018 flood. 360 people were accommodated in Pandavanpara community Hall and 114 people were in Marthoma centre rescue camp.

11.5 Inferences

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. As per census data, Among Female working population, Other worker's category is more in both in main and marginal workers. Other worker's category includes peoples working in IT field, workshop, ex-service, provisional stores, petrol bunks, auto drivers, newspaper agents, teachers, construction workers, textile shop etc. More projects have to be evolved for the economic development of women, Scheduled Cast and Scheduled Tribe people. As the disaster risk concerned, there should be an action plan for the protection of slums and colonies in the Municipality.

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.

The environment of Chengannur Municipality is not much polluted compared to similar towns in the state. This is mostly due to the fact that the municipal area has no high industrial development. The residential density is also not high compared to similar towns in the state. The water quality is good. Most of the households are using the water from the wells directly without any treatment due to this. Air pollution due to vehicular traffic is limited to a very small area in the town centre. The site for solid waste treatment is near the inhabited areas. One important problem in the environmental sector in the Municipality is the letting out of waste water to the storm water drains without any treatments from some of the residences and commercial establishments.

12.1 Climate

Chengannur have a tropical humid climate with an oppressive summers and plentiful seasonal rainfall. The period from March to the end of May is the hot season. This is followed by the southwest monsoon season, which continues till the end of September. During October and major part of November southwest monsoon retreats giving place to the northeast monsoon, and the rainfall up to December is associated with northeast monsoon season.

12.2 Temperature

Generally, March and April months are hottest and December and January months are coldest. At Chengannur the maximum temperature ranges from 29.2ºC to 33.9ºC whereas minimum temperature ranges between 21.8ºC to 26.1ºC.

12.3Wind

The wind is predominantly from east and northeast during morning hours and during the evening hours the predominant wind direction is from west and northwest. The windiest month (with the highest average wind speed) is July (10.1km/h). The calmest month (with the lowest average wind speed) is November (6.2km/h).

12.4 Humidity

The humidity is higher during the monsoon period, June to September. Months with the highest relative humidity are July and August (82%). The month with the lowest relative humidity is February (69%). All through the year, the humidity is high during the morning hours.

12.5 Rainfall

The district receives an average annual rainfall of 2965.4 mm. The southwest monsoon season from June to September contributes nearly 60.3% of the annual rainfall. This is followed by the northeast monsoon season from October to December, which contributes about 20.9% of the annual rainfall, and the balance 18.8% is received during the period from January to May months. Rainfall received in Chengannur during 2015 to 2020 is shown in Table 12-1.

Table 12-1 Rainfall in MM from 2015- 2020

Month	2015	2016	2017	2018	2019	2020
January	0.00	0.00	4.6	0	0	0
February	0.00	0.00	0	15	3	0
March	154.20	23.00	156.84	12	1	15.9
April	239.50	50.00	20	113.4	45	62.8
May	176.00	353.00	372.6	322	37	412
June	548.00	546.25	654	429.8	242.5	408.3
July	205.50	376.50	258	672	338	231.3
August	226.00	179.80	353.8	712.23	634.4	322
September	221.30	58.00	500.6	23.6	324	651
October	405.00	103.00	199	263.3	420	287
November	268.30	184.20	261	243	238	134
December	183.00	11.00	62	77.5	106	51.3

Source: IMD

12.6 Watershed

A watershed is an area of land that drains all the streams and rainfall to a common outlet such as the outflow of a reservoir, mouth of a bay, or any point along a stream channel. Watersheds can be as small as a footprint or large enough to encompass all the land that drains water into rivers.

There are 9 watersheds in the Municipality area. Either Pamba River or any of its channels passes through each watershed point.

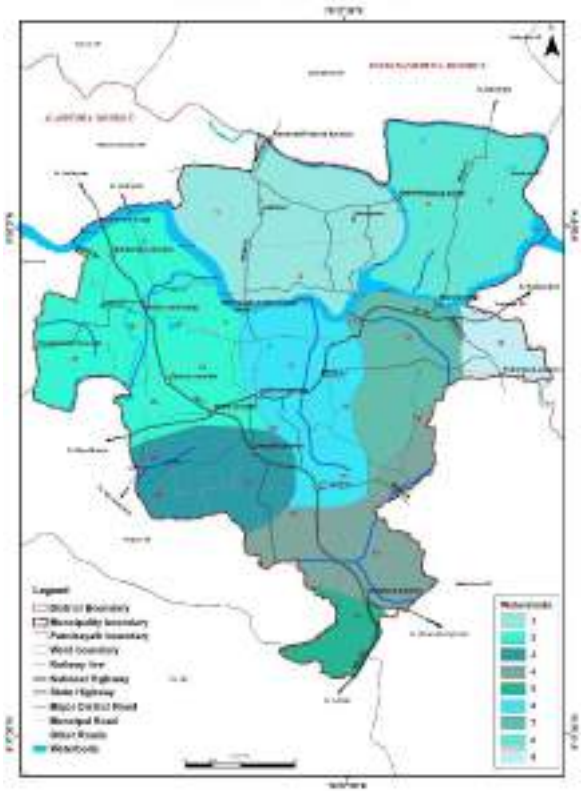

Figure 12:1 Watersheds in chengannur Municipality

Source: LRIS

12.7 Climate Change

12.7.1 Changes in rainfall trend

As per the analysis done by Indian Meteorological Department (IMD) of historic rainfall data of Kerala indicates cyclic trends in annual rainfall with a declining trend and

South West Monsoon rainfall during the last 60 years. This decrease is large in South Kerala, particularly in the hill areas. The annual rainfall has decreased through about 26% of the long term mean in the last 100 years.

12.7.2 Changes in the Temperature

According to Indian Meteorological Department, during the last 43 years, the mean maximum temperature has risen about 0.8^0C, the minimum by 0.2^0C and the average by 0.6^0C over Kerala (27.3^0C - 27.9^0C), a clear upward trend in surface air temperature. Such warming was noticed in the entire Kerala coast. Also differences in maximum and minimum temperature was widening along the high ranges of Kerala. The changes in thermal and moisture regime over the year have resulted in the shifting of climate in Kerala from B4 to B2 class, moving from wetness to dryness within the humid type oclimate. For the last three years, sunstrokes events are reporting which is uncommon in the past, from various parts of the state.

12.7.3 Climate Change Projections

In the first 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) has been pointed out that reduced rainfall, increased atmospheric temperature and flooding due to sea level are the climate change scenarios for the Western Ghats and Kerala in the next 20 years. The minimum surface air temperature in the Western Ghats region may rise by 2°C to 4.5°C.

It is seen that negative change in deviations of rainfall observed in the Northern Districts i.e., Wayanad, Kannur and Kasaragod. It is also seen that other Northern district like Kozhikhode, Malappuram and Kannur may have slight changes (decrease rainfall from normal). Unlike to this, Southern Districts will have tendency of increase the rainfall of 10 to 30 rainfalls from the normal. From the average it is observed that South –Central Kerala districts clearly shows having the maximum deviation of 20 to 30 Centimetre deviation from the normal which comprising the districts of Ernakulum, Alappuzha, Kottayam, Pathanamthitta and Idukki. The scenario of future sea level was obtained by adding the projected values for a given year to the local trend of 0.02 cm per year times the number of years from present.

12.8 SOIL

12.8.1 Geomorphology

The Chengannur block is geomorphologically not uniform. It is characterized within landforms resultant from both denudational as well as marine/coastal processes. Lateritic sloping terrain found on the southern and eastern part is formed by the denudation processes while the imprints of coastal/marine processes can be seen in the western, central and northern parts. Lowland geomorphology with imprints of prehistoric coastal/marine processes forms the major share of landforms of this block. Paleo beach ridge, Swale and Old coastal plains show the regression of sea from this area during the geological time.



Figure 12:2 Geomorphic pattern



Figure 12:3 Soil Classification based on Texture

Source: LRIS

12.8.2 Lithology

When Soil is classified based on texture, it falls into three classes in the study area viz. laterite, syrite and coastal sand and alluvium. The most part of the area agricultural activity practiced are paddy, coconut, vegetables, pepper etc. The major soil type is laterite and it is found in North -West and North- East portion of the project area. More than 60 % of the basin is seen in laterite soil, about 30 % of the area is found in syrite and coastal sand and alluvium is around 10 % on the western tip of study area.

12.8.3 Soil Series

Major portion of the block in the Western side of the block constitutes to Mannar series and a portion of the watershed area falls in Adoor series in the Eastern part. Mannar series soil is generally found in lowland wheras Adoor series soil varies from



Figure 12:4 Soil Classification based on Geology

sand to sandy loam soil and are grayish brown to dark brown in colour. The cultivation of paddy, coconut, vegetables, rubber, pepper etc are common here.

12.8.4 Geology

Geologically, the project area is formed by quaternary sediments. Recent to sub-recent sediments are observed. The quaternaries in the project area are mainly of fluvial deposits process. Residual laterite formations are encountered in south-eastern parts of the district and Granites are encountered in and around Chengannur area. The Charnockite, Khondalite and Granites form the basement. Charnockites and Khondalites are encountered at depth. They are overlain by Tertiaries. The laterite/alluvial sediments overlay the Tertiaries. The major portion of the area is filled with alkaline rocks and a small portion with chamockite group of rocks.

12.9 Pollution

12.9.1 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.

In case of Chengannur Municipality, the concentration of industries or factories are comparatively less, which keeps the area unpolluted. There is no large scale and medium scale industries in Chengannur Municipality. There are only 9 small scale industrial units in the Municipality. The concentration of industrial land use is high in Mundankavu ward. The high concentration in this ward is explained by the presence of few industries in this ward. 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. Table 12.2 shows the average ambient air quality of Chengannur, which seems to be good enough.

Table 12-2 Air Quality Index measure of Chengannur

Pollutant	Value	Air Quality Index	Grade
NO_2	20.6 µg/m³	25	Good
O_3	77.8 µg/m³	77	Satisfactory
PM10	81.0 µg/m³	81	Satisfactory
C0	960.0 µg/m³	48	Severe

Source: CPCB, Thiruvananthapuram Kerala PCB

12.9.2 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 neighbourhood. The main indoor noise sources are ventilation systems, office machines, home appliances and neighbours.

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.

As the count of recreational facilities, factories and public gathering areas are less, pollution due to excessive noise is less. The only way for noise pollution is from vehicles passing through the main roads at peak hours, which is not exceeding the limit.

12.9.3 Water pollution

Pamba is one of the most important rivers in the South Western Hills of Kerala. The famous shrine of Sabarimala is situated in the hills of Pamba plateau which is one of the most popular pilgrim centres in South India and millions of pilgrims visit the shrine. Lack of sanitary latrines, lack of facilities for sewage collection and treatment accumulation of wastes discharged from hotels and commercial establishments located at Sabarimala are the major sources for the pollution of Pamba River (CPCB, 2000). The pollution is mainly due to human excreta and biodegradable waste like used leaves, vegetable wastes, discarded clothes, food wastes etc. Indiscriminate disposal of used plastic bottles forms the major portion of the non-biodegradable waste. The gathering of very large crowds over a short period of time every year in an ecologically sensitive area has given rise to various environmental problems. The daily average sewage generated in Pamba town was seven mld and 3.5 mld of untreated sewage. This was being discharged into the Pamba River. The daily average sewage generated in Sabarimala was 10 mld and the entire 10 mld of untreated sewage was being discharged into the river (CAG, 2011).

Main Pollutants:

1. Ammonium Nitrogen – Human Waste – 3.1kg/hectare
2. Phosphorous – High amount of detergents – 5.6 kg/hectare
3. Nitrate nitrogen – Fertilizers used in plantations

The fertilizer and pesticide inflow from agricultural fields and plantations situated in the upland catchment of Achankovil, Pamba, Manimala and Meenachil Rivers were significant. Hospital wastes and sewage from all towns in the upstream part flowed to these rivers. Apart from these 20,000 tons of fertilizer per year added to the rice fields and 50 tons of pesticides contributed to the pollution load. The total coliform number per 100 ml was reported to be from 40,000 to 46,000 MPN at Pamba. The polluted Pamba river water has become host to

many waterborne diseases in the District of Pathanamthitta and Alappuzha. Rivers being polluted by the discharge of wastes from toilets in the foothills of Sabarimala as well as the towns of Ranny, Erumely, Kozhencherry and Chengannur. Dumping of wastes from slaughter houses and chicken corners in to the Pamba was another major issue. The purity of water at Pamba is deteriorated day by day due to the heavy influx of pilgrim tourism in every year.

It has been reported that open defection, discharge of raw sewage, domestic waste, commercial waste etc, during the Sabarimala pilgrim season spread over 65 days turn the Pamba river highly polluted and the count of coliform bacteria was found to reach a level of three lakhs per 100ml (Kerala State Pollution Control Board). Thousands of chemicals have been identified in drinking water supplies around the world and are considered potentially hazardous to human health at relatively high concentrations (World Health Organisation, 2004). Heavy metals are the most harmful of the chemical pollutants and are of particular concern due to their toxicities to humans.

12.9.4 Pollution Studies in Chengannur Segment

The physical and chemical characters of a river have a major role in sustaining its biota and maintaining the quality of its water. Any change in the parameters will result in alteration in the water quality and thence the diversity of its flora and fauna. So, a study was conducted by Vizhinjam Research Centre of CMFRI by examining the water quality of Chengannur segment of Pampa River.

A. Study area

The study area was Chengannur Segment of River Pamba. It is located at latitude 90 19' 29.07' N and longitude 760 27' 54.31' E with an elevation of 6 Ft above mean sea level. One of the 3 study sites selected was Mundankavu in Chegannur.

B. Collecting and transportation of Sample

Monthly samples were collected from these study sites during Post monsoon (October, November and December 2011) and summer (January, February and April, 2012) seasons. Three samples were taken from each site with an average distance of 500 meters. Samples were collected in pre-sterilized containers and transported to the laboratory in iceboxes within shortest possible time to avoid erroneous data variation due to physical and bacteriological change.

C. Physical Analysis of Sample

In the laboratory pH and dissolved Oxygen was measured using a water quality analyser. Nitrate, phosphate and biological oxygen demand was determined as per the procedures of APHA (APHA, 2005).

Table 12-3 Samples taken from Mundankavu

Index	Post Monsoon	Summer	Mean ± SD
BOD (mg/L)	4.45	1.34	2.895 ± 2.2
pH	6.14	7.08	6.61 ± 0.66

D.O (mg/L)	6.2	5.2	5.7 ± 0.7
Nitrate (mg/L)	0.42	0.68	0.55 ± 0.13
Phosphate (mg/L)	0.82	1.13	0.975 ± 0.21

Source: (Rohini Krishna M V, 2014)

Table 12-4 Chemical Parameters of Achankovil and Pamba River

Parameter	M	NM
pH	5.97	6.92
Conductivity (µS/cm)	30.48	33.27
D.O (mg/L)	6.37	6.92
Alkalinity (mg/L)	11.83	15.67
BOD (mg/L)	2.07	2.05

Source: (Rohini Krishna M V, 2014)

12.10 Channel incision

The shape of the cross-section of a river channel in a given site is a function of flow velocity, the quantity and character of the sediment movement through cross section and the character of the materials that make up the river bank and bed of the channel.

The channel incision in the other rivers is in the order Pamba ›Muvattupuzha Chalakudy›Manimala › Achankovil. It is quite interesting to note that after the year 2000 (during 2000-05), the rate of channel incision has been substantially reduced nine times in Chalakudy river, five times in Pamba river, three times in Periyar river, two times in Meenachil river and less than two times in Muvattupuzha river with respect to 1995-2000 period. It can be related to the effective regulatory measures taken by Government after the implementation of 'Kerala Protection of River Banks and Regulation of Removal of Sand Act, 2001'. At the same time, the rate of channel incision has been increased in the Achankovil and the Manimala rivers. The maximum rate of channel incision observed was in the Meenachil (13.06 cm-1) river during the period 2000-05 compared to other rivers.

Table 12-5 Channel Incision in storage zone of rivers

		Channel Incision (cm^{-1})				
Sl.No.	River	1980-85	1985-90	1990-95	1995-2000	2000-05
1	Achankovil	5.26	11.14	9.52	1.08	5.04
2	Pamba	NA	2.98	20.98	15.48	3.06
3	Manimala	NA	NA	13.84	8.14	11.82
4	Meenachil	NA	19.75	4.46	27.48	13.06
5	Muvattupuzha	NA	5.5	4.2	9.4	6.6
6	Periyar	4.1	3.64	13.2	28.64	9.64
7	Chalakudy	NA	4.46	3.24	9.08	1

12.11 Sensitive / fragile areas

The sensitive areas in the Municipality, include wet lands (paddy) and river side areas. The Municipality has a total extent of 121.17 Ha of paddy and marshyland. Only a fraction of this area is cultivated. The Varattar and Pampa River are passing through Chengannur

Municipality and the canals are Poomala chal- Kuttankeri chal, Vengoor padi- Pampanadi thodu, Vettuthodu and Illimala-Moozhickal thodu.



Figure 12:5 Canals and watercourses in town



Figure 12:6 Location of Paddy Fields & Marshy Land
Source: Land use Survey

12.12 Conservation efforts

The Kerala Conservation of Paddy Land and Wetland Act, 2008 is in force in the town which prevents unregulated conversion of paddy and wet land for other purposes.

12.13 Problems and potentials

The problems faced by the Municipality in the environmental sector are the fast depletion of paddy/wet land, encroachment of waterbodies and water pollution due to waste water entering the storm water drains. The low density and a vast area of land under dry cultivation are the strengths of the Municipality in the environmental sector. The problems identified have not reached unmanageable proportions and hence can be brought under control.

12.14 Inference

Townis not much polluted, because of the very less industrial development. Pollution of natural drains passing through the town. The Municipality has a total extent of 1.0167 sqkm of paddy. Only a fraction of this area is cultivated. Poomala chal- Kuttankeri chal, Vengoor padi- Pampanadi thodu, Vettuthodu and Illimala-Moozhickal thodu etc flowing within Municipality limit. 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 DISASTER MANAGEMENT AND RISK ASSESSMENT

13.1 Introduction

The primary goal of the Disaster Management is to reduce the likelihood that the town will experience disaster and to mitigate the impact of any disasters that might occur in the area. Potential for disaster can be reduced by identifying and correcting hazardous conditions by encouraging alertness in detecting and reporting. This calls for a preliminary identification of the major disasters affecting the Municipality and those areas which are prone to disaster.

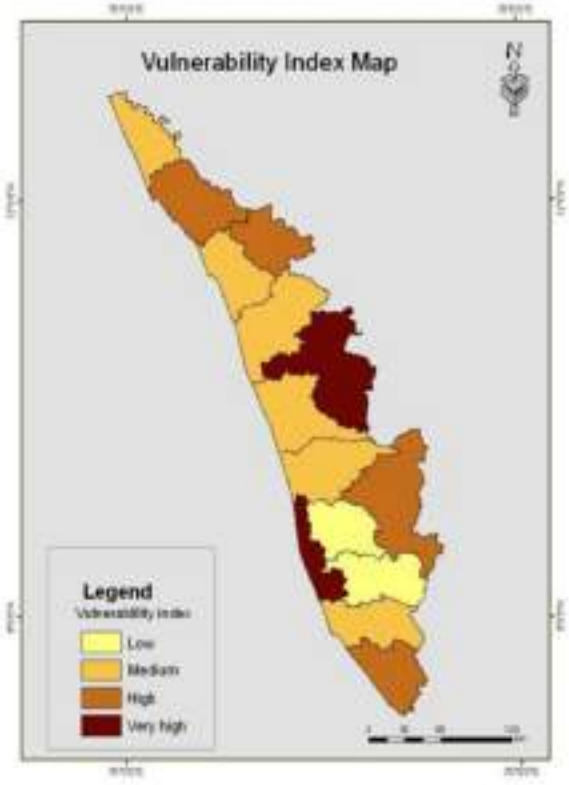

Figure 13:1 Vulnerable districts in Kerala
Source: Kerala State Action Plan on Climate Change, DoECC, 2014

Nowadays climate change acts as a major catalyst for disaster all over the world with Kerala being one of the most vulnerable states in India suffering from subsequent social and economic loss. The Kerala State Action Plan on Climate Change was drafted by the Directorate of Environment and Climate Change (DoECC) with relevant departments, agencies and institutes providing inputs. This was endorsed by the Government of India in 2014. As per the report, Alappuzha is identified as one of the four vulnerable hotspot districts of the state. With respect to Climate change, the hotspot analysis of districts in Kerala is determined based on hazard exposures (flood and drought) impact on biodiversity, and impact on life, livelihood and wellbeing of inhabitants of the areas. The degree of vulnerability of climate sensitive sectors, tribal population and low performer of Human Development Index were also considered in identifying hotspots.

As per the study, Alappuzha and Palakkad districts are the most vulnerable to climate change exposure, as these districts having higher values of Composite Vulnerability Index. Alappuzha showed very higher values of CVI showing exposure in terms various environmental variables like coastal wetlands, lagoons and sand beach. The district which is under very high vulnerability category lack adaptive capacity

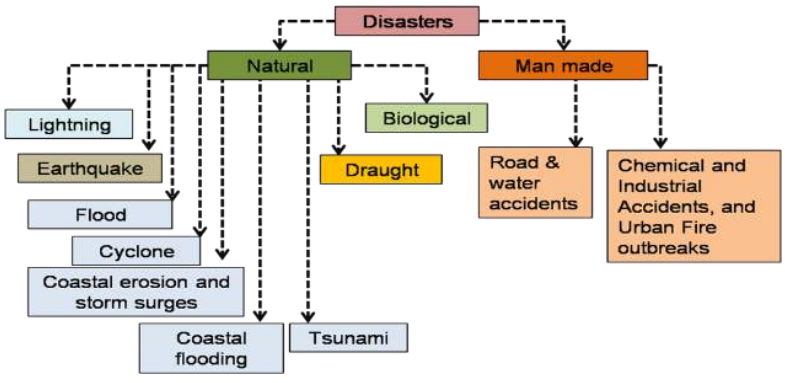

Figure 13:2 Types of Disaster

and show higher sensitivity and exposure to climate change in terms of social and environmental variables.

Alappuzha district has been traditionally vulnerable to natural disasters on account of its unique geoclimatic conditions & vast coastline. Floods and droughts have been recurrent phenomena. The Alappuzha District has a District Disaster Management Plan prepared in the year 2015 by Kerala Disaster Management Authority. The District Disaster Management Plan is envisaged to provide critical inputs that would enhance the efficiency and effectiveness of disaster management in real time. It also helps to foresee disaster risk reduction activities at various levels and develop preparedness for recovery/mitigation. However, events like the flood of 2018 and unpredictable climatic events have occurred over the recent years.

Table 13-1 Hazard Seasonality mapping of the district

Disaster	J	F	M	A	M	J	J	A	S	O	N	D
Drought												
Lightning												
Flood												
Storm surge												

Table 13-2 Hazard profile of the district

Sl.No.	Classification	Types of Disaster
1.	Naturally Triggered/ Weather Related	Flood
		Coastal Tsunami, Coastal erosion Kallakadal, Storm surge
		Thunder and lightning
		Cyclone
		DroughtSalt water intrusion
2.	Geological	Earthquakes
		Landslides
3.	Biological	Epidemics
		Cattle epidemics
		Food poisoning
		Pest attack, Bird Flew
4.	Anthropogenically/ Technologically triggered	Industrial explosions Petro-chemical transportation accidents
		Fireworks accidents
		Road accidents
		Human triggered forest fire
		Stampede
		Short circuit and related fire
		Building collapse
		Boat capsizing Tourism related drowning
		rail accidents
		Hooch accident

Source: District Disaster Management Plan, 2015

Table 13-3 Profile of Disasters in ChengannurTown

Earthquake	Land slide	Coastal Related	Floods	Lightning	Drought	Cyclone	Epidemics
Nil	Nil	Nil	Banks of Manimala Aar & Broad flat bottom valleys (Paddy fields) Mazhukir mel, Puthankavu, **Chengannur**, Mangalkavu	Moderate	Moderate draught	Nil	Common Vector related diseases

Source: District Disaster Management report 2015 for Alappuzha, Draught situation Analysis report by KSDMA 2017, 'Durantha Nivarana Asootrana Rekha'-Nammal Namukkai, 2020

The monsoon season tick's majority of the disaster risk categories in the district with likely occurrence of disasters like flood, landslides, viral infections and mosquito related diseases, coastal erosion and storm surges. Summer season also holds a break out water related diseases like jaundice, typhoid etc. Nammal Namukkai, 2020 report for Chengannur town has also indicated the possibility of seasonal floods in the months of July and August and identified 16 flood vulnerable wards in the town.

13.2Type of hazards

As per the Multiple Hazard Zonation Map of NCESS (National Centre for Earth Science Studies) for the District, it is prone various hazards like coastal erosion, storm surges, flood, lightning as shown below. Chengannur has history of lightening and it has flood prone areas.



Figure 13:3 Multiple hazard Zonation map of Alappuzha

Source: NCESS

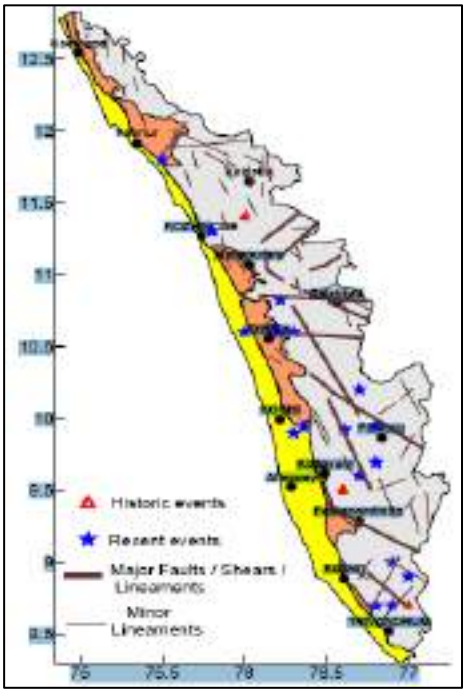

Figure 13:4 Location of historic and recent earthquakes in Kerala

Source: Kerala State Disaster Management Plan Profile

13.2.1 Earthquake

Kerala has been placed in zone III, where the maximum expected intensity is 5.6m. Kerala has experienced occasional mild tremors since historical times. However, pockets of higher ground acceleration have been identified in central Kerala. Several deep-seated faults exist in Kerala together with many minor faults and fractures that can generate minor tremors as a result of crustal readjustment.

13.2.2 Lightning

Occurrence of causalities during monsoon season is common within the district and therefore can be considered as thunder and lightning prone district. The lightning phenomena majorly occur during the summer showers and the N-E monsoons. The lightning crisis management plan of the district as mentioned in the disaster management plan is distributed to four stages. 'Normal' stage where the preparation and updating of inventory occurs with participation from line departments. The second stage when 'warning' is received SEOC/IMD play major role. The Chengannur town has past lightning events and has a score 1 in the lightning frequency map for the District.

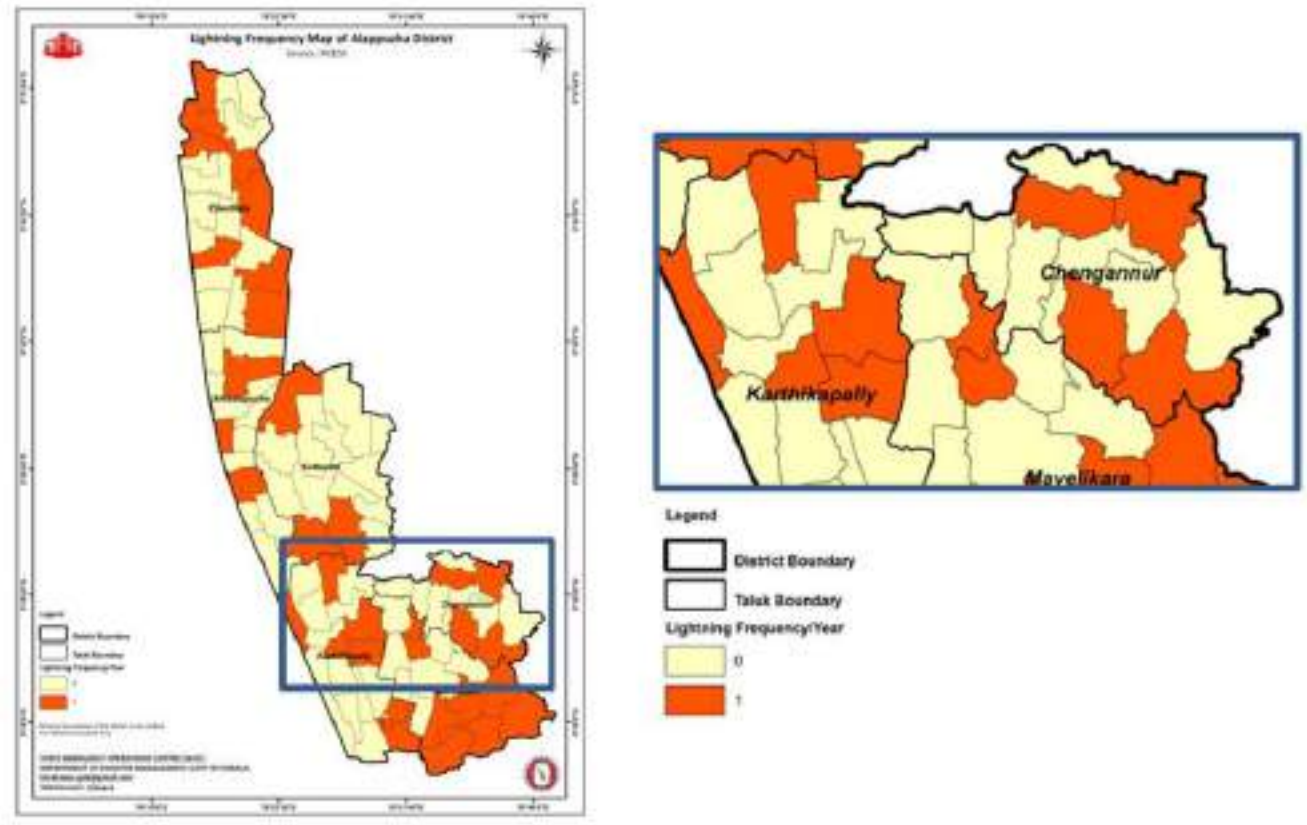

Figure 13:5 Chengannur in Lightning Frequency map of Alappuzha District
Source: District Disaster Management Plan, 2015

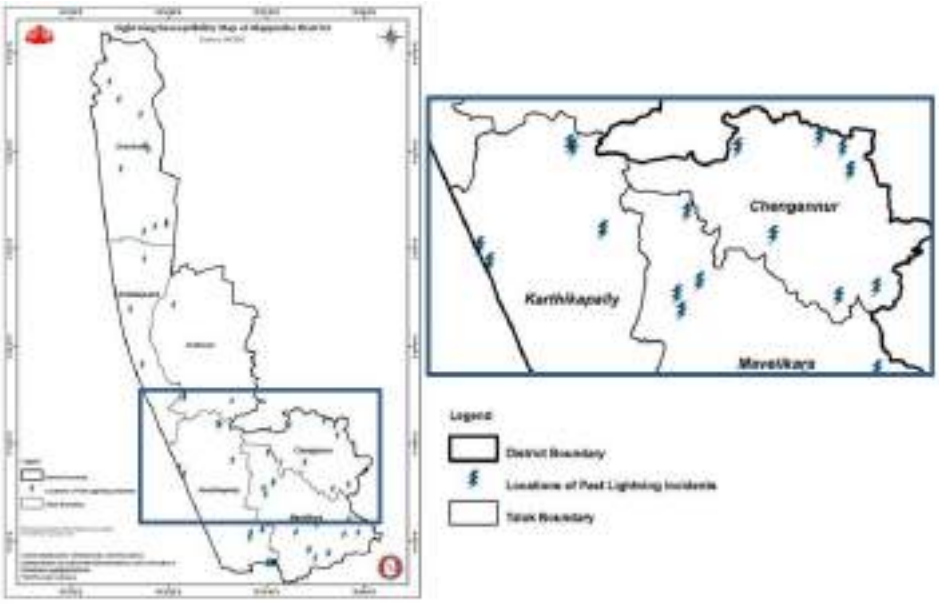

Figure 13:6 Chengannur in Lightning Susceptibility map of Alappuzha District
Source: District Disaster Management Plan, 2015

13.2.3 Landslides

On analysing the topography, the town has a general flat terrain with gentle slopes. So, there is less danger of landslides. But it also has some area with a height up to 59m from MSL located at the south eastern regions of the town which shows the character of midland regions in Kerala. Nammal Namukkai Report, 2020 for Chengannur town has indicated the possibility of mild landslides/mudflows in ward 20 and 22. However the disaster management plan 2015 has not yet recorded it as a major threat.

13.2.4 Drought

The State of Kerala experiences seasonal drought like conditions every year during the summer months. Even in the years of normal rainfall, summer water scarcity problems exist in the midland and highland regions. Drought is mainly reflected in the non-perennial rivers and lowering of ground water table. This adversely affects the rural and urban drinking water supply. In Kerala draught is principally manifested as drinking water shortage. The district disaster management report 2015 classifies Chengannur into Moderate drought classification. This might be due to the rainfall pattern that has become more unpredictable and the unprecedented use

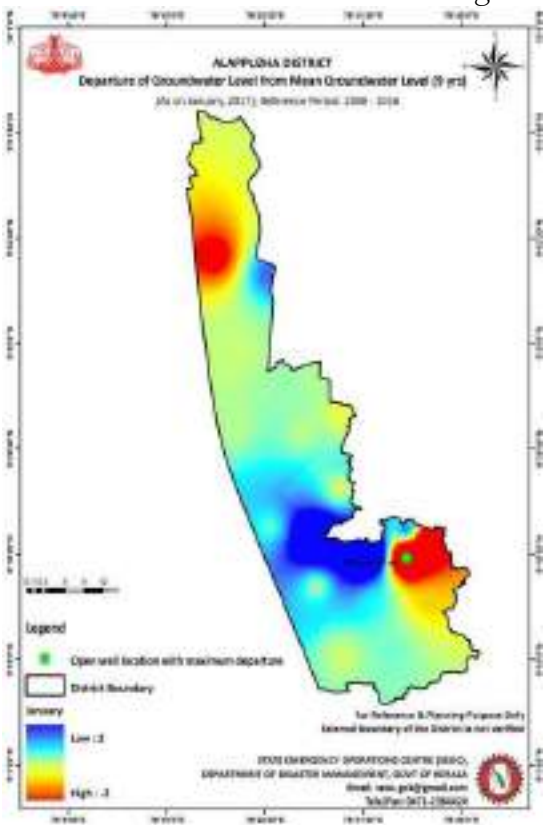

Figure 13:7 Location of Chengannur Town in Departure of Ground water from MGWL for last 9 years
Source: Drought - Situation Assessment Report by KSDMA, 2017

of ground water which has increased over time along with reduction in vegetative ground cover and rapid urbanisation.

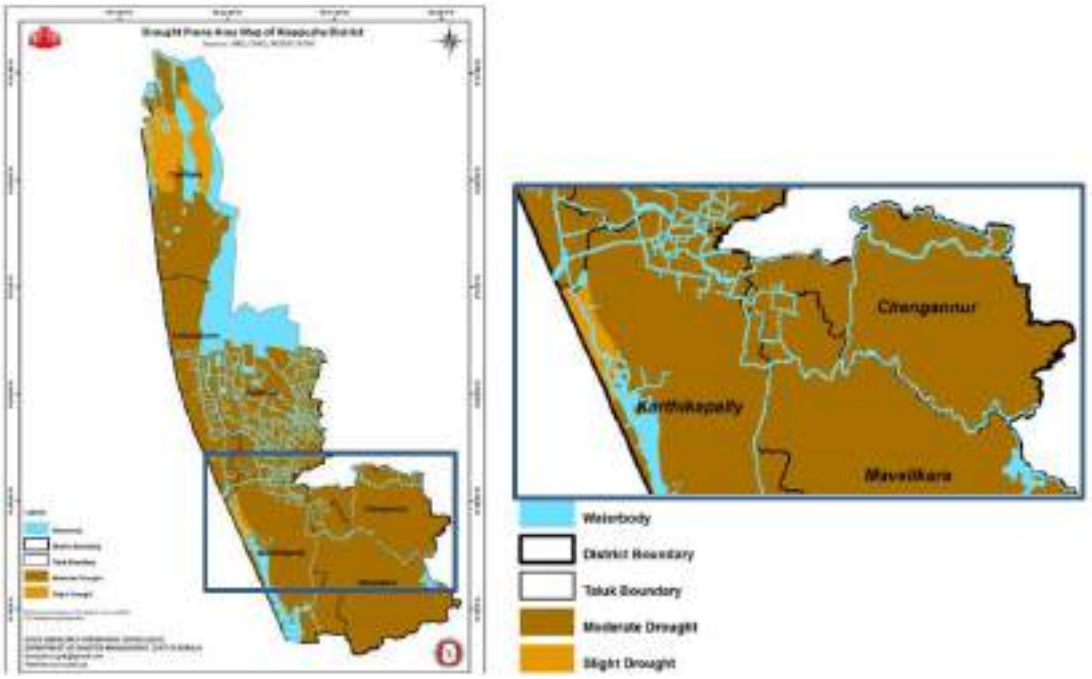

Figure 13:8 Draught prone areas in Alappuzha District

Source: District Disaster Management Plan, 2015

The Departure of Ground water from MGWL for last 9 years for Alappuzha district as per the Drought - Situation Assessment Report by KSDMA, 2017 shows that the Chengannur regions has high values of ground water departure. The use of ground water by open/bore well is a major source of water for the people in town area. So, this alarming situation needs urgent action for ground water recharge measures. The Ground water profile obtained from KSDMA and micro watershed map of town shown in Figure 13:10 and Figure 13:11. Town area has the presence of nine micro watersheds. It is seen that the elevated areas of town have moderate ground water level and low-lying areas has very good to good ground water level. Town needs more measures for recharging the ground water through various ways by improving infiltration capacity and other measures for ground water recharging.



Figure 13:9 Map showing Draught proneness of Chengannur Town

Source: KSDMA, Nammal Namukkayi report, 2020

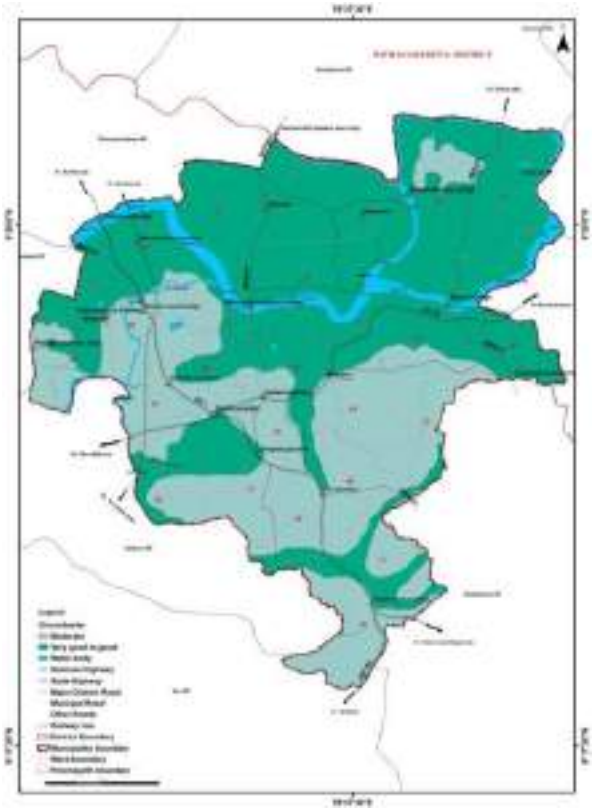

Figure 13:10 Ground water profile map

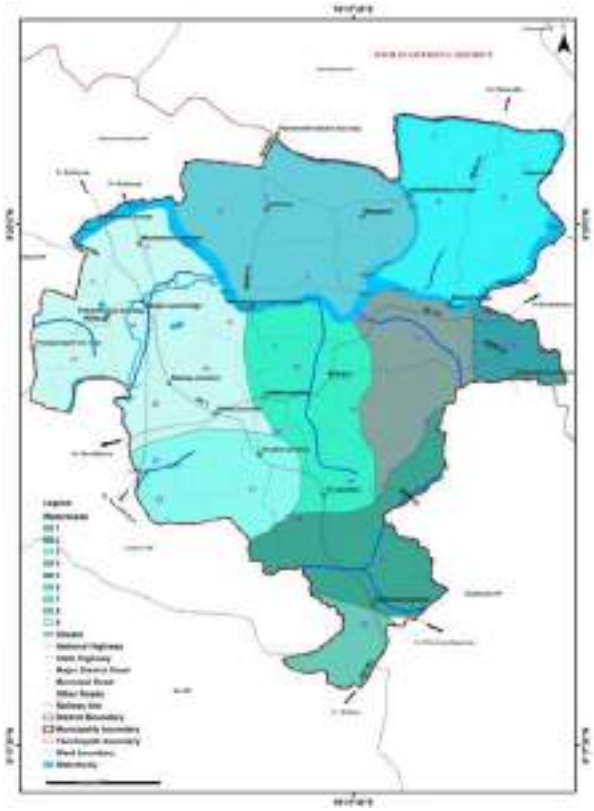

Figure 13:11 Micro watershed map of Chengannur town
Source: LRIS



Figure 13:12 Groundwater Level during monsoon season 2020



Figure 13:13 Groundwater Level during summer season 2020
Source: Ground Water Department

According to the studies of Ground Water Department, Ground Water level has drastically depleted after 2018 floods. This is mainly due to the deposition of of Impermeable Clay. There is a 4- 10m declination of Ground Water level. Removal of such depositions in rechargeable areas must be done to increase the permeability of soil. Paddy fields, vacant lands,

recharge ponds/ pits must be cleared off such clay deposits to improve water permeability and increase the Ground water level in the area.

Water Kiosks

As per the details in the KSDMA website, the concept of Water Kiosks evolved in the 'urgent workshop on drought preventive measures' held on 26th December 2012 at Institute of Management in Government (IMG) organized by KSEOC, considering the serious drought conditions that the state was facing in the year 2012. The idea of a water kiosk is simple – a large 5000 to 10,000 litres of PVC water tank located on a pedestal in a public area with a tap attached to it. Water to the kiosk shall be filled in them by district administration from approved water sources using GPS fitted and monitored vehicles and a log book shall be maintained by the local ward member countersigned by the Village Officer concerned. The concept was first approved vide GO (Rt) No. 5634/2015/DMD dated 8-05-2015. Subsequently during the 2016-17 drought season vide GO (Rt) No. 793/2017/DMD dated 25-2-2017 and GO (Rt) No. 852/2017/DMD dated 2-3-2017 Government approved the establishment of 5000 water kiosks. Chengannur town area has a total number of 45 water kiosks present, and the locations of these are shown in Figure 13:14.

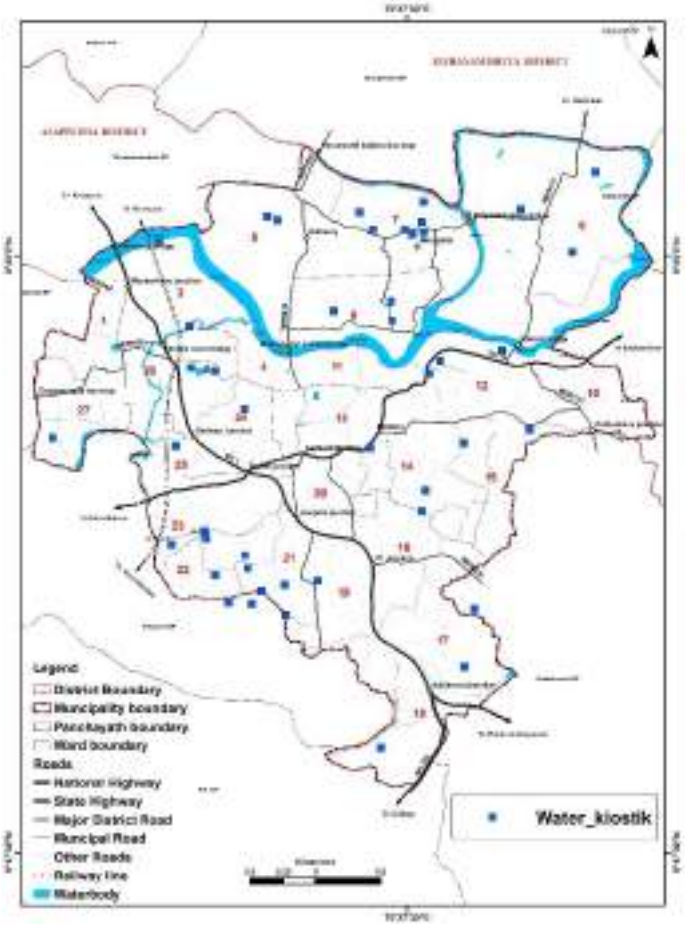

Figure 13:14 Location of water kiosik

13.2.5 Biological Hazard

Disaster caused by the exposure of living organisms to germs and toxic substances are included in this category of disasters. The district disaster management plan 2015 for Alappuzha has listed epidemics, cattle epidemics, food poisoning, pest attack and Bird flew to the profile of biological disasters in the district. The global pandemic COVID-19has led to death, devastation, migration and economic slowdown throughout the world. The first case in Kerala was reported in January 30th2020 and ever since the wave has been going up and down while being declared a state specific disaster demanding isolation and containment. The future

possibilities of such outbreaks are high and therefore adopting early planning measures to arrest the outbreak and defining of containment zones needs to be considered.

13.2.6 Chemical, Industrial and Fire outbreaks

There is no major industry in Town, which could be pointed out as a cause for chemical and industrial disaster. Although reasons for urban fire outbreaks are known, there is hardly any hazard or vulnerability assessment carried out in this regards and hence specific risk reduction strategies are very less. The Chengannur town has no major festivals, tourist place and major crowd events that might lead to stampedes or other related disasters as per disaster management report for Alappuzha 2015.

13.2.7 Flood

Flood is the major natural disaster occurring in Alappuzha District. After the 2018 Mega flood in the state, a study on 'Modification Strategy of the Settlement Pattern in The Present Flood Context: Alappuzha District', was conducted by the LSGD Planning wing. It identified flood plains of Chengannur as the second major flood prone region after the Kuttanad region in the District.

As per NCESS, Trivandrum about 53.77% of the total area of Alappuzha district is prone to flood. Kuttanad region in the district is identified as the major flood prone area of the district with flood vulnerability of 92.11% of area. Another important flood prone region in the district is the flood plains of Chengannur, which is created by Manimala, Pamba and Achankovil Rivers. As the gradient of this region is comparatively high, the pace of flooding and water retrieve will be very quick unlike Kuttanad region.

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, 25,50 & 100 years in each case is considered here for analysis. In case of 1 in 10 year return probability based on historic data 4.38sqkm and for RCP 8.5 climate change scenario 8.83 sq.km area of the town will be under flood. Figure 13:15 shows the area under inundation based on historic data and RCP 8.5 climate change scenario for 1 in 10 year return probability.

In the case of 1 in 25 year return probability based on historic data 4.86 sqkm and for RCP 8.5 climate change scenario 9.30 sq.km area of the town will be under flood. Figure 13:16 shows the area under inundation based on historic data and RCP 8.5 climate change scenario for 1 in 25 year return probability. In the case of 1 in 50 year return probability based on historic data 5.79 sqkm and for RCP 8.5 climate change scenario 9.60 sq.km area of the town will be under flood. Figure 13:17 shows the area under inundation based on historic data and RCP 8.5 climate change scenario for 1 in 50 year return probability.

In the case of 1 in 100 year return probability based on historic data 6.275 sqkm and for RCP 8.5 climate change scenario 9.87 sq.km area of the town will be under flood. Figure 13:18 shows the area under inundation based on historic data and RCP 8.5 climate change scenario for 1 in 1000 year return probability.

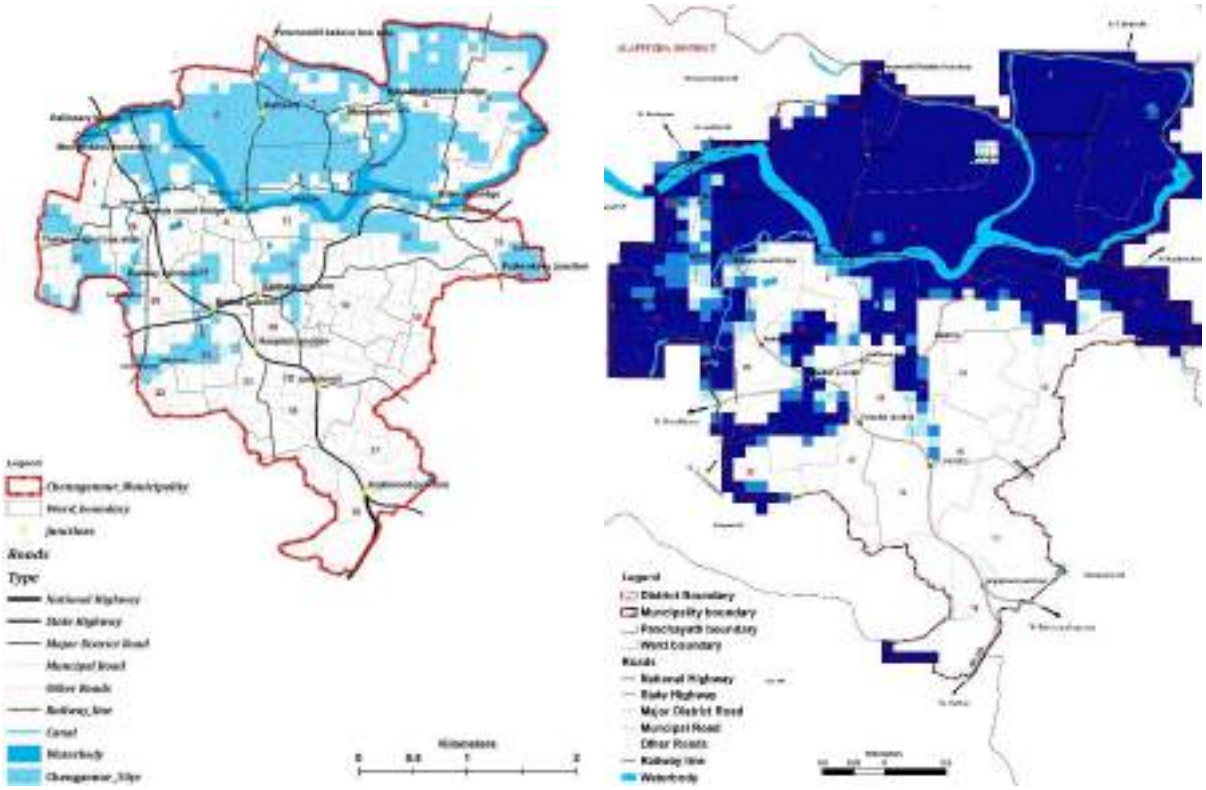

Figure 13:15: Map showing the area under inundation based on historic data and RCP 8.5 climate change scenario for 1 in 10 year return probability

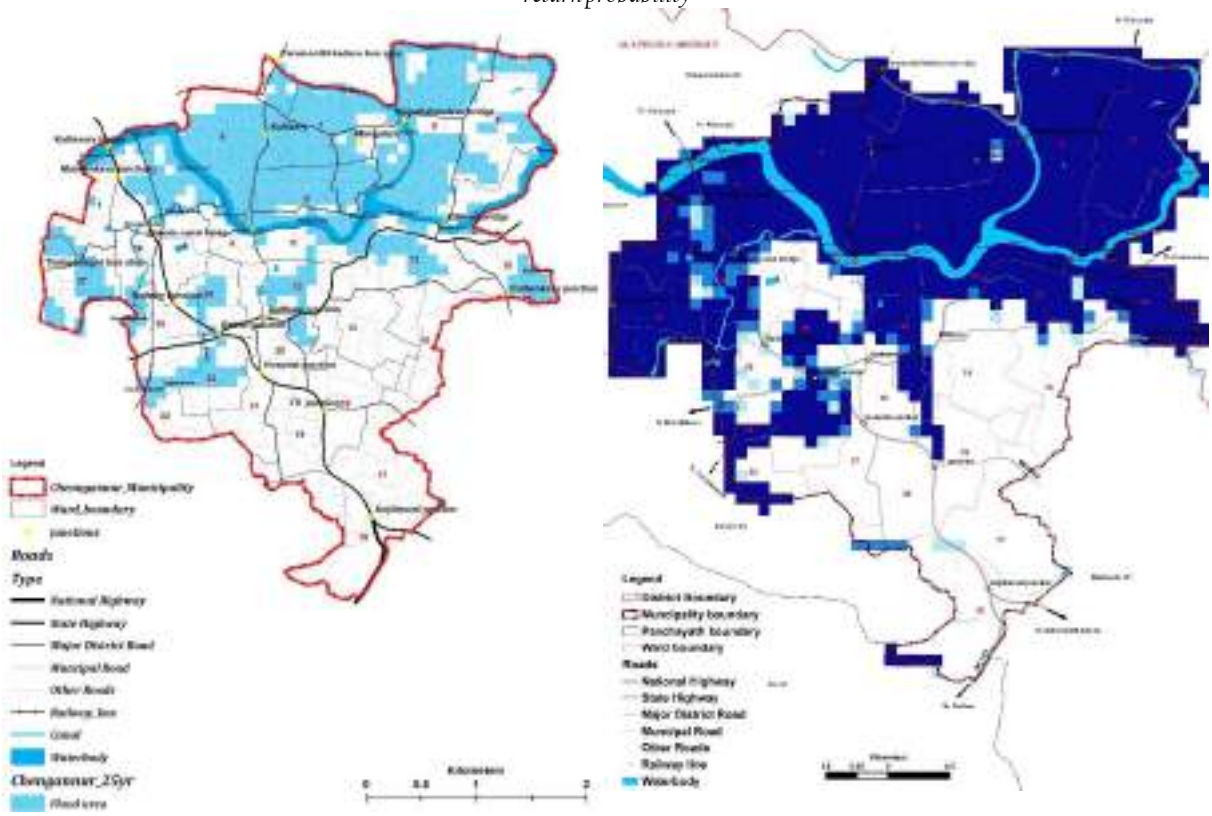

Figure 13:16: Map showing the return probability of flood in 25 year for Chengannur Town
Source: Generated from the return probability maps of KSDMA

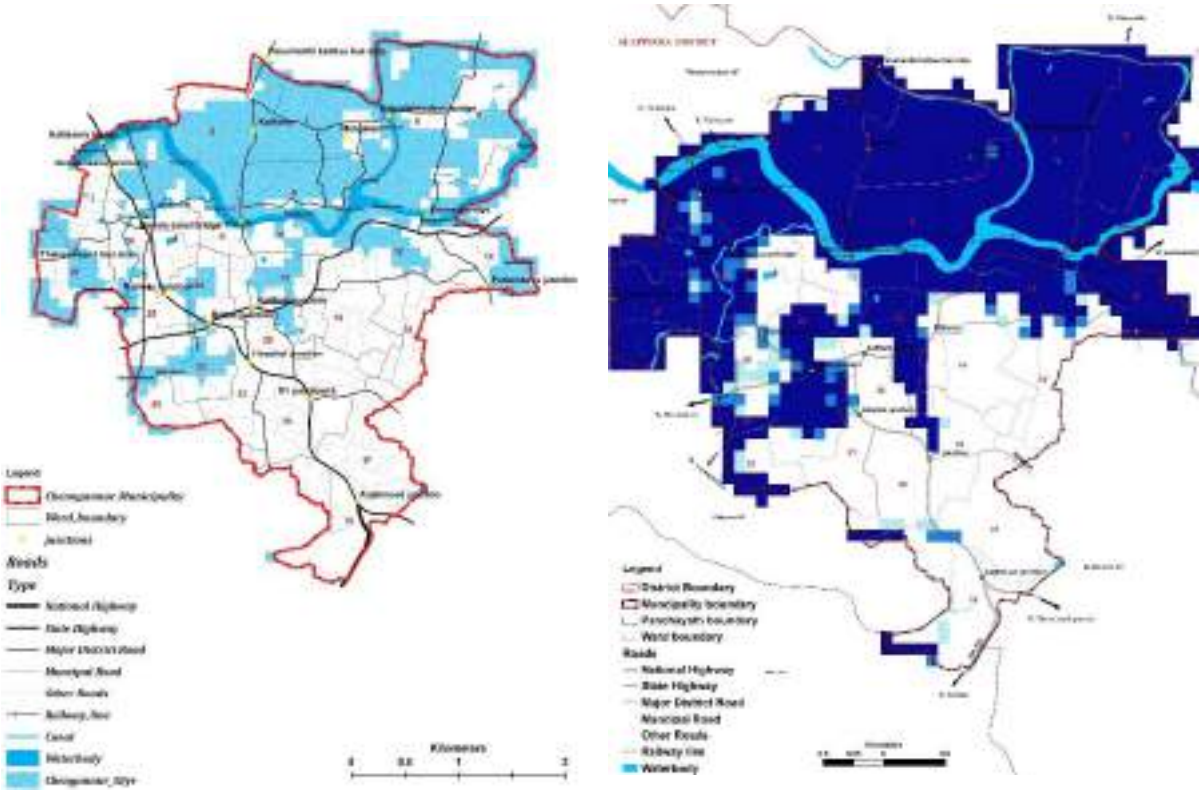

Figure 13:17: Map showing the return probability of flood in 50 year for Chengannur Town

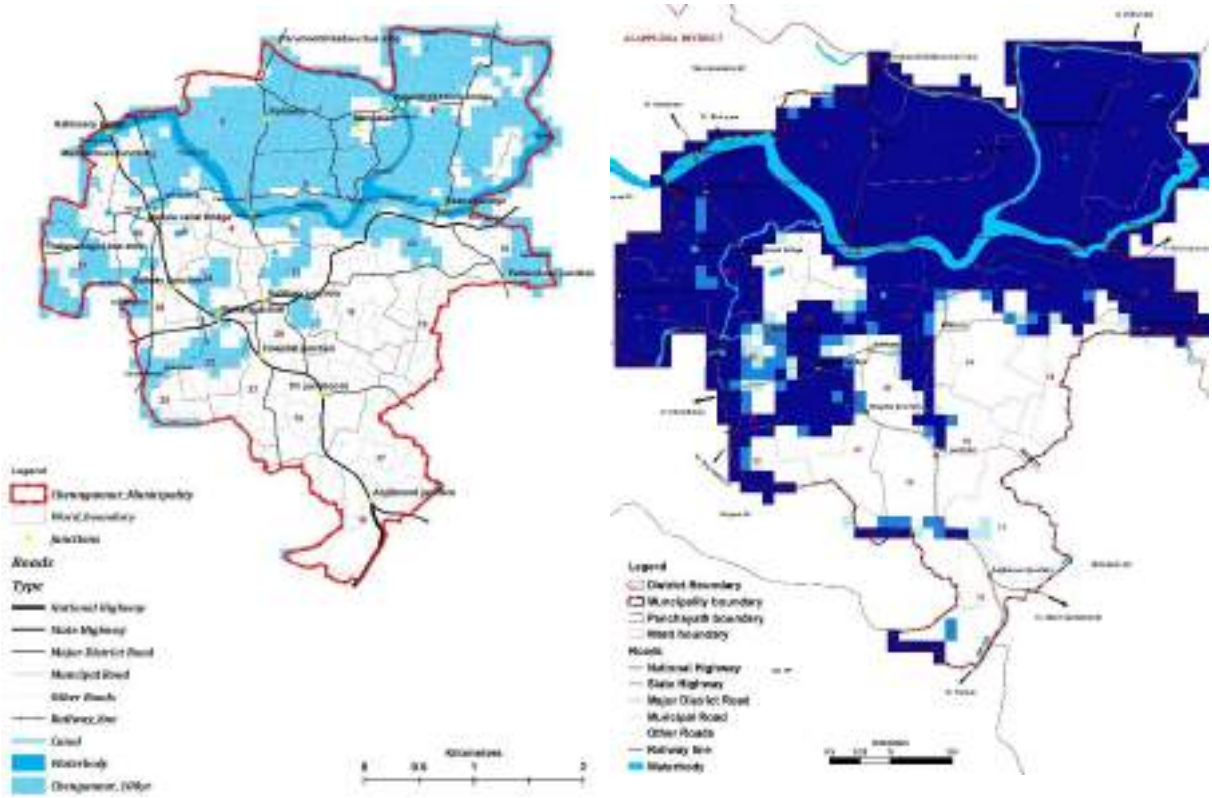

Figure 13:18: Map showing the return probability of flood in 100 year for Chengannur Town
Source: Generated from the return probability maps of KSDMA

13.3History of hazards

13.3.1 Flood 2018 – Kerala State and Alappuzha district

The document Additional Memorandum, Kerala Floods – 2018, 1st August to 30th August 2018, submitted by State Relief Commissioner, Disaster Management, Govt of Kerala, states that the State received an excess of 96% during the period from 1st to 30th August 2018, and 33% during the entire monsoon period till the end of August. It is represented in Table 13-4 which shows the rainfall excess that the state has received during this period. Note that in the 2nd stage forecast issued on 30th May 2018, the prediction was only of 95% of LPA (5% less than long period average) during the month of August, while the state received 96% excess rainfall. This unpredicted excess intense rainfall spell has caused significant damage to life and property.

Table 13-4 Monsoon Rainfall Assessment from 1st to 30th August 2018

District	Actual Rainfall (mm)	Normal Rainfall (mm)	Percentage Departure (%)	
Thiruvananthapuram	373.8	142	163	Large Excess
Kollam	644.1	258.7	149	Large Excess
Pathanamthitta	764.9	352.7	117	Large Excess
Alappuzha	608.2	343.1	77	Large Excess
Kottayam	619.2	386	60	Large Excess
Idukki	1478.9	527.3	180	Large Excess
Ernakulam	648.3	401.3	62	Large Excess
Thrissur	734.7	440.1	67	Large Excess
Palakkad	848.8	333.8	154	Large Excess
Malappuram	913.7	395.3	131	Large Excess
Kozhikode	836	500.9	67	Large Excess
Wayanad	1053.5	592.9	78	Large Excess
Kannur	665.3	540.9	23	Excess
Kasaragode	636.9	636.3	0	Normal
TOTAL	821	419.3	96	Large Excess

Source: IMD

Kerala experienced an abnormally high rainfall from 1 June 2018 to 19 August 2018. This resulted in severe flooding in 13 out of 14 districts in the State. As per IMD data, Kerala received 2346.6 mm of rainfall from 1 June 2018 to 19 August 2018 in contrast to an expected 1649.5 mm of rainfall. This rainfall was about 42% above the normal. Further, the rainfall over Kerala during June, July and 1st to 19th of August was 15%, 18% and 164% respectively, above normal.

Table 13-5 Month wise Actual rainfall variations in Kerala from the Normal

Month	Normal Rainfall (mm)	Actual Rainfall (mm)	Departure from the Normal (In Percentage)
June 2018	649.8	749.6	15
July 2018	726.1	857.4	18
1-19 August 2018	287.6	758.6	164

Source: IMD Data

The Hydrological Studies Organisation of Central Water Commission of Government of India submitted a detailed report titled 'Study report – Kerala Floods of August 2018' on September 2018. This report states that, the actual rainfall from 15th to 17th August in the State

was 414 mm as compared to the extreme rainfall from 16th to 18th July 1924 during which it was 443 mm. This generated around 12 billion Cubic Meter runoff within these three days, which is just about 3% lesser runoff than in 1924.

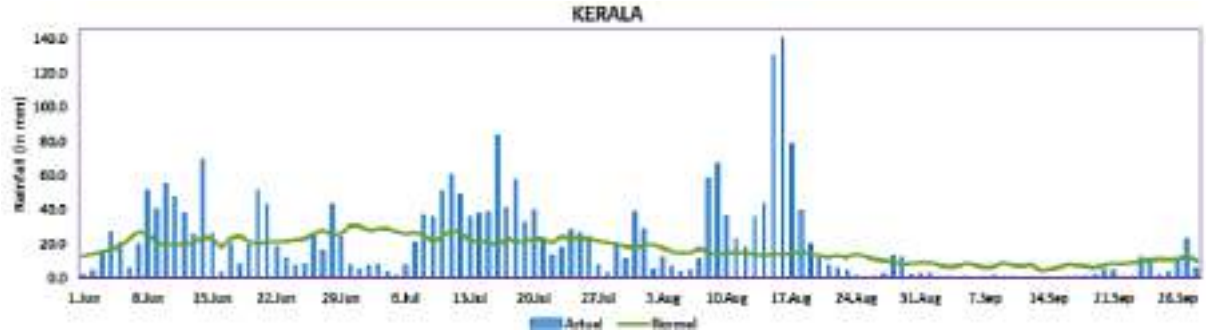

Figure 13:19 Rainfall Distribution- SW Monsoon 2018 in Kerala

Source: IMD Data

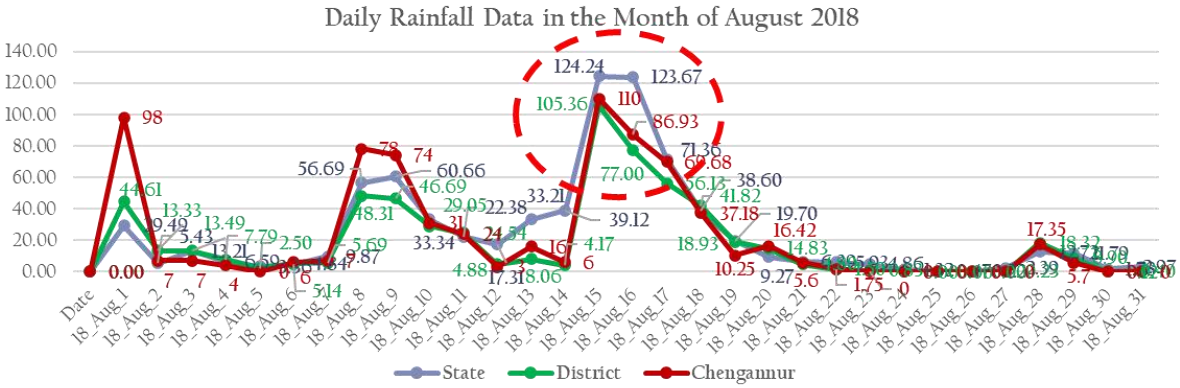

Figure 13:20 Daily Rainfall Data in August 2018

Source: IMD Data

Figure 13:19 shows the rainfall data in the month of August,2018. Extreme rainfall is observed during August 15 to 17. From the CWC (Central Water Commission) report it is observed that during mega flood 2018 between 15 August and 17 August, the catchment areas of major rivers flowing through Alappuzha has received 1283 mm of rainfall. This resulted in generating a runoff of 1.634 BCM. Blockage of existing streams and channels including the tributaries of pampa river has resulted in overflow of flood water into the land area.

Table 13-6 Percentage of Departures from Actual Rainfall from the Normal

District	*Percentage of Departures of Rainfall Variations from the normal for the Year 2018 (Source IMD Data)*											
	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
Alappuzha	-92	-47	-11	-21	4	-4	22	77	-74	-2	-18	27

Source: IMD Data

Table 13-6 shows the percentage of departures from actual rainfall from the normal. In the month of July & August Alappuzha received rainfall which was 22% & 77% above the normal rainfall as expected. Figure 13:20 show that Kerala experienced heavy rain during the week of 10th to 17th August of 2018. The district wise annual rainfall data shows that, Alappuzha district received annual rainfall of 2916.4mm in the year 2018.

Table 13-7 District wise Seasonal and Annual rainfall (mm) in the year 2018 of Kerala

District	Winter(mm)	Pre-Monsoon (mm)	Monsoon (mm)	Post Monsoon(mm)	Annual(mm)
Alappuzha	16.3	455.1	1898.3	546.8	2916.4
Kannur	2.0	444.9	2642.1	304.6	3393.5
Ernakulam	8.4	570.6	2589.2	706.2	3874.3
Idukki	43.3	543.3	3793.7	526.4	4906.7
Kasargod	4.8	438.9	2426.2	208.5	3078.3
Kollam	12.1	485.7	1706.5	503.3	2707.6
Kottayam	5.2	686.5	2047.0	798.8	3897.4
Kozhikode	8.5	678.8	2984.4	360.2	4032.0
Malappuram	5.9	528.1	2723.7	401.0	3658.6
Palakkad	25.7	474.0	2377.9	266.7	3144.3
Pathanamthitta	47.4	766.8	2164.3	904.6	3883.1
Trivandrum	22.3	366.0	1023.7	446.9	1858.9
Thrissur	3.7	405.0	2146.8	333.6	2889.0
Wayanad	11.2	451.6	3068.2	301.1	3831.9

Source: IMD Data

Alappuzha witnessed a rainfall departure of 29% excess during the monsoon period from 01 June 2018 to 22 August 2018. From the report of Central Water Commission, September 2018 it is observed that the runoff water reached during August 15, 16 and 17 to Alappuzha district is 1.63 billion Cubic Metre (BMC). This water along with regional rainfall created flash flooding in Alappuzha.

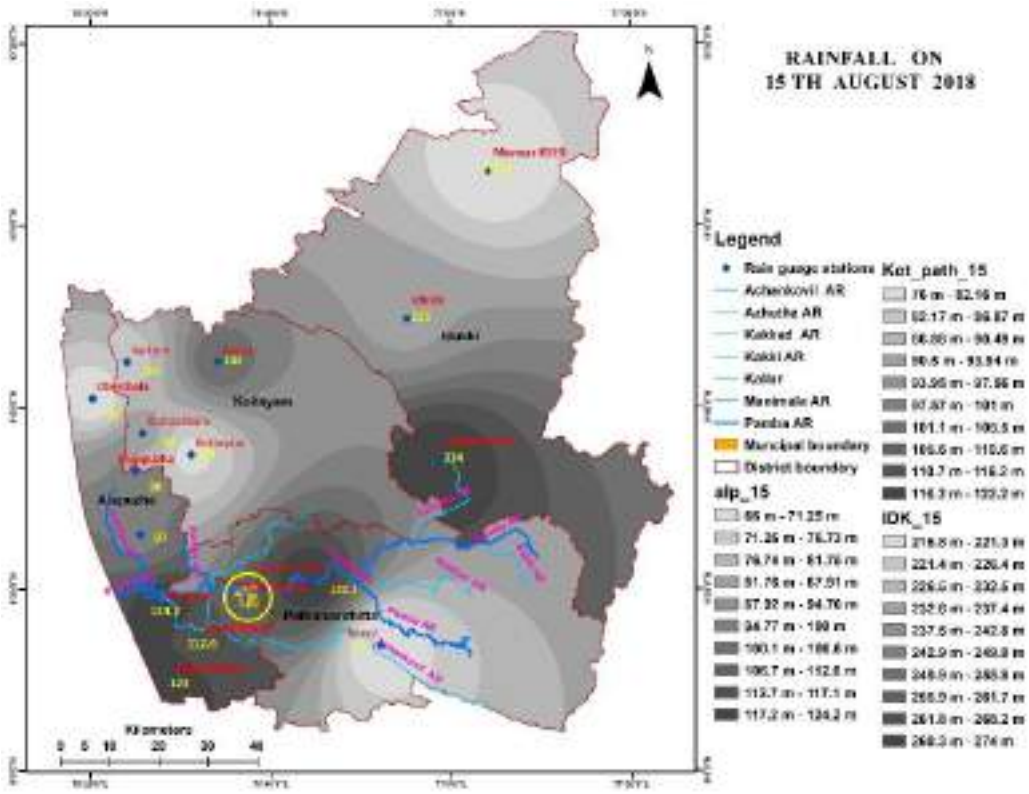

Figure 13:21 Rainfall on 15 August 2018

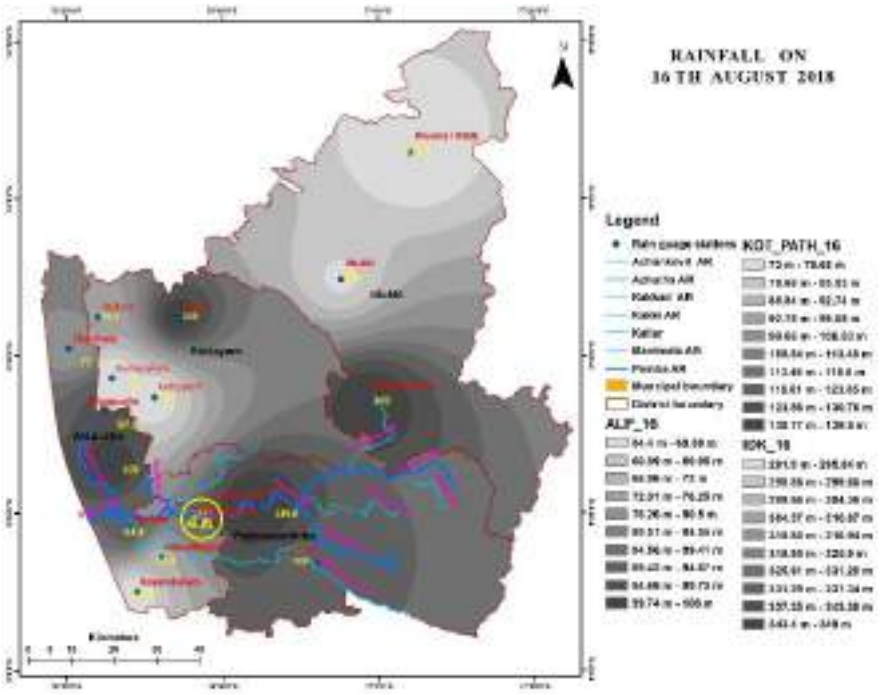

Figure 13:22 Rainfall on 16 August 2018

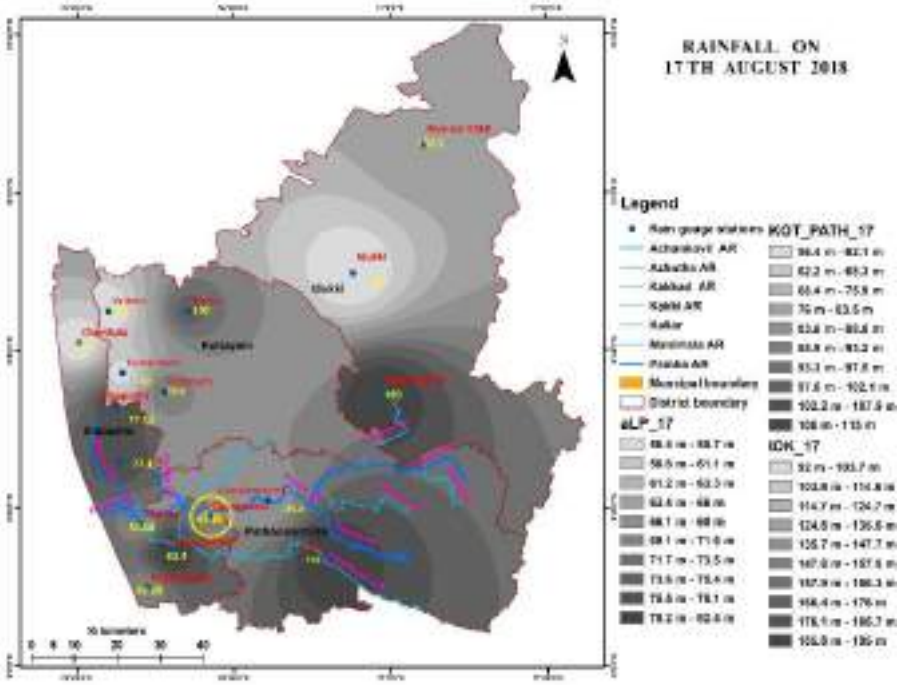

Figure 13:23 Rainfall on 17 August 2018

Source: Author generated Map interpolating IMD Data

From Figure 13:21, Figure 13:22 and Figure 13:23 it can be seen that, the flood in Chengannur is caused not onlyby the excessive rainfall in the town, but by the over flow of Pamba river due to the excessive rainfall in the catchment areas of Pamba river. On analysing the rainfall data for the months May, June, July and August of 2018, it is observed that, there was summer showers during May and heavy rainfall during the month of July also. From these rains, ground was saturated and the capacity to rainwater was low. This also intensified the situation.

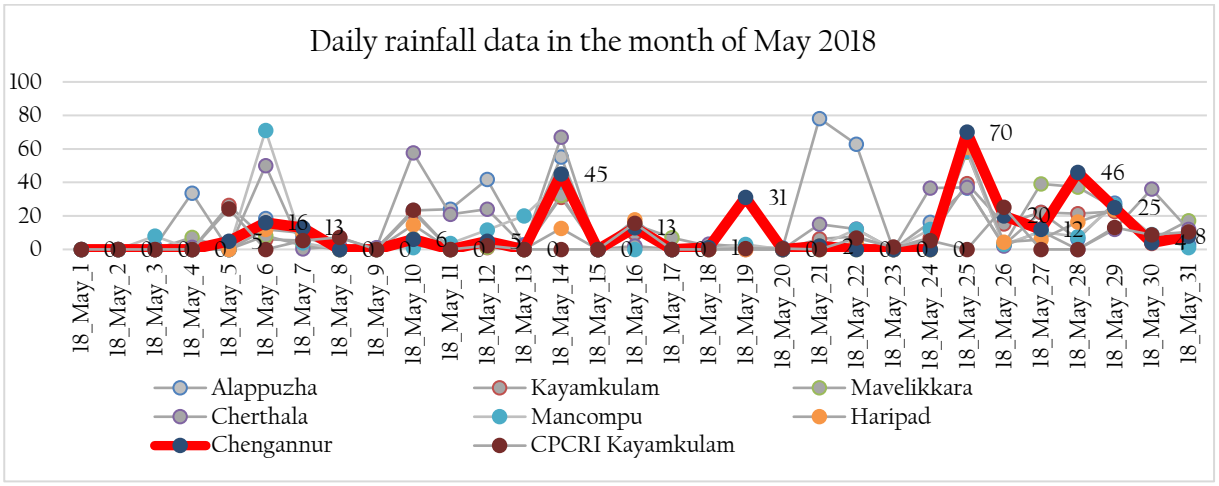

Figure 13:24 Daily Rainfall Data in May 2018

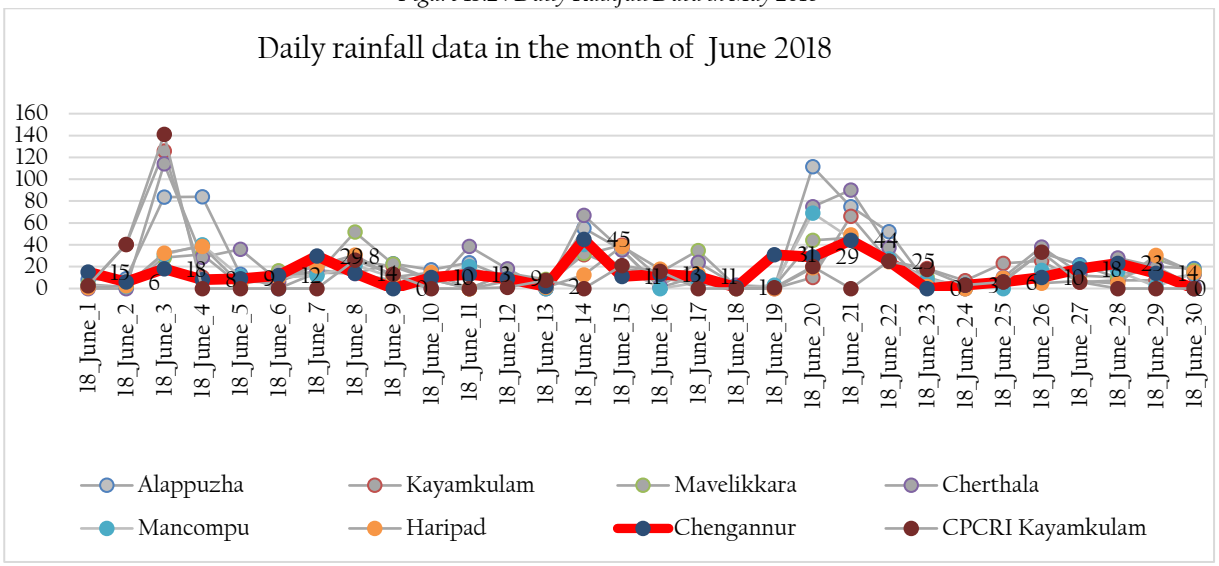

Figure 13:25 Daily Rainfall Data in June 2018

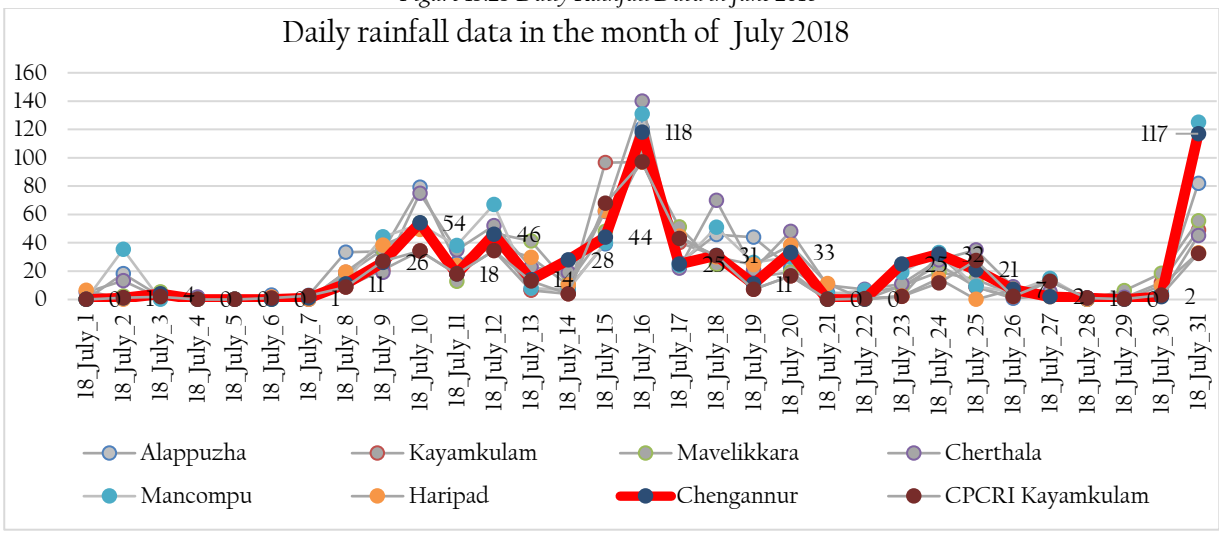

Figure 13:26 Daily Rainfall Data in July 2018

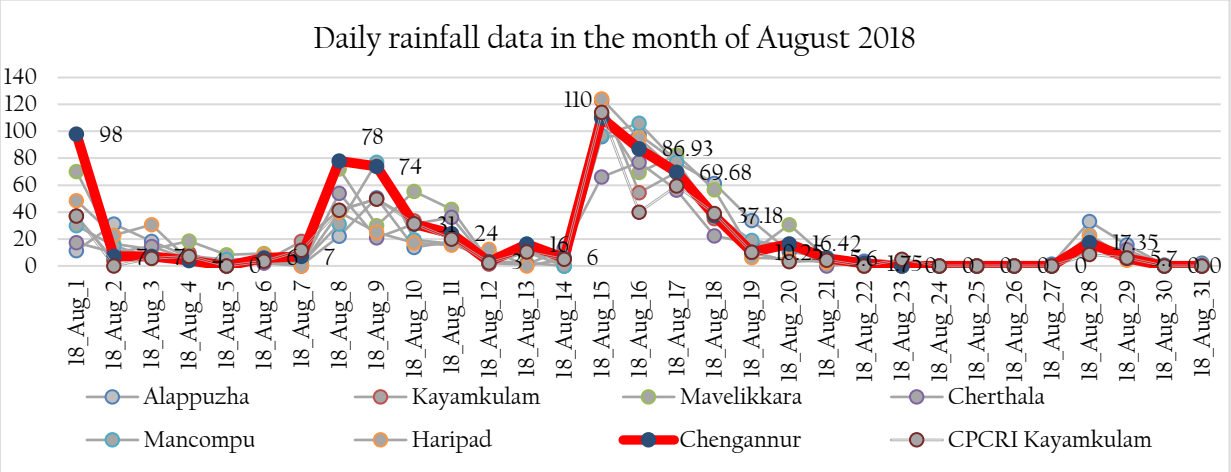

Figure 13:27 Daily Rainfall Data in August 2018



Figure 13:28 Photos of Chengannur during Flood 2018

Source: IMD Data

A. Flood 2018 and 2019- Chengannur town

In Alappuzha district, Other than Kuttanad region the most affected region during the flood 2018 was Chengannur. Chengannur region has faced a flash flood due to its position and physiography. But due to the presence of number of distributaries this flood water removed very fast. In 2019 also Chengannur region has faced a similar flood situation but its intensity was less.

The report by district administration, "Managing the Disaster: A Report on Handling of Kerala Floods 2018 In Alappuzha District" has divided the entire series of events occurred in Alappuzha during 2018 flood into two distinct phases, the first phase started from 15.07.2018 and the second phase started from 15.08.2018. The first phase of floods was characterised by inundation of most of the villages in Kuttanad area. The second phase was more furious with flash floods and inundation in hitherto unflooded areas in Chengannur area and flooding in many low-lying areas in the district. The flood has occurred again in 2019, too but the damages were less severe compared to 2018. The study on flood 2018 conducted by the department, observed three concentration points for water to enter into the district. Two of these concentrations point namely the area in and around Chengannur and Kuttanad are mostly affected during the flood 2018.

B. Flooded area of Town

Chengannur Municipality and the nearby village panchayats of Pandanad, Budhanoor, Puliyoor were severely affected by the massive 2018 floods, causing extensive devastation to people's lives, livelihood, habitation, land, livestock, water and sanitation systems. Out of the total area of 13.06 sq.km of the Chengannur Town, 8. 31sq.km area ie, 63.65% of the total land area is flood prone. The flood prone area of the town is shown in Figure 13:29. The flood area of town is shown in contour, elevation, slope profile, and Digital Elevation Model of town is also represented in the flowing images.

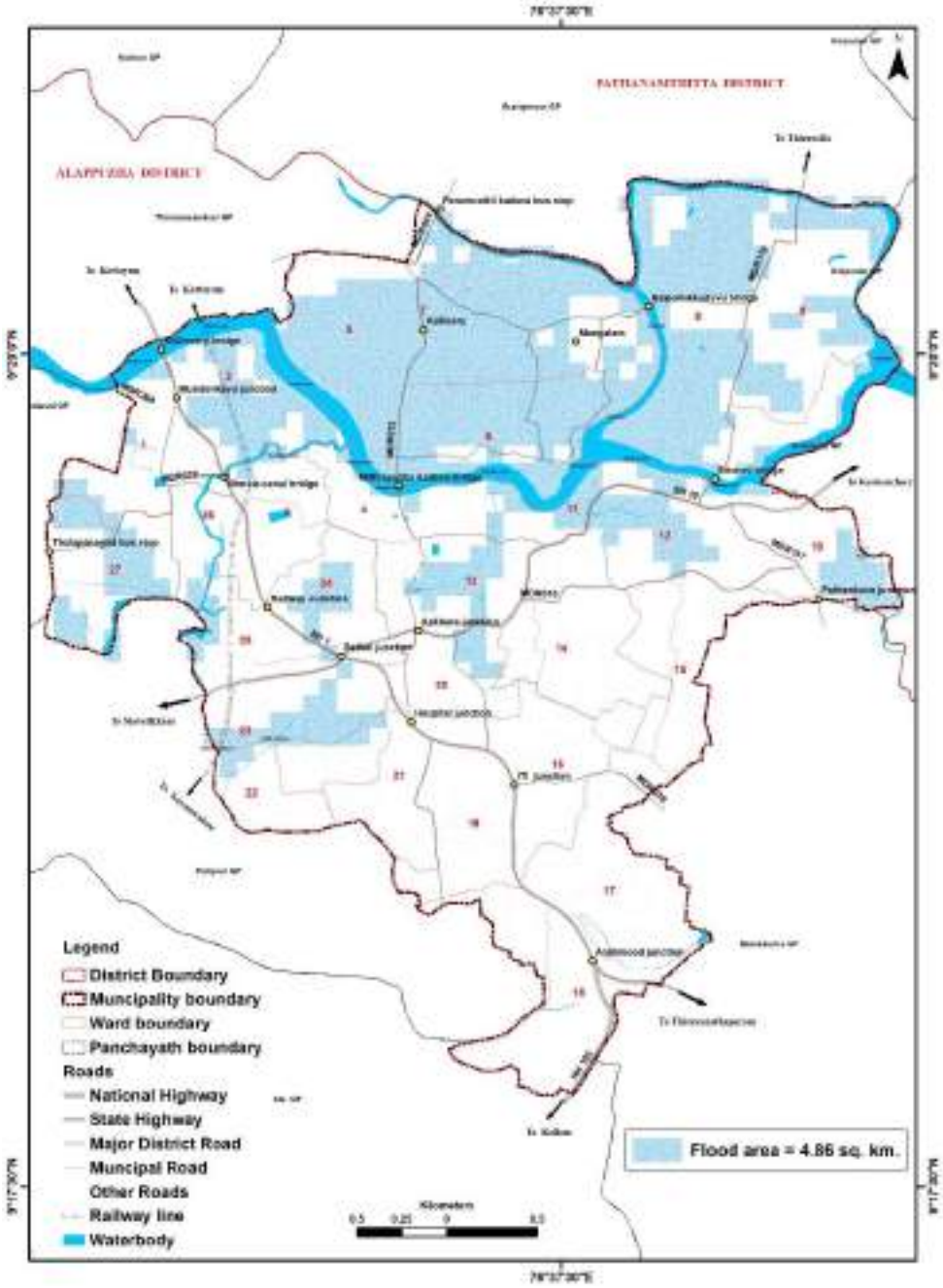

Figure 13:29 Flood prone area of Chengannur Town

The Nammal Namukkayi report prepared in 2020 by the Municipality has reported the damages caused by the flood 2018 and 2019. As per the report, 69% of the land area is reported as flood prone region. All the wards of the town were affected by the flood and heavy rain in 2018, and 16 out of 27 wards in the town as shown in figure below were the ones which are directly affected by flood, among which 6 wards were severely affected and the remaining were moderately affected. Other wards were less affected. The 2019 flood has caused less damage than year 2018 and affected 7 wards as shown below.



Figure 13:30 Flood affected wards in Town 2018



Figure 13:31 Flood affected wards in Town 2019

Source: Nammal Namukkayi Report, 2020; Graphical representation by Author



Figure 13:32 Photos of flooded areas of Chengannur Town

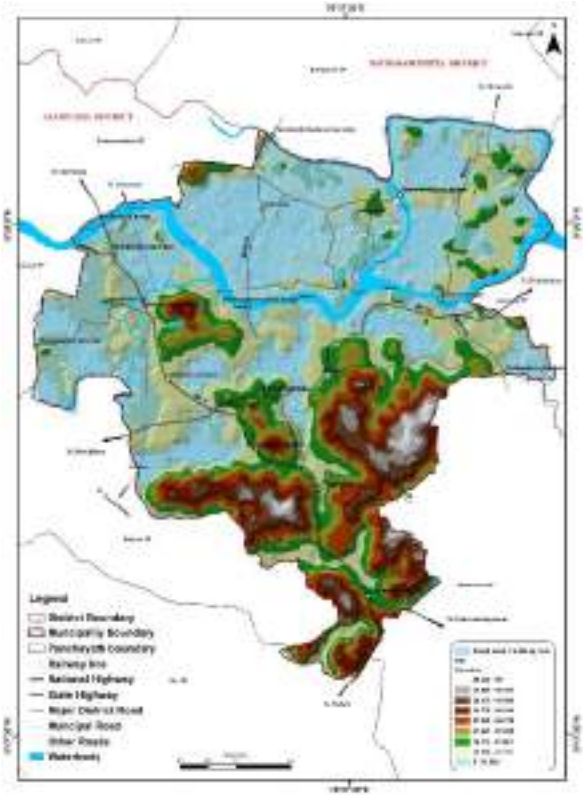

Figure 13:33 Flood prone area in Elevation Map

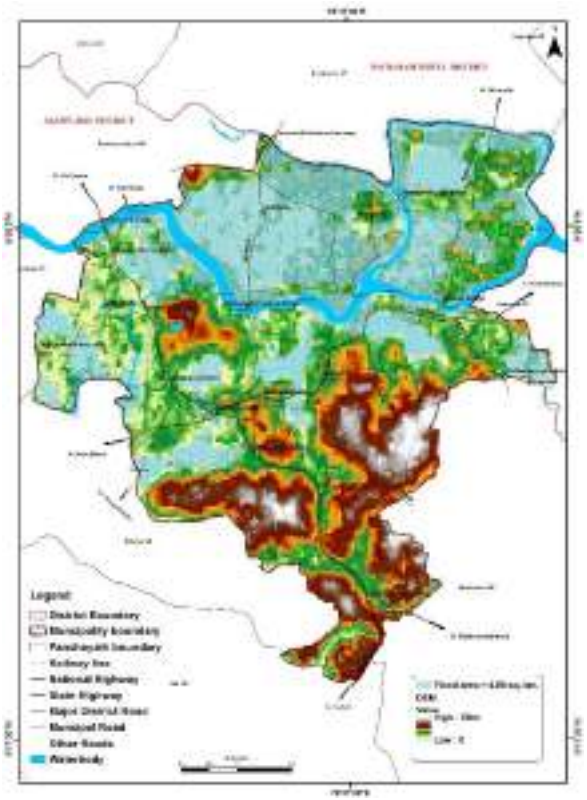

Figure 13:34 Flood prone area in Digital Elevation Model



Figure 13:35 Flood prone area in Contour Map

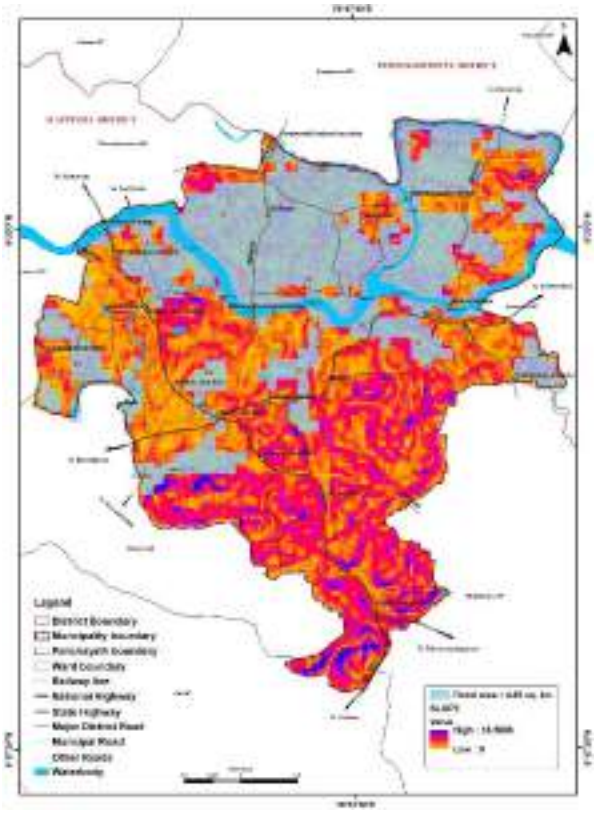

Figure 13:36 Flood prone area in Slope Profile

C. Land use in flood prone regions of Town

The percentage of various land use types that are in the flood prone region are (Figure 13:37) listed in the table and shown in the diagram below. The major affected land use is residential followed by dry cultivation use. The residential affected areas constitute 52.82% of the total residential areas in town. 61.64 % of total commercial use in town was affected even though it constituted only 1.94% and 43.69% of the total public use of the town was affected during flood which constituted only 3.9% of the total flood affected area. Even though the industrial land use in the town is very less more than 90% of the total industrial use in the town was affected during the flood.

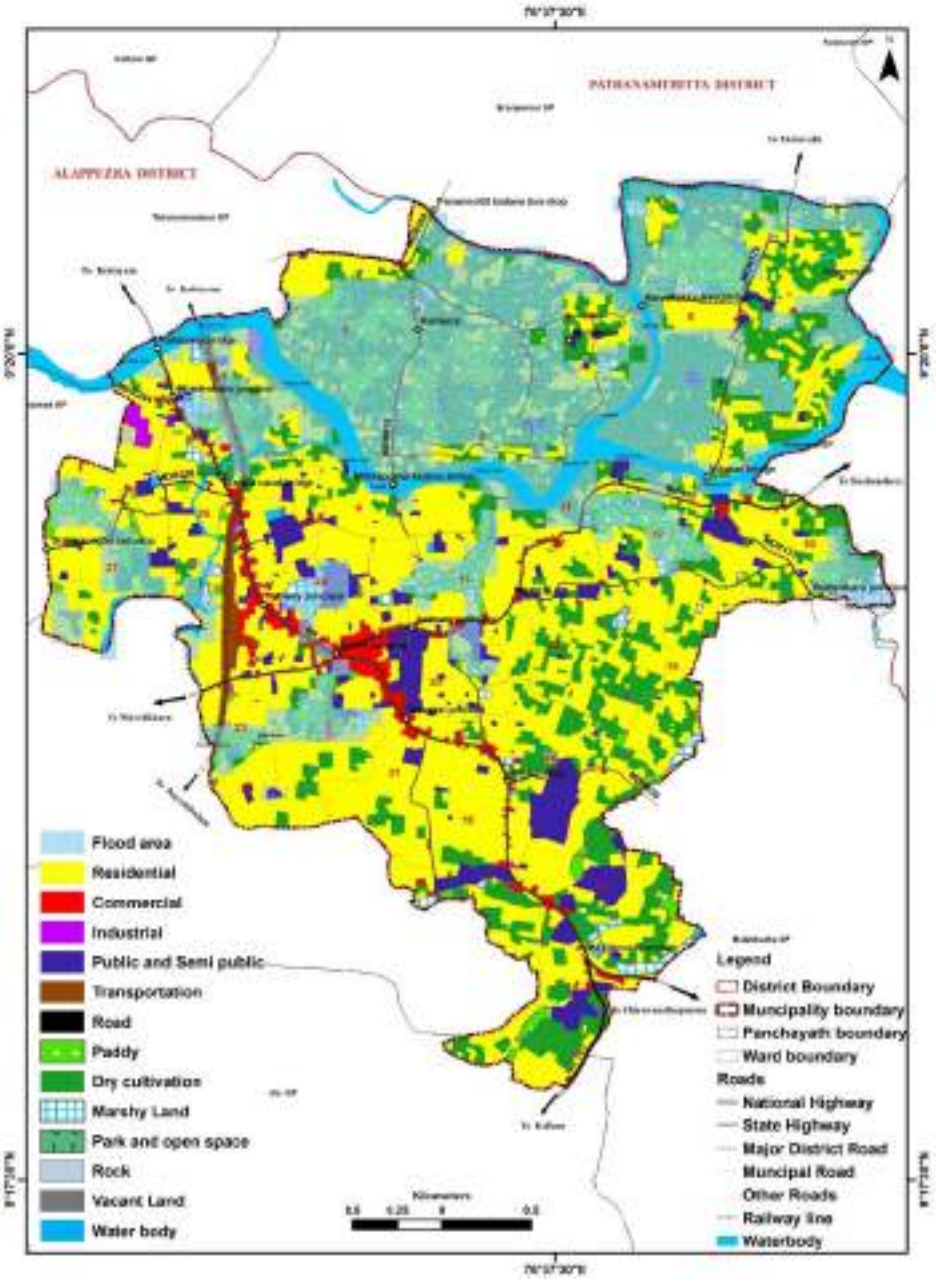

Figure 13:37 Flood prone area in Land use Map

Table 13-8 Area and percentage of land use type in flood prone area

Type of Land use affected	Area affected in sq.m	% of affected land use to total flood affected area	% of affected land use to the that particular land use type in town
Residential	3172426.20	38.16	52.82
Paddy	961329.06	11.56	94.55
Dry cultivation	2401628.53	28.89	67.03
Public	324189.69	3.90	43.69
Commercial	161305.49	1.94	61.64
Road	138491.70	1.67	64.57
Rock	5122.45	0.06	48.22
Transportation	142252.52	1.71	98.88
Industrial	43143.95	0.52	91.14
Marshy land	210822.19	2.54	76.61
Park	12887.31	0.16	67.87
Vacant land	9119.28	0.11	82.64
Waterbody	730705.13	8.79	100.00
	8313423.51		

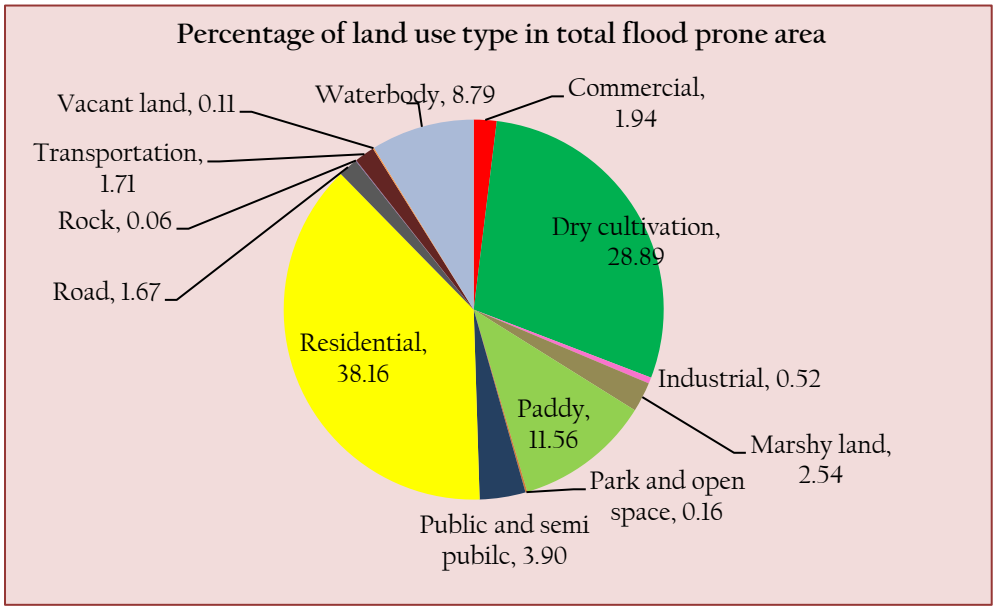

Figure 13:38 Percentage of land use type in flood prone area



Figure 13:39 Operation MADAD- Armed forces helping authorities in flood hit Kerala in rescue & relief during flood 2018

13.3.2 Impact of Flood

Alappuzha district experienced immense calamities in the 2018 monsoon causing significant damage to life and property. Large populations of the district were affected directly or indirectly by these events. Chengannur Town was also affected severely by the flood 2018.

As per the pilot survey conducted in February 2021, the flood levels of 2018 were measured at different locations within the flood prone area of the town. These measurements were then mapped to understand the floodlevel rise using GIS and is shown in Figure 13:40.

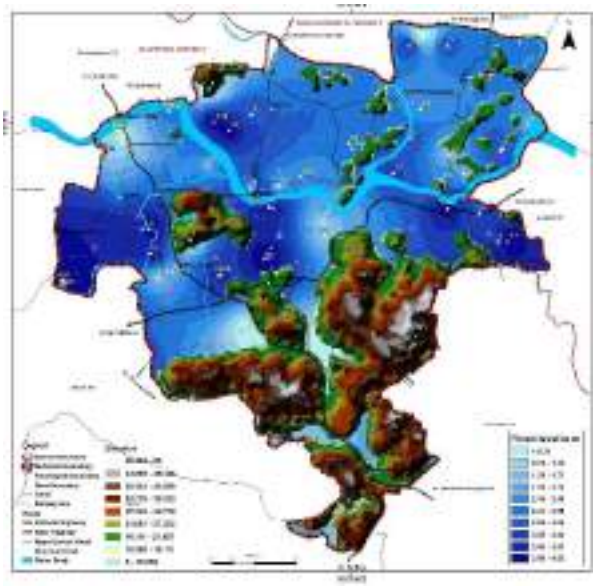

Figure 13:40 Flood level mapping, 2018

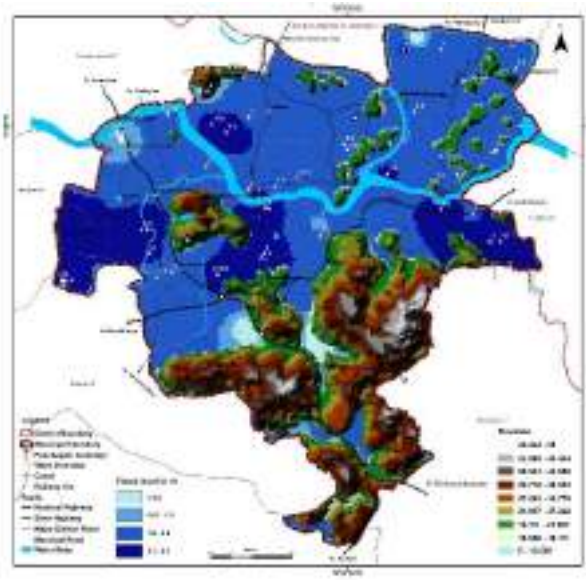

Figure 13:41 Flood level categorization,2018
Source: Primary Survey, February 2021

The flood has resulted in the loss of lives of 4 persons and affected 2838 houses which made to relocate 13398 people in to 30 relief camps. It has damaged major economic sectors and agricultural activities in the town. It resulted in the loss of lives of 118 animals, about un-insured agriculture in 2.24 Hectare, caused complete damage of 31 houses, partial damage of 721 houses and also damaged 8 other nonresidential buildings. The flooding in 2019 has affected 8 wards in town and caused partial damages to 15 houses and loss of un-insured agriculture in 1.3Hectre. For reducing the effects of 2019 flood in view of the past experience in hand, preventive measures are taken and relocated 138 households to 22 relief camps.

A. Housing Sector

About 44% of the total households in the town were affected by flood. An area of 3.17 sq km which constitutes 38.16% of the total flood prone area is residential land use. Buildings in the flood affected areas are surveyed and the damages caused by flood are categorized as completely collapsed and partially damaged. The ward wise details on damages to households are shown in

Table 13-9 and are represented in Figure 13:43.

Table 13-9 Ward wise details of Households affected by flood 2018

Ward No.	Name of Ward	Completely collapsed	Partially damaged	Total No. of HH affected
1	Mundankavu	1	175	176
2	Kodiyattukara	3	227	230
3	Temple ward	1	16	17
4	Mithrapuzha	1	100	101
5	Vazharmangalam	4	183	187
6	Mangalam South	6	242	248
7	Mangalam North	2	78	80
8	Edanadu West	2	236	238
9	Edanadu East	4	176	180
10	Puthenkavu East	1	236	237
11	Arattukadavu	0	5	5
12	Puthenkavu West	1	116	117
13	Sasthamkulangara	4	101	105
14	Angadickal	0	2	2
15	Malayil	0	3	3
16	ITI	0	12	12
17	College	0	6	6
18	Angadickal South	0	6	6
19	Hatchery	0	6	6
20	Moolappadavu	0	32	32
21	Thittamel	0	4	4
22	Pandavanpara	0	34	34
23	Bethel	0	35	35
24	Town	1	108	109
25	Railway Station	0	106	106
26	Vandimala	1	279	280
27	Valiya Palli	2	230	232
	Total	34	2754	2788

In Chengannur Municipality, out of 27 wards, 16 wards faced the severe effect of flood. 2788 Households were affected in the 2018 flood. (Total number of households were 6278 as per 2011 census). 13,398 people from 2788 households were placed in relief camps during 2018 mega flood. 30 relief camps functioned in the Municipality limit. In 2019 as a precaution, 622 families were shifted to 22 relief camps prior to monsoon flood. The most affected ward was Vandimala (26) with 280 affected households, and the least affected Angadickal (14) with only 3 affected households.

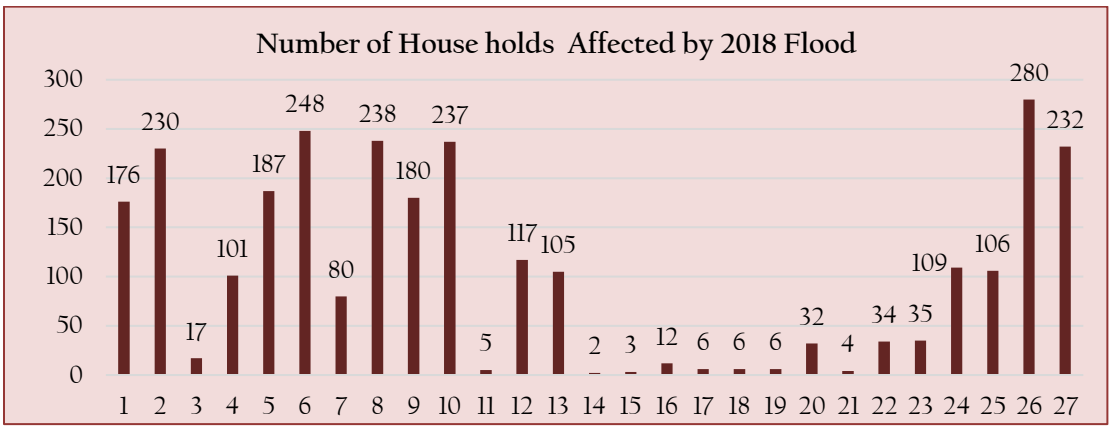

Figure 13:42 Ward wise details of Households affected by flood

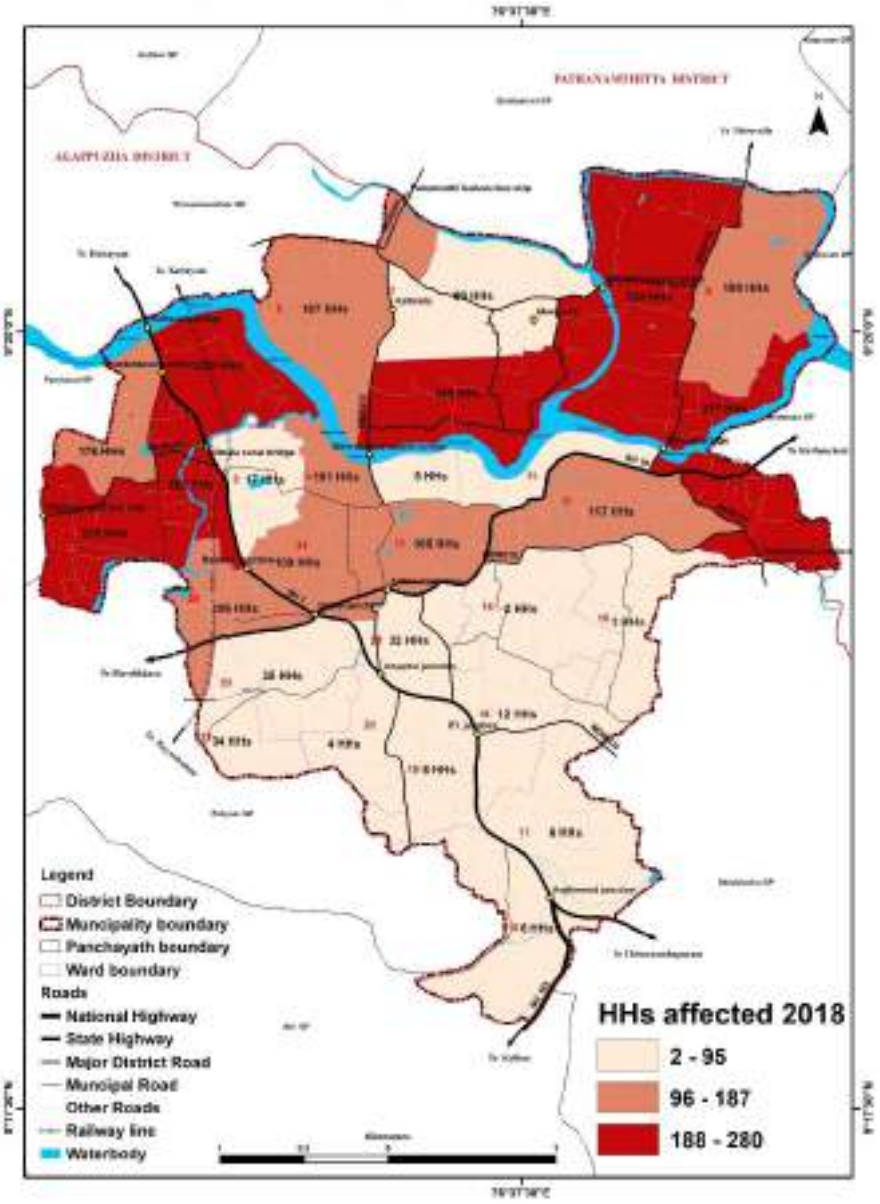

Figure 13:43 Ward wise representation of number of HH affected due to 2018 flood



Figure 13:44 Photos of sediment deposited in houses as the result of flood

It is seen that 34 houses were completely damaged in the town area and more than 200 houses were damaged in 6 wards. About 100-200 houses were affected in 6 wards and less than 100 houses were damaged in 13 wards of the town. The major damages have occurred in the wards that are located along the banks of Pampa River and other existing natural streams.

Age of the building

In order to know the extent of the damage, it is necessary to cross-reference the data with the age of the building and its typology to understand why a particular extent of damage has occurred.

The data from the Municipality on ward wise details on age of buildings affected by flood is shown in following table. From the figure showing the percentage of houses in each age group to the total no of affected houses, it is clear that majority of the buildings affected were coming under the age group of more than 31 years (48.06%). While considering the whole town area, it seems that the age of the building has a direct relation to the damages caused by flood, as the age advanced the damages were more severe. But in some wards more no of buildings in 11 to 30 Years age group were the ones more affected by flood as seen in the table.

Table 13-10 Ward wise age of buildings affected by flood 2018 (Percentage)

Ward no	Age below 5 years (%)	5 to 10 Years (%)	11 to 30 Years (%)	More than 30 Years (%)
1	6.86	13.71	30.29	49.14
2	8.81	8.37	25.11	57.71
3	0.00	0.00	75.00	25.00
4	19.00	10.00	28.00	43.00
5	4.92	15.30	34.43	45.36
6	3.31	3.72	36.36	56.61
7	2.56	6.41	35.90	55.13
8	2.54	4.24	49.58	43.64
9	6.82	11.93	44.32	36.93
10	2.97	7.20	39.41	50.42
11	16.67	33.33	50.00	0.00
12	8.62	12.07	25.00	54.31
13	0.00	6.93	48.51	44.55
14	0.00	0.00	100.00	0.00
15	0.00	0.00	100.00	0.00
16	0.00	0.00	100.00	0.00
17	0.00	0.00	83.33	16.67
18	0.00	0.00	100.00	0.00
19	0.00	0.00	100.00	0.00
20	6.25	21.88	46.88	25.00
21	0.00	0.00	100.00	0.00
22	2.94	11.76	67.65	17.65
23	5.71	5.71	65.71	22.86
24	3.70	4.63	51.85	39.81
25	3.00	6.00	19.00	72.00
26	3.94	10.04	45.52	40.50
27	2.61	5.65	27.39	64.35
Total %	**4.91**	**8.40**	**38.63**	**48.05**

Type of houses

The data from the Municipality on ward wise details of type of houses that were affected by the flood are shown in the following table. It shows that 41.79% of affected houses were brick and tile type followed by 33.41% of concrete type houses.

Table 13-11 Ward wise typology of buildings affected by flood (Percentage)

Ward no	Tent	Thatch	Brick Tile	Concrete	Others
1	0	6.86	42.86	45.71	4.57
2	0	14.98	49.34	33.48	2.20
3	0	12.50	62.50	25.00	0.00
4	0	12.00	46.00	36.00	6.00
5	0	19.67	33.88	38.25	8.20
6	0	17.77	36.78	35.95	9.50
7	0	14.10	42.31	38.46	5.13
8	0	33.05	39.41	22.88	4.66
9	0	48.86	33.52	15.34	2.27
10	0	13.98	45.76	35.59	4.66
11	0	60.00	40.00	0.00	0.00
12	0	13.79	48.28	26.72	11.21
13	0	12.87	56.44	18.81	11.88
14	0	0.00	100.00	0.00	0.00
15	0	0.00	100.00	0.00	0.00
16	0	0.00	33.33	33.33	33.33
17	0	0.00	0.00	0.00	100.00
18	0	0.00	100.00	0.00	0.00
19	0	0.00	66.67	16.67	16.67
20	0	0.00	50.00	34.38	15.63
21	0	0.00	100.00	0.00	0.00
22	0	5.88	35.29	41.18	17.65
23	0	11.43	37.14	28.57	22.86
24	0.92	33.33	35.19	25.00	5.56
25	0	5.66	26.42	59.43	8.49
26	0	13.98	43.73	34.41	7.89
27	0	10.00	42.17	41.74	6.09
Total %	0.04	17.76	41.79	33.41	7.01

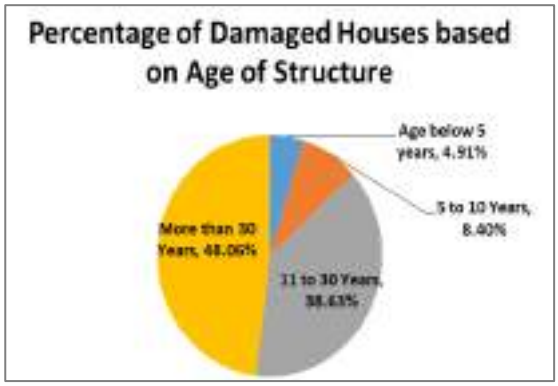

Figure 13:45 Percentage of Houses Damaged Based on Age of Structure in total houses affected by flood

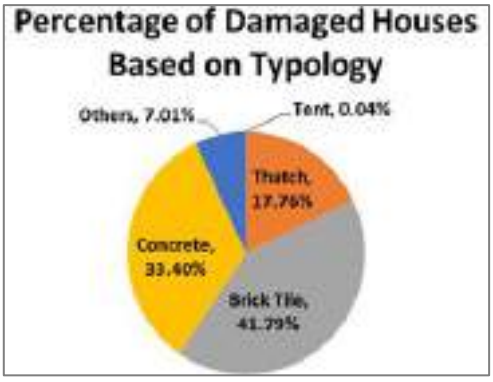

Figure 13:46 Percentage of Houses Damaged Based on Type of Structure in total houses affected by flood

B. Transportation

One of the major issues observed during the flood period is the loss of connectivity. The study on 'Modification Strategy of the Settlement Pattern in The Present Flood Context: Alappuzha District', done by the departent states that, even though the railway network of the district is not affected by flood; flooding in other parts of Kerala cause railway to stop or limit their service during this time. In the case of road network many of the residential roads and village roads were submerged under water causing isolation of many areas especially those near the major water bodies.



Figure 13:47 Chengannur Railway Station during Flood 2018

The major roads in the town connecting nearby regions were also submerged in flood waters causing traffic operations to stand still at town area which was severely affected by the flooding. Even though the rail line was not affected, the railway station, bus stand and its premises were fully flooded causing it to be non-accessible to people. 64% of the total road network in the town was submerged in the flood water. The existing transportation network map in the flood inundation map of town area is shown in Figure 13:48.

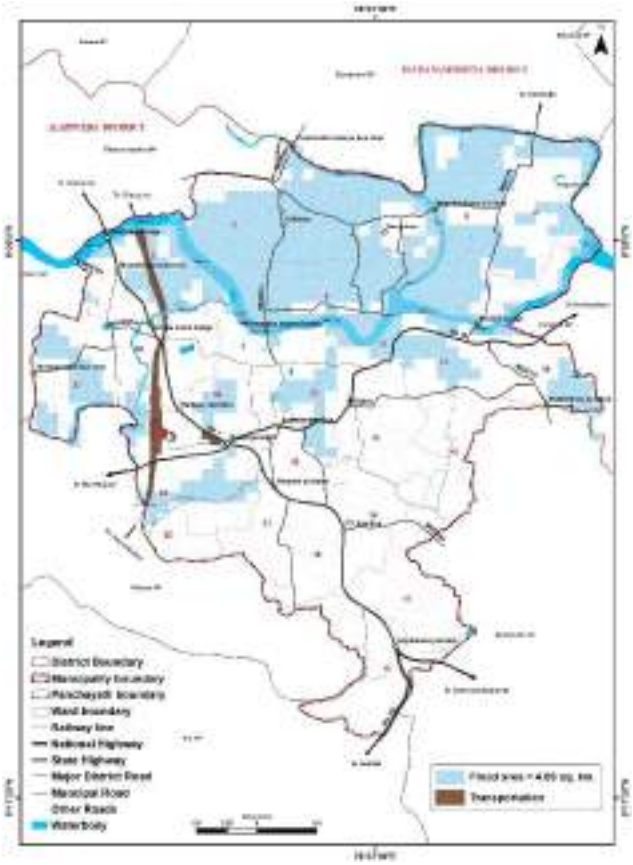

Figure 13:48 Road network Map in flood prone area

C. Water Supply

Public water supply schemes in the Town are managed by KWA and the Municipality. The use of ground water by open/bore well is the major source of water for the people. The Urban - Post Flood Daily status as on 01 Sept 2018 shows that 3892 wells that are spread across 25 wards of the town were affected and were polluted due to the flooding. The details are shown in table below. The flood prone area is overlaid in ground water profile of town and is shown in Figure 13:49. The heavy rains resulted in increased dissolved solids and microbial pollutants in all surface water sources and the flood squads played a major role in cleaning of these surface water sources and wells.

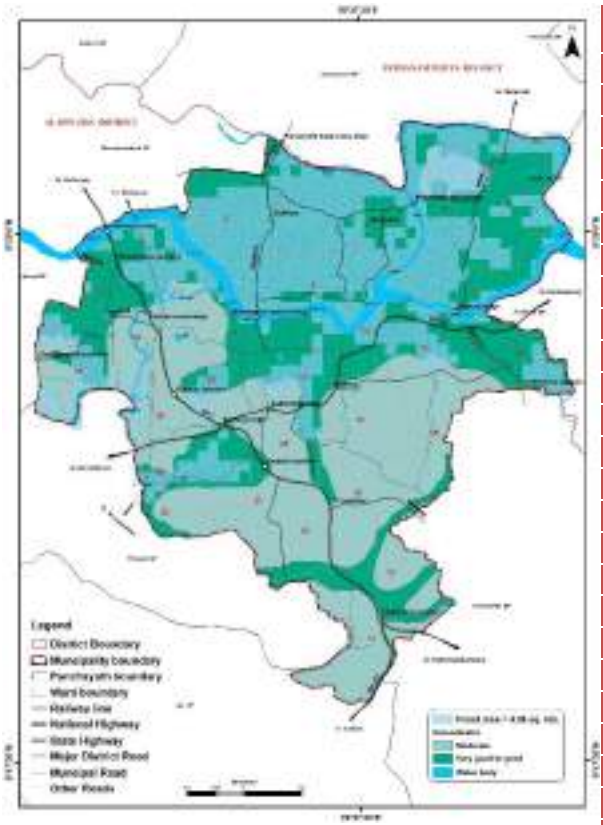

Figure 13:49 Ground water profile of town in Flood prone area

Table 13-12 Affected well details in each ward

Name of Ward	No of Flood Affected Wells
Mundencavu	200
Kodiyattukara	302
Temple	40
Mithrappuzha	250
Vazharmangalam	85
Mangalam South	200
Mangalam North	250
Edanad West	260
Edanad East	260
Puthencavu East	300
Arattukadavu	236
Puthencavu West	200
Sasthamkulangara	98
Angadickal	20
I T I	10
College	15
Hatchery	20
Moolappadavu	40
Thittamel	4
Pandavanpara	52
Bethel	60
Town	200
Railway Station	150
Vandimala	350
Valiyapalli	290
Total Number of affected wells	**3892**

D. Productive sector- Agriculture, Soil, Fisheries and Livestock

Productive sector includes agriculture, livestock, fisheries, Industry and commerce, tourism, banking and finance sectors. The total agriculture area affected including paddy and dry cultivation constitute 40.45% of the total flooded area. 94.55% of total paddy land and 67.03% of total dry cultivation land were affected due to flood. Agriculture sector of the district has been destroyed completely. Almost all paddy fields were damaged. 66.4 Hectare of 'virippu' paddy is reported to be damaged in the Chengannur ADA.

Major loss happened in the various agriculture sectors. It is important to note that while crop loss is an immediate visible effect of the flooding, larger issues related to loss of top soil, degradation of fertile land, silt formation in paddy fields etc. make restoration of

agricultural activities a difficult task. A total amount of loss recouped by central and state governments was 3.23 lakh rupees in this sector.

Table 13-13 Details of Crop loss at Town due to flood 2018, Source: Agriculture Dept.

Name of Crop	Loss in Kg/No	Amount of Loss Recouped by Central and State Governments
Banana Bunched	1285	128500
Banana Non-Bunched	1522	114150
Cocunut B	3	2100
Cocunut 1 Year	253	26008
Tubers (Colacasia, Yam)	2.12 Ha	14416
Nutmeg B	49	19600
Nutmeg N B	121	18150
Pepper B	8	600
Total		323524

Source: Department of Agriculture

Another impact in the primary sector is the loss of cattle and poultries. Most of the farmers had cattle and poultry in their home. The loss of connectivity, lack of time and transportation facility most of the farmers were forced to leave their cattle and poultry during rescue time. This raised the death toll of domestic animals and birds in flooded region. The losses in the livestock sector in Town are mentioned below. The Urban - Post Flood Daily status 01 Sept 2018 states that a total no of 1694 carcasses of large and small animals and birds were buried by the post flood cleaning squads in the town.

Table 13-14 Details of loss in Livestock Sector in Town

Item	Cattle	Calf	Goat	Hen	Duck	Cattle Shed
No.	11	25	55	2184	66	35

Source: Animal Husbandry Department

E. Other infrastructure

Damages to educational infrastructure facilities in town are listed in Table 13-15. An estimated cost of about 30.53lakhs damage is assessed during the flood period.

Table 13-15 Details of loss in Infrastructure Sector

Sl No	Name of School	Type	Ownership	Estimated loss
1	J B S Mangalam	LP	Govt	1353000
2	N S S H S Edanad	HS	Aided	1700000
			Total	3053000

The Urban - Post Flood Daily status as on 01 Sept 2018 shows that a total number of 130 public buildings were affected during 2018 flood. The details of number of floods affected public building are shown in Table 13-16.

Table 13-16 Number of floods affected public buildings

Name of Ward	No of Flood Affected public Buildings
Mundencavu	2
Kodiyattukara	6
Temple	1

Mithrappuzha	1
Vazharmangalam	10
Mangalam South	20
Mangalam North	15
Edanad West	5
Edanad East	4
Puthencavu East	8
Puthencavu West	3
Sasthamkulangara	2
Moolappadavu	6
Town	28
Railway Station	12
Vandimala	5
Valiyapalli	2
Total No	130

13.4 Flood Hazard analysis

Hazard Analysis involves mapping of areas, which are prone to disaster so as to develop a visual representation of the hazard. The analysis aims at identifying areas in which the potential impact of a disaster is higher.

13.4.1 Social Vulnerability and flood affected wards - Nammal Namukkayi Report, 2020

The different group of people, who needs special care during any hazard as per the Nammal Namukkayi Report, are listed below. These socially vulnerable people are spread across the different wards of town. 16 wards of the Municipality were affected During 2018 and 2019 floods and are listed in Table 13-18 and shown in Figure 13:50.

Table 13-17 Number of Socially vulnerable category of people

Sl no	Category	No of Female	No of Male	Total
1	Children: 0-6 age group	1107	1005	2112
2	Elderly: Above 60-year age group	1492	1150	2642
3	Elders who live alone	11	8	19
4	Specially Abled	23	18	41
5	Those in palliative care	190	145	335
6	Those in care homes	12	8	20
7	Destitute/Poor People	26	18	44
8	Other state workers/ Migrant labourers	122	482	604
9	Female headed households	---	---	625

Source: Nammal Namukkayi report, 2020

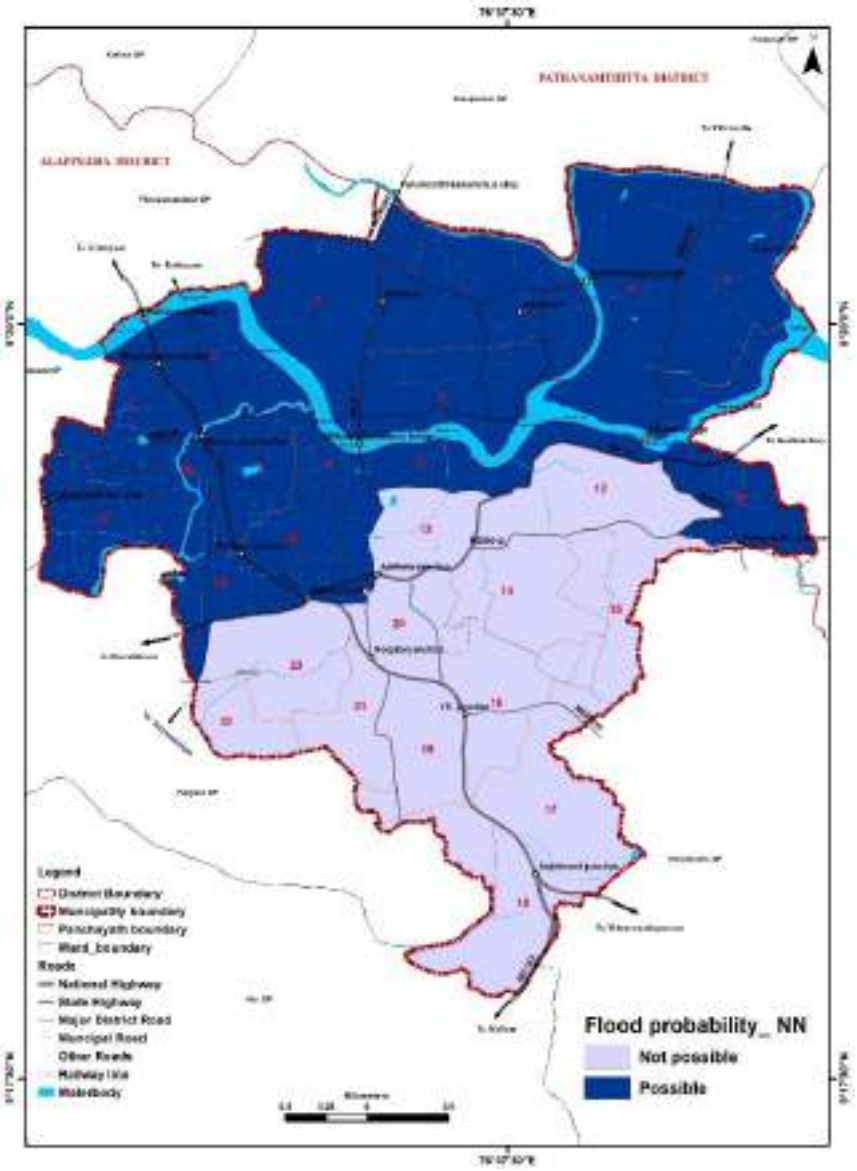

Figure 13:50 Flood affected wards in Town identified as per Nammal Namukkayi report, 2020

Table 13-18 Flood affected wards in town as per Nammal Namukkayi report, 2020

Ward No.	Name of Ward	Ward No.	Name of Ward
1	Mundankavu	9	Edanadu East
2	Kodiyattukara	10	Puthenkavu East
3	Temple ward	11	Arattukadavu
4	Mithrapuzha	12	Puthenkavu West
5	Vazharmangalam	24	Town
6	Mangalam South	25	Railway Station
7	Mangalam North	26	Vandimala
8	Edanadu West	27	Valiya Palli

13.4.2 Vulnerability level of wards based on 2018 flood affected HH

Vulnerability level of wards are identified based on the number of households (HH) affected during flood and its complete/partial loss identified during primary surveys. The identified different Vulnerability Categories are as follows: High, where the flood Affected HH are 200 above; Moderate, where 100 to 200 HH were affected or any complete loss of HH occurred other than the High-risk wards; and Low where less than 100 HH were affected. It showed 6 highly vulnerable and 10 moderate vulnerable wards in town.

Table 13-19 Vulnerability level of different Wards in town based on 2018 flood

Ward No.	Name of Ward	Completely collapsed	Partially damaged	Total No. of HH affected	Vulnerability Categories 1. High (Affected-200 above HH) 2. Moderate (100 to 200 HH/ Any Complete loss of HH) 3. Low (Below 100 HH)
1	Mundankavu	1	175	176	Moderate
2	Kodiyattukara	3	227	230	High
3	Temple ward	1	16	17	Moderate
4	Mithrapuzha	1	100	101	Moderate
5	Vazharmangalam	4	183	187	Moderate
6	Mangalam South	6	242	248	High
7	Mangalam North	2	78	80	Moderate
8	Edanadu West	2	236	238	High
9	Edanadu East	4	176	180	Moderate
10	Puthenkavu East	1	236	237	High
11	Arattukadavu	0	5	5	Low
12	Puthenkavu West	1	116	117	Moderate
13	Sasthamkulangara	4	101	105	Moderate
14	Angadickal	0	2	2	Low
15	Malayil	0	3	3	Low
16	ITI	0	12	12	Low
17	College	0	6	6	Low
18	Angadickal South	0	6	6	Low
19	Hatchery	0	6	6	Low
20	Moolappadavu	0	32	32	Low
21	Thittamel	0	4	4	Low
22	Pandavanpara	0	34	34	Low
23	Bethel	0	35	35	Low
24	Town	1	108	109	Moderate
25	Railway Station	0	106	106	Moderate
26	Vandimala	1	279	280	High
27	Valiya Palli	2	230	232	High

13.4.3 Vulnerable Cluster Identification

Based on the identified vulnerability levels of wards, the different vulnerable housing groups were identified and are shown in the table below. The identified clusters in high and moderate risk wards are to be considered with high priority in any possible future flood events. A total no of 342 HH with a total 1434 no of people are present in the identified LIG housing colonies in the town. Among this, 5 housing colonies are identified in high-risk wards and 7 are identified in moderate risk wards. These constitute a total number of 404 people who are in flood prone areas.

Table 13-20 Identification of clusters in Different vulnerable category wards

Ward No.	Name of Ward	Vulnerability Category of Ward	Name and Number of LIG Housing colonies/ Slums	Total number of HH in Housing colonies/ cluster	Total number of People in Housing colonies/ clusters
			(As per Nammal Namukkayi report, 2020)		
1	Mundankavu	Moderate	1. Devathara Colony	5	18
2	Kodiyattukara	High	--		
3	Temple ward	Moderate	--		
4	Mithrapuzha	Moderate	--		
5	Vazharmangalam	Moderate	1. Puthanoozhathil Colony	11	38
6	Mangalam South	High	1. Vettukattil Colony 2. Valiyathara (Sangetham)	5 5	20 18
7	Mangalam North	Moderate	1. Vylattuthara colony 2. Unmathara (Sangetham)	18 7	88 20
8	Edanadu West	High	1. Mooloor Lekshamveedu colony 2. Udikkana Sangetham	6 7	28 34
9	Edanadu East	Moderate	1. Velan Colony	9	42
10	Puthenkavu East	High	--		
11	Arattukadavu	Low	--		
12	Puthenkavu West	Moderate	1. Kaattil Colony	5	20
13	Sasthamkulangara	Moderate	--		
14	Angadickal	Low	1. Channathiloozhathil Colony 2. Kuttiyil Colony	6 5	37 20
15	Malayil	Low	1. Amariyoozham Colony 2. Kizhavaramodi	25 9	133 51
16	ITI	Low	--		
17	College	Low	1. Kaappimala Colony	15	79
18	Angadickal South	Low	--		
19	Hatchery	Low	1. Thondippara Colony 2. Chettiyanmodi Sangetham	15 10	52 53
20	Moolappadavu	Low	1. Pulikkunnu Colony	45	178
21	Thittamel	Low	1. Chakrapaniyoozhathil Colony	7	31

22	Pandavanpara	Low	1. Pandavanpara Colony 2. Valiyakulathumbatt Colony	76 6	279 22
23	Bethel	Low	1. Priyadarshini Colony	24	91
24	Town	Moderate	1. Pathiyamparambil colony	8	33
25	Railway Station	Moderate	--		
26	Vandimala	High	--		
27	Valiya Palli	High	1. Thazhamthara Colony	13	49
Total				342	1434

Source: Nammal Namukkayi Report, 2020

13.4.4 Vulnerable Built Up Clusters of Town

The vulnerable built-up clusters are identified based on flood prone area map of town, the total number of houses affected, and the presence of residential areas in the flooded region. In Table 13-20 the housing clusters within different category of vulnerable wards in the town area are shown. The slum areas, low-income group colonies and other residential colonies are included in the identified flood affected residential areas and they need special care during the occurrences of any future hazard. The residential areas in flood prone region are shown in Figure 13:51, it is seen that 52.82% of total residential area falls in flood prone region.

The spatial distribution of residential land use is scattered in the town area, so the cluster identification was difficult thus they were mapped by focussing on the major built up areas in the flood prone region. With the flood prone area, residential land use and built-up concentration, 22 clusters were identified for further study as shown in Figure 13:52. These clusters were affected in various extends during the 2018 floods. These built-up clusters are identified and marked in the google map. Preliminary pilot survey was conducted on Feb 2021 for collecting the data from these clusters regarding the flood 2018 inundation depth, the various measures they took during flood and the camps/relocated area during the flash flooding.

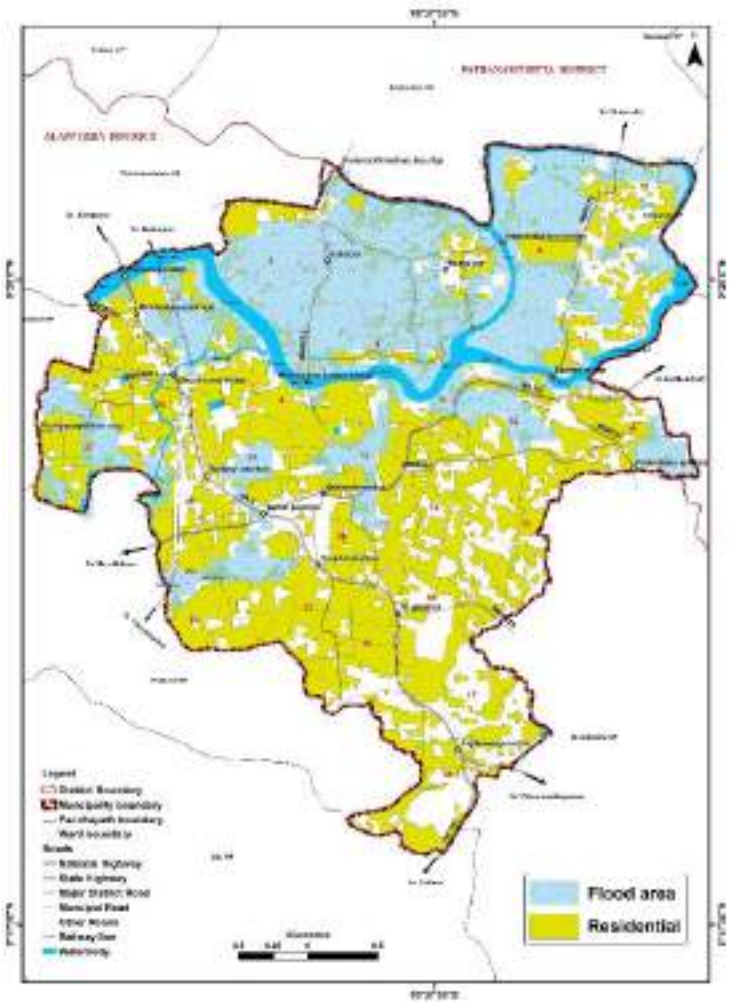

Figure 13:51 Residential areas in flood prone region

Cluster 1 in ward 27, consists of the Thazhanthara colony was adversely affected in some areas, they were taken to Chrsitian College as their relief camp. Clusters 2 and 3, the IHRD Engineering college was used as their relief camp. Cluster 4 lies on the banks of the river Pampa and the people were evacuated to the nearing relief camps such as the NSS Auditorium, Valiyapalli and Govt UP School.

In ward number 5, the settlement pattern seen is dispersed in nature so the only cluster identified is Cluster 5. These dispersed settlements outside the cluster include a low-income housing group named Puthanoozhathil Colony of 11 households located on both sides of the access road connecting the colony to Chegannur - Othera road and about 3m inundation from the ground is seen here. The other scattered houses in these low-lying areas near water bodies and paddy lands were flooded upto a height of 4.13m during the flash flood. All of these residents were relocated to elevated places of the same ward which is located at the identified cluster 5 in IPC Hebron Church Hall and St. Mary's LPS, Kallissery. There is an old age home named 'Maruppacha' is functioning among these dispersed residential areas which was severely affected during the flood. During the time of 2018 flood, the inhabitants were shifted to first and second floor of the 3-storey building and it functioned as a camp for its inhabitants. Here water level rose up to 4.30 metre from ground and a large number of domestic animals died during the flood. The identified residential Cluster no 5 was not that much affected during 2018 flooding since it is situated in comparatively elevated areas and it act as a relief area for the nearby low lining residences with the presence of two relief camps.

The residential areas of Ward 6 and 7 are included in Cluster no 6. Three LIG Hosing areas are present in this cluster and Vylattuthara Colony of Ward 7 is the larger among these with 18 households and the other two are situated in ward 6. The JBS Mangalam School is one of the severely affected public buildings in this area which is a single-storey structure. There is need for construction of G+1 building for this kind of severely affected public buildings and shifting of imported documents and major electrical installations/instruments to first floor is necessary to reduce any future possible similar hazard events. The inhabitants in these flooded regions of ward 7 were shifted to the nearby St George Orthodox Church Auditorium. In the other low-income housing situated in ward 6 of this cluster were first shifted to the first floor of adjacent buildings & St. Thomas Church Hall. This church hall was also flooded to its podium level and they moved to the



Figure 13:52 Identified Built – up Clusters

mezzanine floor and stayed there till the water level decreased. The water level rose above 2 metre height. When water level rose in St. Thomas Church Hall, some of the inhabitants were shifted to Mangalam Orthodox Church Hall at ward 7 and some of them were shifted to JBS School by boat.

Cluster no 7 is located in the ward 6 along the sides of the Vaazhar Mangalam road, some inhabitants in the comparatively elevated places where the flood level was up to the height of window sill level and had G+ 1 structure managed to sustain the flood by moving to the upper floors. Other affected inhabitants where water level rose above 2 meters' height were relocated to the first floor of adjacent buildings and to Mangalam Orthodox Church Hall in ward 7.

Cluster no 8 falls in Ward no 8, the inhabitants near the elevated rock 'Kallarippara' were moved to higher areas of rock during the flash flood. There was about 3.30m height of flood water level is observed. A LIG Housing, Mooloor Colony with about 5house holds is also present in this identified cluster area where the flood water level reached to a height above 2 m. People of this colony were first moved to first floor of adjacent buildings, but then shifted to Mangalam Orthodox church hall in ward 7 due to increased water level. Other residents found outside the cluster area in ward 8, where flood level raised about 3m from ground were first moved to NSS School, Edanadu but due to the further flooding in school, they had to shift to nearby double story residential building which acted as a relief camp for them during 2018 and some of them were evacuated to JBS School by boat.

The Cluster no 9 falls in ward 8 and 9, the inhabitants near Varattar in this cluster where the flood water level was above 3m stayed at the first floor of adjacent buildings till the flood water level reduced. Cluster 10 is in Ward 9; the inhabitants were shifted to the first floor of adjacent buildings near them during flood. The flood water level was about 2.5m from ground near Varattar. The nearness to Varattar a branch of River Pampa has caused a high velocity flow of flood water in the wards 8, 9 and 10 and increased the severity of flood damages. People from clusters 9, 10, 11 and 12 evacuated to the Engineering College during the rising floods. Cluster 13, 14 have frequent water logging issues during monsoons.

Vulnerability assessment was carried out for the 22 clusters using various factors. The factors were population density, flood level, elevation of terrain, proximity to water body and presence of low-income housing. The individual measures are weighted according to their relative importance. A cumulative score is then generated by adding the weighted values. Flood level was given a weightage of 30%, Elevation and Proximity to water bodies were given a weightage of 20% each and Population Density and LIG were given a weightage of 15% each for the vulnerability assessment purpose. The cumulative vulnerability score of various clusters is shown in Table 13-21.

Clusters 1, 2, 3, 4, 8 16, 19 and 21 have the highest score and are more vulnerable to such floods in the future, while cluster 5, 17 and 22 are the least vulnerable amongst the lot. This is depicted in Figure 13:53. The clusters in the higher vulnerability zone are beacause of their higher ranks in the monitored factors. This is the cumulative weightage assessment to understand the vulnerability of the various built-up clusters of Chengannur town.

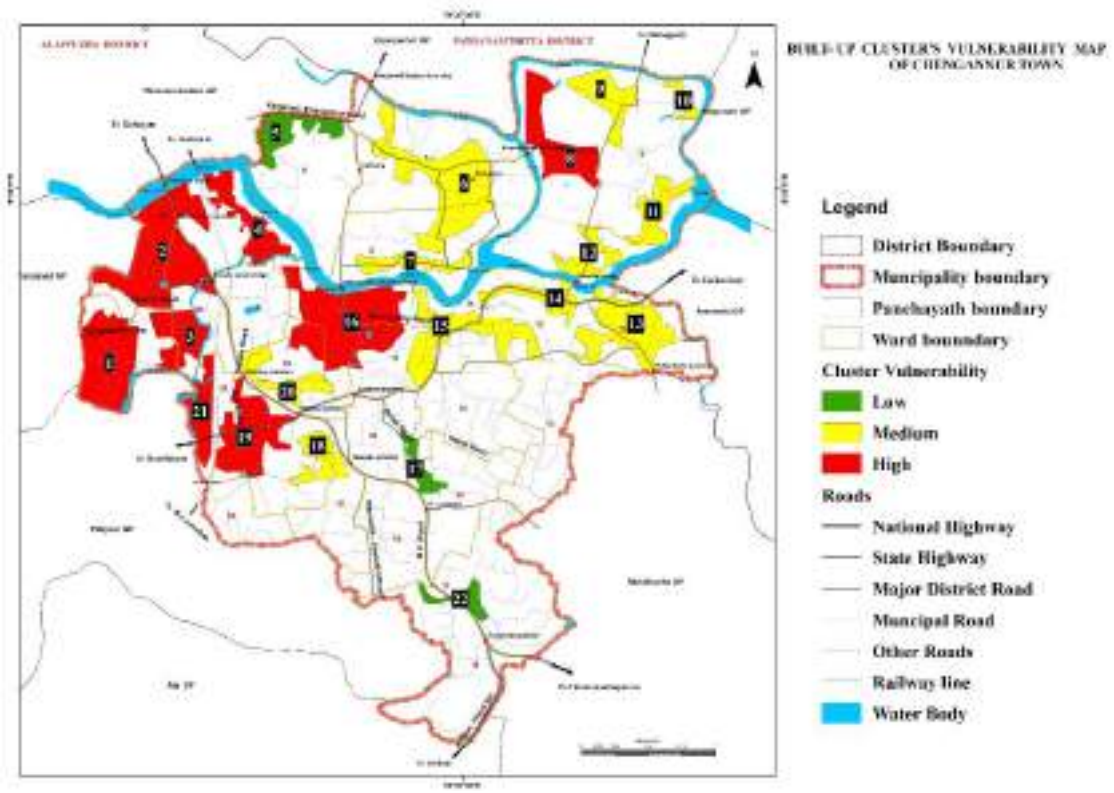

Figure 13:53 Vulnerability Level of Clusters based on Vulnerability Score

Table 13-21 Vulnerability score for different clusters

Cluster ID	Population Density		Flood Level		Elevation		Proximity to water body		Presence of LIG		Cumulative Vulnerability Score	Vulnerability Clasification
	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score		
1	2	0.3	4	1.2	4	0.8	2	0.4	2	0.3	3	High
2	2	0.3	3	0.9	4	0.8	4	0.8	2	0.3	3.1	High
3	2	0.3	4	1.2	3	0.6	3	0.6	0	0	2.7	High
4	2	0.3	3	0.9	3	0.6	4	0.8	0	0	2.6	High
5	1	0.15	0	0	1	0.2	1	0.2	1	0.15	0.7	Low
6	1	0.15	3	0.9	3	0.6	1	0.2	4	0.6	2.45	Medium
7	1	0.15	3	0.9	3	0.6	4	0.8	0	0	2.45	Medium
8	1	0.15	4	1.2	3	0.6	3	0.6	3	0.45	3	High
9	1	0.15	3	0.9	2	0.4	2	0.4	2	0.3	2.15	Medium
10	1	0.15	3	0.9	3	0.6	3	0.6	0	0	2.25	Medium
11	1	0.15	3	0.9	3	0.6	3	0.6	0	0	2.25	Medium

12	1	0.15	3	0.9	2	0.4	4	0.8	0	0	2.25	Medium
13	1	0.15	4	1.2	3	0.6	2	0.4	0	0	2.35	Medium
14	2	0.3	3	0.9	3	0.6	2	0.4	0	0	2.2	Medium
15	2	0.3	2	0.6	3	0.6	3	0.6	1	0.15	2.25	Medium
16	3	0.45	4	1.2	1	0.2	4	0.8	2	0.3	2.95	High
17	3	0.45	1	0.3	3	0.6	0	0	1	0.15	1.5	Low
18	2	0.3	1	0.3	3	0.6	4	0.8	1	0.15	2.15	Medium
19	3	0.45	2	0.6	3	0.6	4	0.8	1	0.15	2.6	High
20	3	0.45	4	1.2	3	0.6	0	0	0	0	2.25	Medium
21	3	0.45	3	0.9	4	0.8	3	0.6	0	0	2.75	High
22	1	0.15	1	0.3	3	0.6	1	0.2	1	0.15	1.4	Low

13.4.5 Vulnerability level of wards based on percentage of flood prone area

In Figure 13:54 the flood prone region is shown within the ward map of town and then in Figure 13:55 the percentage of affected area of each ward is plotted. From, it is clear that, 16 out of 27 wards of town have more than 70% of its area in flood prone region. Only 8 wards which are located in comparatively elevated areas of town have less than 25% of its area in flood prone region.

Table 13-22 Percentage of flood prone area in different wards

Ward No.	Name of Ward	% of flood prone area	Ward No.	Name of Ward	% of flood prone area
1	Mundankavu	100	15	Malayil	8
2	Kodiyattukara	98	16	ITI	13
3	Temple ward	29	17	College	9
4	Mithrapuzha	70	18	Angadickal South	14
5	Vazharmangalam	88	19	Hatchery	4
6	Mangalam South	82	20	Moolappadavu	27
7	Mangalam North	88	21	Thittamel	9
8	Edanadu West	98	22	Pandavanpara	23
9	Edanadu East	70	23	Bethel	75
10	Puthenkavu East	86	24	Town	71
11	Arattukadavu	100	25	Railway Station	100
12	Puthenkavu West	67	26	Vandimala	100
13	Sasthamkulangara	86	27	Valiya Palli	100
14	Angadickal	1			



Figure 13:54 Flood prone area in different wards of town



Figure 13:55 Percentage area of wards in flood prone area

13.4.6 Analysis of Critical Facilities

This analysis aims at identifying the critical facilities in the Town like educational institutions, police stations, hospitals, fire and rescue stations, etc. These facilities play a central role in disaster response and recovery and hence, it is important to protect these critical facilities to ensure that disruption of public service is minimized during the disaster. The available critical facilities are listed below and are shown in Figure 13:56.

- Schools- 18 numbers.
- Colleges- 4 numbers.
- Hospitals- 8 numbers.
- Mini civil station
- Police Stations/ Aid posts- 3 numbers.
- Shelter Homes
- Telecom Offices- 2numbers
- Other Government Office buildings- 24 numbers.
- Community Centers/ Auditoriums- 8 numbers.
- Fire Stations-1 number.

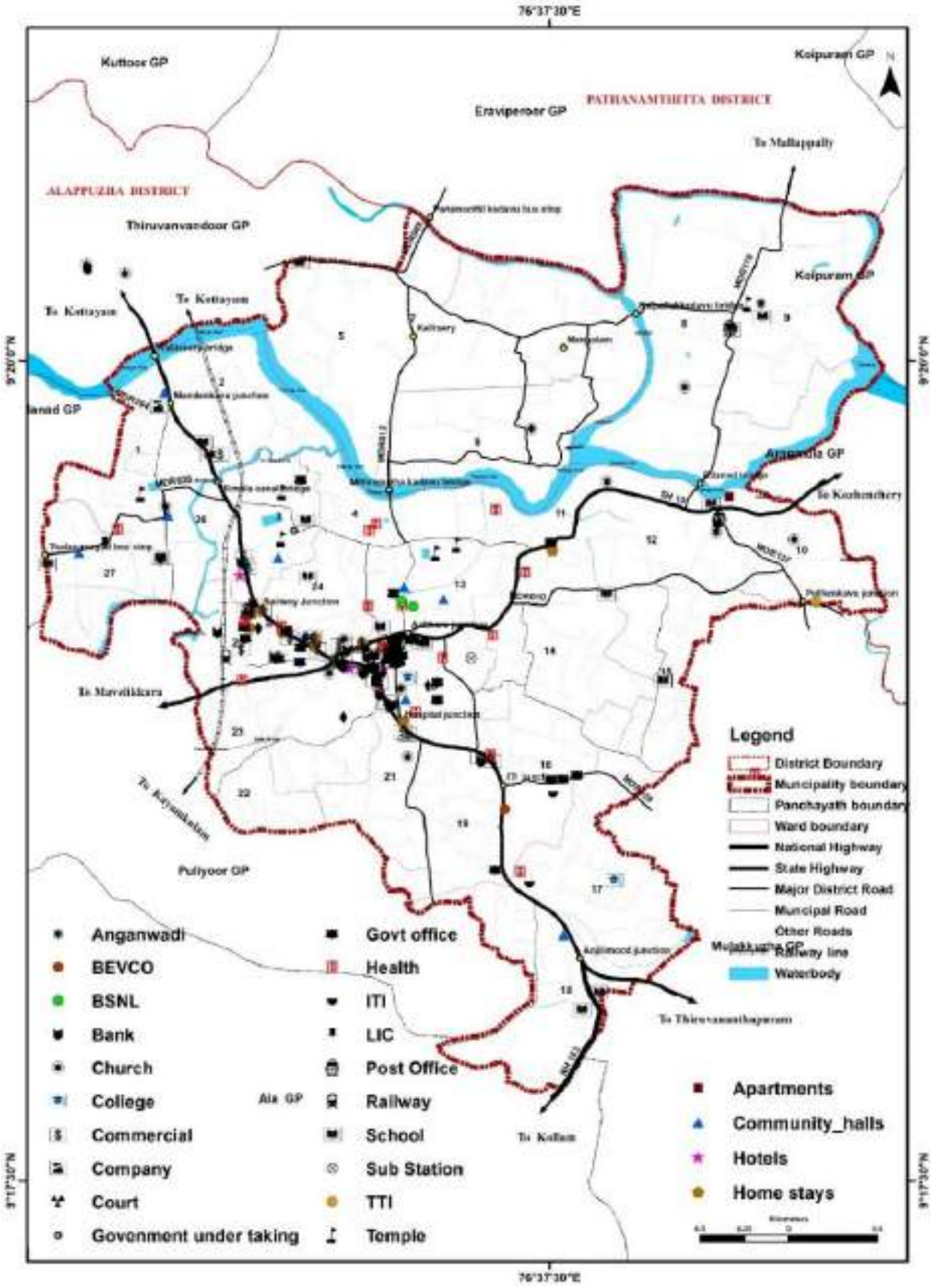

Figure 13:56 Available infrastructure facilities in Town

13.4.7 Integrated analysis of Land use v/s Hazard zone

Based on the damages occurred to households due to past flooding and percentage of flood prone area, the wards in town area classified into Highly affected, Moderately affected, Moderate Safe and Safe zone, with the following criteria used for analysis.

Table 13-23 Criteria used for Categorisation of Wards in to various zones

Number of houses affected due to flood	0 to 70	71 to 140 or Complete loss of 3 houses and below	141 to 210/ Complete loss of 4 houses and above	Above 210
Percentage of flood affected area	0 to 25	25 to 50	50 to 75	Above 75
Approximate population affected in each ward	0 to 300	300 to 600	600 to 900	Above 900
Category	Safe	Moderate Safe	Moderately afffected	Highly affected

Table 13-24 Categorisation of Wards in to various zones.

Ward No.	Name of Ward	Houses affected due to flood			% of area affected	Approximate No of population affected	Category of wards
		Completely collapsed	Partially damaged	Total No. of HH affected			
1	Mundankavu	1	175	176	100	686	Highly affected
2	Kodiyattukara	3	227	230	98	861	Highly affected
3	Temple ward	1	16	17	29	210	Moderate Safe
4	Mithrapuzha	1	100	101	70	533	Moderately affected
5	Vazharmangalam	4	183	187	88	794	Highly affected
6	Mangalam South	6	242	248	82	778	Highly affected
7	Mangalam North	2	78	80	88	765	Highly affected
8	Edanadu West	2	236	238	98	703	Highly affected
9	Edanadu East	4	176	180	70	478	Moderately affected
10	Puthenkavu East	1	236	237	86	695	Highly affected
11	Arattukadavu	0	5	5	100	667	Highly affected
12	Puthenkavu West	1	116	117	67	718	Highly affected
13	Sasthamkulangara	4	101	105	86	699	Highly affected
14	Angadickal	0	2	2	1	13	Safe
15	Malayil	0	3	3	8	69	Safe
16	ITI	0	12	12	13	107	Safe
17	College	0	6	6	9	84	Safe
18	Angadickal South	0	6	6	14	128	Safe
19	Hatchery	0	6	6	4	42	Safe
20	Moolappadavu	0	32	32	27	256	Safe
21	Thittamel	0	4	4	9	84	Safe
22	Pandavanpara	0	34	34	23	219	Safe
23	Bethel	0	35	35	75	628	Moderately affected
24	Town	1	108	109	71	727	Moderately affected
25	Railway Station	0	106	106	100	1117	Highly affected
26	Vandimala	1	279	280	100	766	Highly affected
27	Valiya Palli	2	230	232	100	846	Highly affected
	Total	34	2754	2788	63.65%		

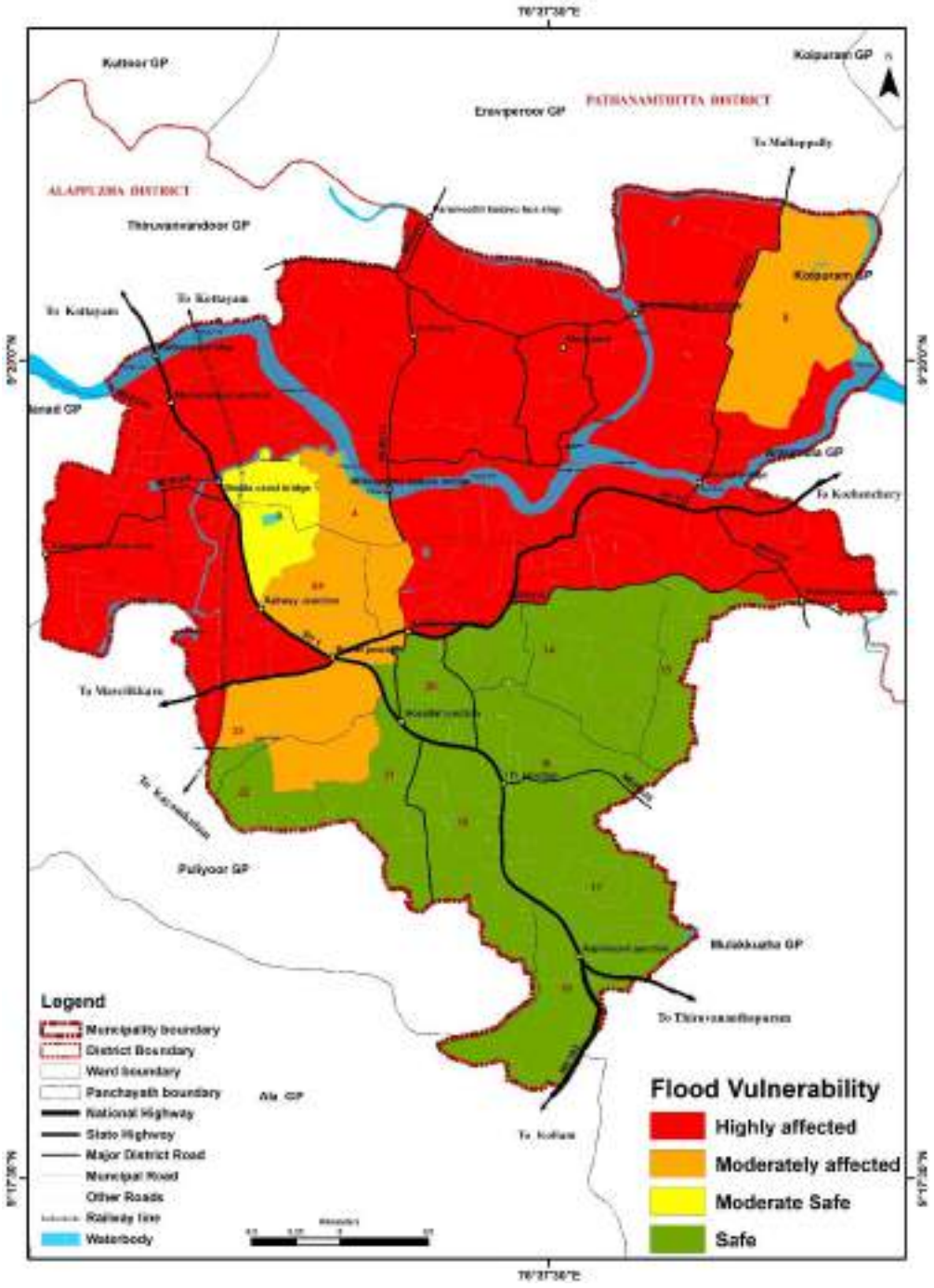

Figure 13:57 Ward wise Flood Hazard vulnerability zonation map

Based on the criteria mentioned inTable 13-23, a ward having any one of values of the above 3 parameters fall under maximum value that ward is categorised as Highly affected, Moderately affected, Moderate Safe and Safe zones. Ward wise categorisation map showing the vulnerability level is shown in the Figure 13:57.

The result shows that 17 wards in town are moderate risk to high-risk zones. Based on this study, some restrictions needed to be imposed on areas coming under high-risk zones and in moderate risk zones limited human interventions can be imposed, in moderate safe zones regulated interventions and in the safe zone all human activities can be permitted.

13.5 Analysis of Flood Affected Area v/s Distribution of Infrastructure facilities

The different available infrastructure facilities in town are plotted with the flood affected area to identify the availability of these facilities in a future possible flood event and the inter connectivity of the available facilities. It is shown in Figure 13:58.

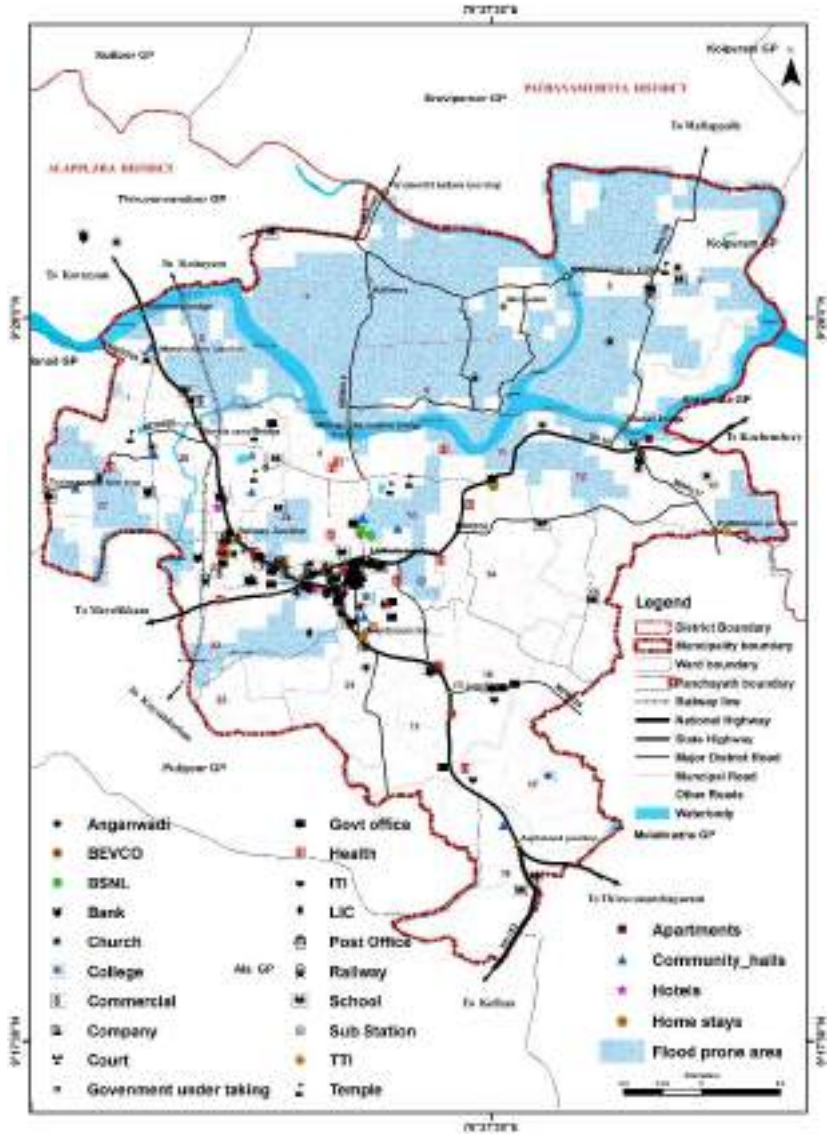

Figure 13:58 Infrastructure facilities in town within flood affected area

13.5.1 Relief camps

The 2018 flood event, which made to urgently relocate more than 10000 people in town was managed by the officials and this unpredicted event made them to find and arrange 28 relief camps which falls within the Town area. It includes temples, Churches, Auditorium halls, Schools, Colleges, etc. Those camps are spatially represented in Figure 13:59.

All of these can be used in case of possible hazards, but the nature of its usual purpose is a matter of concern while thinking of permanent relief camps for addressing any future

possible hazard events. It is always good to avoid any ground level of buildings while selecting for the flood relief camps on low laying areas, and buildings in elevated areas and those outside flood prone regions should be considered as a first priority. The school, college buildings, auditoriums, community halls, high rise buildings, public buildings in elevated areas and outside flood prone region can be developed as possible relief shelters and its infrastructure facilities needs improvements as and when required with the consideration to accommodate maximum number of people during any possible future hazards. The basic infrastructure facilities of these buildings are to be strengthened to attain the full functionality.



Figure 13:59 Location of Relief camps functioned during flood 2018 vs flood affected area

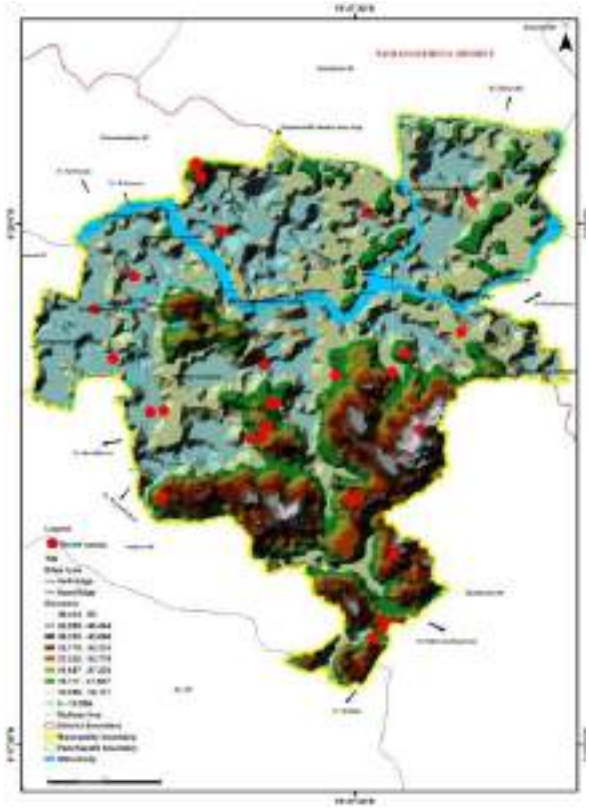

Figure 13:60 Location of Relief camps functioned during flood 2018 vs elevation profile map

On analysing the camps with respect to elevation map, it can be seen that the relief camps which were functional during 2018 flood were on comparatively elevated places or having multiple storeys. The relief camps which fall outside flood prone area are listed below:

Table 13-25 Rilief Camps of 2018 Outside Flood affected area

Sl no.	Name of Camp	Sl no.	Name of Camp
1	St. Mary's LP School	9	SNDP Union Office
2	IPC Hall	10	E.A.L.P School
3	SBS Camp Centre	11	GOVT. ITI
4	SCRV UP School	12	Christian College
5	Govt Boy's School	13	GOVT HSS
6	Govt. Girl's School	14	MMAR Residential School
7	IHRD College	15	St Annie's school
8	YMCA Hall	16	Pandavan Para Community Hall

13.6 Inference

Flood and draught are the major identified natural hazards in town. More than 60% of total land area of town is flood prone and the town is classified as 'moderate draught' area. While the low-lying areas are flood prone, the elevated areas face water scarcity and severe draught situations during summer seasons which shows high vulnerability of town to natural hazards. Any development without considering these aspects would not be sustainable.

14 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.

14.1 Summary of Findings

14.1.1 Regional Setting

Chengannur Municipality is the Second Order settlement in the district based on the state urbanization report of Kerala 2012. The connectivity patterns show that Chengannur town, being one of the revenue divisional headquarter and commercial center serving the entire district, acts as the second 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 Chengannur Municipality. Functional character of Chengannur Municipality shows that it exhibits rural character. The LSGI's surrounding Chengannur except Puliyoor are also rural in nature. Chengannur is the commercial hub of adjacent local bodies. The town is well connected to the other parts of the district and State.

14.1.2 Demography

The total population of Chengannur Municipality is 23,466 which is about 1.10 % of the total district population of Alappuzha. Population growth rate of the town as well as the district is gradually declining. During 2001-2011 the decadal growth rate of population of Chengannur town is -7.6 which is very low when compared to the district average of 0.88. Chengannur Municipality has the least population density comparing with other urban centres in the district. Its population density is 1607. The ward wise population density varies from 672 to 4456. According to 2011 census, sex ratio of Chengannur Municipality is 1146. This sex ratio is second highest among the municipalities in Alappuzha district. The literacy rate is higher than the state average and district average. The household size is lower than the state & district average.

14.1.3 Employment

The total number of workers in Chengannur 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. It is observed that rural area of the Municipality is also slowly withdrawing from primary sector and is leaning more on service sector. The shift in occupational structure is conspicuous.

14.1.4 Land Use

From the analysis of land use it is observed that about 46 % 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. There is no major industry in the town and the industrial land use constitutes only 0.35 % of the municipal area. As per the land use, 27.43% of land belongs to Dry cultivation, 7.78% for the paddy, transportation is 2.74%, commercial uses are 2%, water body is 5.59%, Public and semi public land use is 5.68% respectively.

35.21 % (Paddy 7.78 % +Dry Cultivation 27.43 %) of land under agriculture shows scope for agricultural allied activities. On analyzing the residential landuse of Chengannur Municipality, it is seen that majority of the residential land comes under the category of residential cum agricultural area. This means that more than half of the residential land in Municipality has potential for dry land cultivation.

The major urban activities of the town like higher order commercial establishments, public buildings etc. are concentrated in the central part of the town. The percentage of industrial use is far below the suggested UDPFI standard. Non agriculture activities are concentrated around the central part of the town and the agriculture activities are scattered throughout the town.

14.1.5 Economic Aspects

A. Tourism

Chengannur is a transit point for Sabarimala pilgrims. Sree Mahadevar temple one of the focus points of pilgrims from distant places for refreshment and for religious rituals before moving to Sabarimala temple. Many other traditional religious places are in the town. Pandavan Para is a tourist point in the town. Presence of River Pamba can be used for water tourism. The town is well connected with tourist centers in the neighbouring areas. It can be developed as a tourist transit point by considering its location in between tourist centers and pilgrim centers.

Number of people are coming to Chengannur during Sabarimala Mandala-Makaravilakku season time, and this makes Chengannur as an Edathavalam of Sabarimala and the pilgrim's hospitality and facilities must be catered for. 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. Areas having tourist potential are not developed so as to attract tourists. This potential can be tapped through proper planning without harming the environment and local residences.

B. Trade & Commerce

Chengannur Municipality is a second order settlement in the district. The town therefore has to cater the higher order requirements of a wider service area, covering immediate surrounding Grama Panchayats of Pandanad, Thiruvanvandoor, Ala, Puliyoor and

Mulakkuzha. Commercial facilities are seen mainly in the town centre and as ribbon development along the major transport corridors. Commercial nodes within the town are mostly characterized by congestion due to vehicular and pedestrian traffic beyond the capacity of the existing facilities. First order commercial activity is seen in the Bethel Junction. Angadickal Junction, ITI Junction, Mundankavu Junction, Bethel Junction and Puthenkavu Junction are the other nodes with significant commercial activities. The main market complex in Chengannur town is situated at Bethel Junction and is very congested.

C. Agriculture

Rubber and Mixed crops are the major cultivation in the Municipality. Agriculture produces 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 unavailability of labourers. The Sasthampuram market is the main market within the Municipality that sells the agricultural products. Even though scope for irrigation facility is available, agriculture sector is in a declining stage. Major portion of paddy fields are remaining uncultivated or used for cultivation of crops other than the paddy. Agriculture has not become organized and is not being done on a professional basis.

D. Animal Husbandry

Animal Husbandry sector is weak in Chengannur Municipality. However, there is a possibility for developing the sector with creation of adequate infrastructure in the sector. In poultry sector efforts may be made 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.

E. Industry

The existing industrial base of the town is not very strong, mainly due to lack of entrepreneurship and cultural orientation towards out migration to Middle East and European countries for employment. However, the town has potential for growth in house hold industrial units which are a need of the hour in view of the anticipated changes in the employment pattern in the Middle East and elsewhere. Efforts to regain the status of the town as a trading centre of agricultural produces will open out chances of value addition units.

F. Fisheries

The Municipality has no coast line and hence fishery is not an important sector of economy of the Municipality. Even though the Municipality has rivers flowing through it, the fishing sector is not prominent.

14.1.6 Traffic & Transportation

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 MC

road passing through the town is overcrowded. The situation in the State Highway is also not different. 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 centres is another issue to be tackled. The number of passengers travelling by bus is more. It could be inferred that 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. There is no space for loading and unloading of goods. For that a proper truck terminal is needed for the development of trade and commerce in the town.

14.1.7 Physical Infrastructure

A. Water Supply

As per planning standards and data received from KWA, the quantity of water supplied is sufficient. According to the study, well is the main source of water. Ground water table level is low in certain areas open wells are not efficient in meeting water demands and they depend completely on the government water lines. Proper water supply schemes must be initiated to meet water demands especially during the summer season.

In addition, uninterrupted supply of potable water has to be ensured as part of efforts for improving the quality of life of the people. Proposals under water supply sector have to be evolved in this consideration. The existing water supply schemes in the area are inadequate and there is much scarcity for water throughout the year in areas of high elevation and especially in Sabarimala festival season as it needs to cater the demand of floating population too.

B. Drainage

The drainage network of the Municipality needs total revamping. There should be a planned provision of roadside drains for all the inner area roads. 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 natural drainage channel revival has to be taken in consideration.

C. Sewerage System

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. The general practice in Chengannur town for disposal of sewage is to resort to septic tanks. However, many households still adopt soak pits, E.S.P type/two pit latrines etc. it is noticed that there are a few houses even without sanitary latrines particularly in the slums. A major share of this untreated waste water ends up in the canals causing foul smell and water pollution. So, a public sewerage system is needed.

D. Solid Waste Disposal

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. Most of the solid waste is disposed off on the personal compounds of residents.

E. Energy

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.

14.1.8 Social Infrastructure

A. Education

The conventional educational facilities in the town, especially at the school level are commensurate with the population of the town. There is only one professional engineering college & two ITI's are in the town. Basic educational facilities available in the Municipality are sufficient in quantitative terms. But in Qualitative terms the facilities are below standard.

B. Health

There is no super specialty hospital in Chengannur Municipality. Hence the people have to depend on hospitals outside the Municipality. Major problem in the health sector is the inadequacy of facilities in the hospitals. Most of the hospitals are in private sector affecting the affordability of health care. The infrastructure facilities are to be upgraded in the hospitals for Ayurvedic and Homeopathic systems.

C. Recreational Facilities

The recreational facilities in the Municipality are not adequate to cater to the present population leave alone the target 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. There are no public open spaces or public play grounds or stadium in the town. Only one cinema theature functioning in the town. There is one municipal library in Railway Station ward. Chengannur badly lack a place for conducting cultural events and fairs.

D. Other Civic Amenities

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.

E. Housing

In Chengannur Municipal area the housing sector as such do not show any serious problems. Only 6.1% of the houses in the Municipality are kutcha/huts. 93.9% of houses are in pucca or in moderate condition. 99% of people reside in their own land. Only 1% of people live in rented or lease buildings. There is no shortage of houses in the municipal area at present. But there is a need to replace the 567 kutcha houses with pucca houses. This 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 severe. There are 10 listed slums in Chengannur. In all the above human settlements 251 families are residing. Lack of drinking water facilities, lack of sanitation facilities and absence of internal roads are major problems.

14.1.9 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 Cast and Scheduled Tribe people. As the disaster risk concerned, there should be an action plan for the protection of slums and colonies in the Municipality.

14.1.10 Environment

Town is not much polluted, because of the very less industrial development. Pollution of natural drains passing through the town. The Municipality has a total extent of 1.0167sqkm of paddy. Only a fraction of this area is cultivated. Poomala chal- Kuttankeri chal, Vengoor padi- Pampanadi thodu, Vettuthodu and Illimala-Moozhickal thodu etc flowing within Municipality limit. 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.

14.1.11 Disaster Management & Risk Assessment

Flood and draught are the major identified natural hazards in town. More than 60% of total land area of town is flood prone and the town is classified as 'moderate draught' area. Any development without considering these various risk factors would not be sustainable. The wards are classified in to various risk zones based on flood hazard, and the result showed that 17 out of 27 wards in town area are in moderate high to high-risk zones. While the low-lying areas are flood prone, the elevated areas face water scarcity and severe draught situations during summer seasons which shows high vulnerability of town to natural hazards.

14.2 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 6 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

14.2.1 Regional & Demographic Aspects

STRENGTH	WEAKNESSES
▪ One of the revenue divisional head quarter of the district. ▪ Commercial hub of adjacent local bodies ▪ Good road & rail connectivity ▪ The household size is lower than the state average and the district average. ▪ Least population density among the municipalities of the district.	▪ Population growth rate is declining.
OPPORTUNITIES	**THREATS**
▪ The literacy rate is higher than the state average and the district average ▪ WFPR is increasing ▪ 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.

14.2.2 Economic Aspects

STRENGTH	WEAKNESSES
▪ Immense potential for development of tourism sector with a clean and beautiful environment. ▪ Presence of Paddy Fields. ▪ Soil Suitability for Agriculture ▪ Land availability for homestead farming ▪ Scope for value addition of Agricultural products	▪ 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. ▪ Market area is very congested and it doesn't have proper waste disposal and drainage facilities.

	▪ Insufficient space for parking, loading & unloading ▪ Animal husbandry sector is very weak
OPPORTUNITIES	THREATS
▪ Potential for development of waterfront tourism. ▪ Agriculture has not become organized and is not being done on a professional basis.	▪ Pollution of waterbodies affect tourism & Environment.

14.2.3 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
▪ Proposal of By-pass Road ▪ To improve public transport operations, parking facilities.	▪ Unavailability of land for future developments.

14.2.4 Physical Infrastructure

STRENGTH	WEAKNESSES
▪ Presence of canal and drainage networks. ▪ Electricity supply systems are in good condition.	▪ The coverage of drainage and sewerage network is very poor. ▪ Improper waste collection and disposal methods ▪ 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.	▪ Existing water supply distribution pipes are very old. ▪ Depletion in Ground water level

14.2.5 Social Infrastructure

STRENGTH	WEAKNESSES
▪ High literacy rate within the Municipality. ▪ Sufficient number of educational institutions	▪ Recreational facilities in the town are inadequate. ▪ No super speciality hospitals. ▪ Inadequate of facilities in hospitals ▪ Infra structure facilities are less in slums of the Municipality
OPPORTUNITIES	THREATS
▪ Scope for providing higher order facilities to cater the service population including the nearby local bodies ▪ To use the possibilities to improve the healthcare facilities.	

14.2.6 Environment

STRENGTH	WEAKNESSES
▪ Presence of River, Canal etc. ▪ Presence of paddy fields and wetlands. ▪ Presence of micro watersheds.	▪ All the canal stretches are contaminated. ▪ Lack of drainages leads to flood proneness of the area ▪ Missing links and encroachment of natural drainage channels ▪ No scientific methods for the treatment of solid and liquid wastes.
OPPORTUNITIES	THREATS
▪ Improving and upgrading environmental quality can substantially improve the urban environment and quality of life.	▪ In the event of overflow of river, 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.

15 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.

15.1 Development Approach

As per District Urbanisation report, Chengannur Town is an existing second order settlement in the region with its surrounding panchayaths as fourth order settlements. The Bethel junction in Chengannur is an existing third order node in the eastern region of the district to provide higher order facilities for this region. DUR also shows that most of its service areas are having primary activity. The town is also the headquarters of Chengannur Revenue Division, which is one of the two revenue divisions of the district. These factors imply that Chengannur has to act as a sub-regional centre at the eastern part of the district, which caters to the higher order service requirements in the region for its entire service area including surrounding Grama Panchayaths. The existing town centre is based along the M.C. Road which provides greatest accessibility to the entire town and to the passing trade. The comparative high density residential areas are located adjacent to the other major district roads in town.

The major development strategy is to take advantage of the M.C. Road and Mavelikkara- Kozhenchery Road, so as to create a town which has direct access to high quality road infrastructure which links to nearby service areas. It will be useful to provide supporting facilities to major economic development activities like agriculture, animal husbandry and allied activities, tourism, along with the aspects of flood disaster resilience. Chenagnnur, The Gateway of Sabarimala, also has a scope of development in terms of pilgrim and heritage tourism. The other possible tourist attractive areas in the town can be together developed to make tourism as one of the major economic generating activities.

Spatial distribution of higher education facilities in education sector of the region shows that existing facilities of the town suffices in the region. In general, Chengannur is a major commercial center of the region which provides higher order facilities of commercial, Institutional, Public and semi-public uses, etc. The presence of Pampa River and other natural drains always address the possibility of a future flooding and the town will always be ready to face any natural treats or hazards that might happen in the future. The flood resilience along with economic and environmental sustainability are the major concerns of the town development approach.

15.2 Development Vision

The vision has been built on the three pillars of development which are economic growth, quality of life and environmental sustainability along with the concept of risk informed master plan. The prime challenges identified are proper traffic and transportation system, environmental conservation, park & open spaces, provision of basic infrastructure like water supply, sewerage system, solid waste management, storm water drains, health and

housing. However, the priority is adequate provision of basic infrastructure along with mitigation of disaster risk which needs to be addressed as the prime challenges towards attaining a sustainable development model.

This master plan is created with the aim of not only providing inhabitants a better quality of life and improved environment but also to furnish an apt, sustained and effective development of the town as well. The problems & potentials existing in the area and the conclusions & recommendations of sectoral studies are also considered for the formulation of development vision. During 2018, Chengannur region has faced a flash flood which made severe hardship to people in the region. Hence mitigation of this disaster risk is the major concern & vision of our risk informed master plan.

Considering this reality, the development vision of the town is defined as:

"***To develop Chengannur as a flood resilient, environment friendly and ecologically sustainable town with focus on strengthening of the economic base, improvement of the urban infrastructure facilities and quality of life of its residents at all levels.***"

Figure 15:1 shows a pictorial illustration of the development vision for Chengannur town.

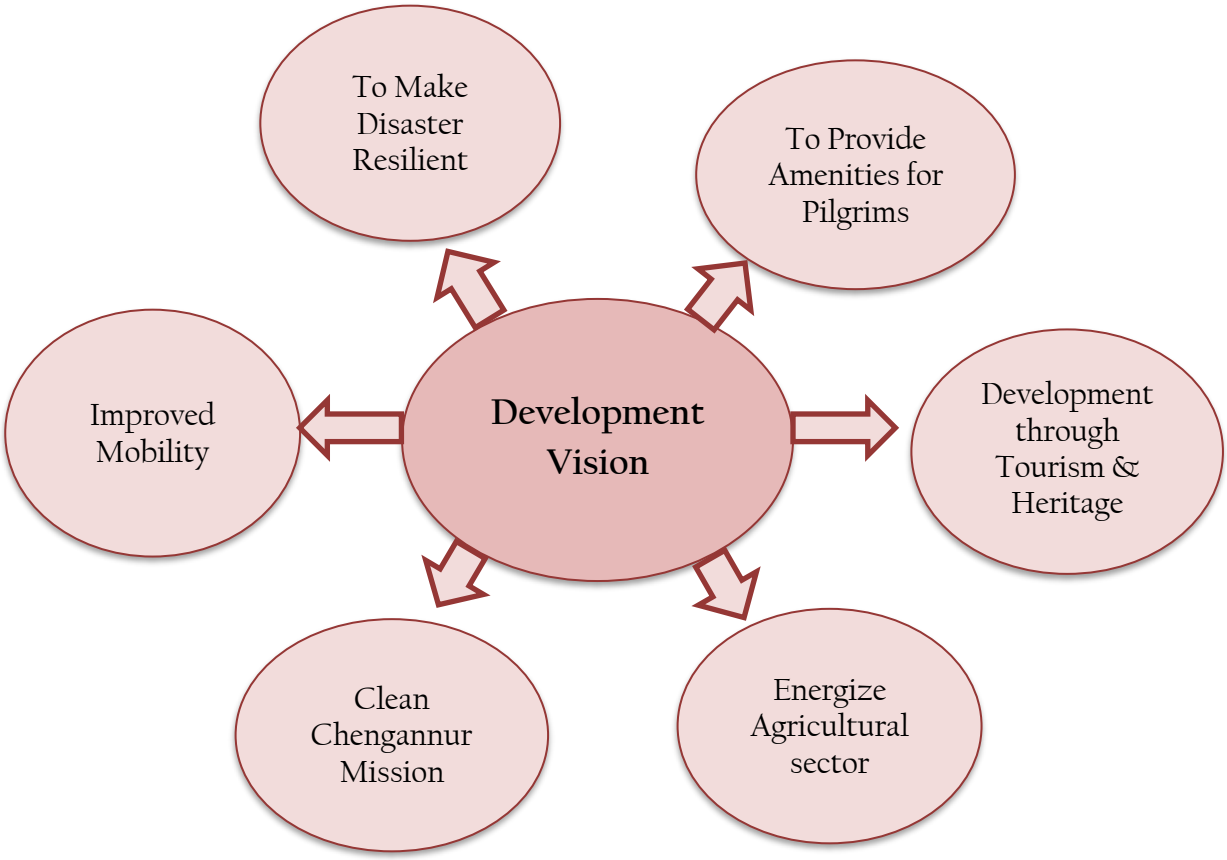

Figure 15:1 Development Vision for Chengannur Town

15.3 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 and the various sectoral analysis, local level analysis and spatial analysis.

The following development goals & objectives are formulated for developing Chengannur into a vital town in the social, economic and administrative scenario of the state, 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 Chengannur as a flood resilient town

- Setting up disaster response team and early warning system
- Introducing landuse zoning & regulations and building codes for flood resilient constructions
- Do not disturb the natural flow of any water course either by land development or by construction activities
- Widening and deepening of Pamba channel will improve the carrying capacity of the river and flood effect can be reduced.
- Identifying and zoning river buffer area.
- Removal of blockage in canals (Illimala-Moozhikkal Thodu, Vettuthodu etc) running through the Municipality and maintain the flow in it.
- Cleaning of drainage lines of Municipality before monsoon every year.
- Prohibiting the practice of dumping of solid wastes into the rivers and canals. This majorly affecting the water carrying capacity of the river.
- Increase public awareness in regards to the protection of the environment.

2. To develop the town as Edathavalam by providing Pilgrim Amenity centres

- Provide better residential facilities around railway station, bus stand and Mahadeva temple
- Construct public comfort stations
- Provide beter public transportation systems
- Provide good quality drinking water
- Provide prayer hall for religious ritual activities

3. To develop the tourism and heritage potential of the town

- Promote tourism through development of related infrastructure and create a tourism circuit covering important destination within the town
- Provision of an efficient traffic and transportation network with regional connectivity.

- Ensure round the clock cleanliness in tourism spots.
- Architectural importance of Chengannur Mahadeva temple and Pazhaya suriyani pally are to be projected.
- Scope of water front tourism is to be promoted.

4. To promote agriculture & allied activities in and around the town

- Promotion of Homestead agricultural activities and bio-organic farming, etc.
- Promotion of Paddy Cultivation
- Encourage youngsters and farmers to agriculture sector with the help of agriculture department through Krishi Bhavan with innovative technologies and scientific methods of farming
- Promoting industrial and agriculture activities by using the available resources and by providing sufficient infrastructures and development of marketing facilities.
- Promote value addition products under agriculture and animal husbandry sector.
- Formation of Labour Bank and Farmers Group
- Provide subsidy, seeds and compensation for agriculture productivity losses

5. To ensure healthy living condition through Clean Chengannur Mission

- Create awareness among the people about existing environmental problems and train them to restrict the use of harmful resources
- Basic sanitation facilities to be ensured for each and every citizen of the town.
- Prepare and implement a comprehensive Solid Waste, Sewerage and Drainage Plan
- Programmes for controlling the use of plastic and such non-bio degradable materials to be highlighted.
- Implement Urban forestry /Social Forestry and promote bio-diversity conservation
- Improve urban aesthetics

6. To improve the connectivity and Traffic & Transportation facilities of the town

- 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 also reduce pollution of atmosphere.
- Widening of existing major roads in the town
- Introducing bypass road for reducing the traffic.
- To create adequate parking spaces as an integral part of commercial, industrial and institutional planning and development
- Spatial improvement of main Junctions in the town
- Create green walkways, pedestrian friendly streets, cycle tracks.

16 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 risk informed master plan is formulated based on the results of flood vulnerability assessments, flood prone regions in the Municipality, existing land use, activity pattern, and conclusions arrived from sectorial studies and the different development objectives. Development objectives spatially located provides the development concept of plan. The development concept will clearly indicate how the Municipality area will develop in future with the possibility of occurrences of different hazards especially flood.

As per District Urbanisation Report of Alappuzha, Chengannur is the second order settlement in the district and the service area is the surrounding grama panchayats. Hence Chengannur shall be developed with higher order facilities through proper infrastructure improvement along with the concept of disaster preparedness and flood mitigation measures.

The key development aspects of the plan area identified through detailed analysis of flood vulnerability, existing transportation network, commercial activities, industries, tourism and agricultural activities. Development concepts of the above sectors are integrated to evolve the development concept of the planning area.

16.1 Spatial distribution of activities

Spatial distribution of activities is obtained by interpolating the concentration index and land use pattern by ranking. Agriculture or primary activity dominates in the outer wards on northern and south eastern sides, secondary activity is seen in ward 18 and tertiary activity is seen the central parts of the Municipality. Corridor development of urban activity is seen expanding along the M.C. Road and also along other major roads.

Activity pattern for Chengannur Municipality is shown in Figure 16:1, Urban activities are seen mainly along the major roads of the Municipality. Corridor form development of urban activity is seen along the M.C. Road and Mavelikara-Kozhencherry Road. Along MC Road it is seen expanding towards north and south of the M.C Road and it started to develop along the west and eastern direction along



Figure 16:1 Activity Pattern for Chengannur Municipality

Mavelikara- Kozhencherry Road. CBD area is where the state highways meet and the major traffic nodes like bus stands, railway station are present. Public use dominated mixed activity is seen along the major roads. Residential activities are concentrated on the immediate surroundings of these two activities. The agriculture activities and low-density residential developments are in the western central part of the Municipality. Agriculture activity dominates in the outer wards ie, along the periphery towards north east and south east.

16.2 Population distribution

Spatial distribution of population is in such a way that high density is seen around immediate surroundings of CBD Area, along the State highways and major district roads. Agriculture dominated area have less population density.



Figure 16:2 Population distribution of the town

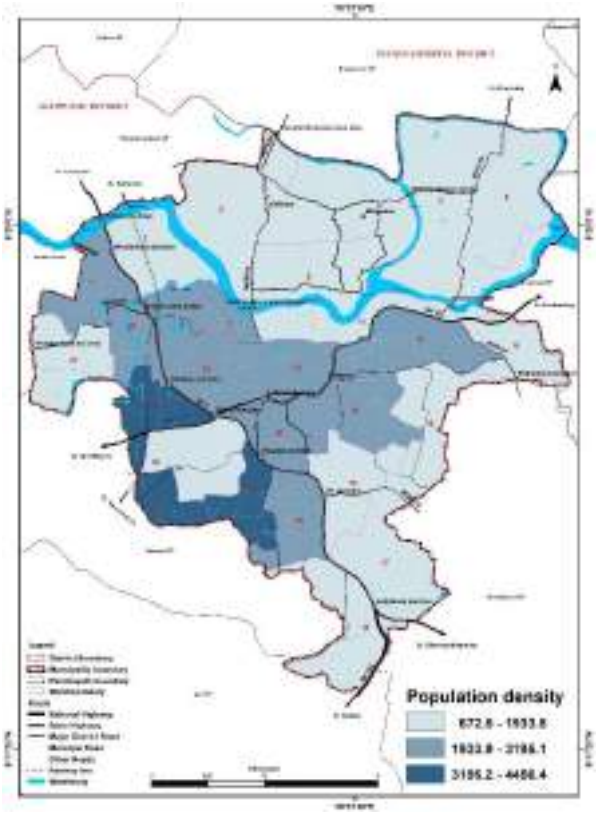

Figure 16:3 Ward wise Population Density of town

Source: Census Data 2011

16.3 Geographic profile of Municipality

The contour profile of the Municipality shows that south and south east sides of the Municipality boundary are elevated portions with steep slopes. Northern portion is the lowest portion where mainly wet lands and water body exist. The elevated portions are mainly occupied by residence and other mixed activities. Figure 16:5 shows the contour and slope profile of the Municipality.



Figure 16:4 Contour map of Chengannur Municipality

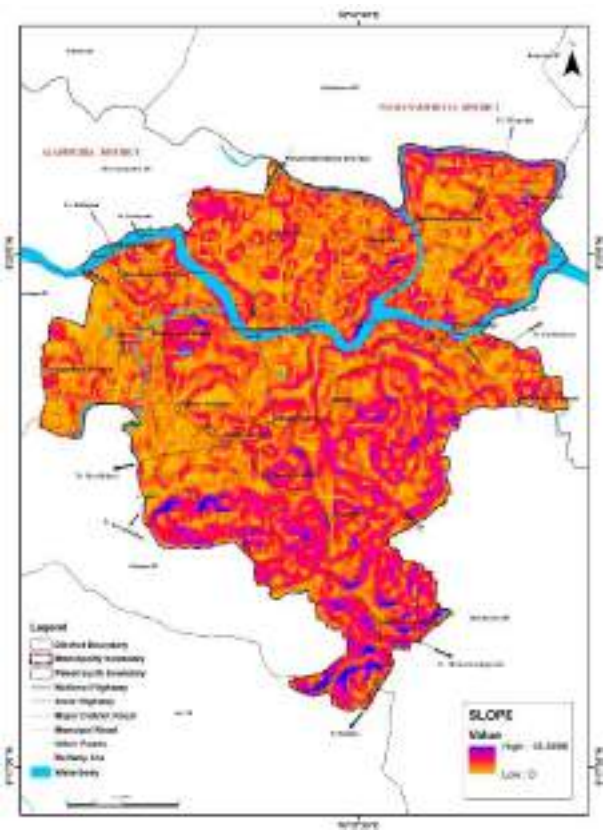

Figure 16:5 Slope Profile of Chengannur Municipality
Source: LRIS

16.4 Ecological sensitive areas

The Paddy fields, marshy land, and water bodies are taken into account considering its environment importance as shown in Figure 16:6. The paddy field is found near the river and natural drains connecting these lands to the main channels are present in Municipality. The water from the elevated areas finally reaches these existing paddy/wetlands and these acts as collection basins of water during rains which helps in ground water recharging and hence these are to be protected. All environmentally sensitive regions including water bodies, paddy/ wetland, etc. are excluded from future development potential zones to prevent its conversion to other land uses. The flood hazard risk zones are identified based on these land uses, and it is being identified and included in less human intervention zones.



Figure 16:6 Location of Environment sensitive areas

16.5 Major roads and nodes

Chengannur is well-connected by road and rail. State Highway 1 (SH-1), popularly known as the MC Road, passes through the heart of the Municipality and connects Chengannur to Thiruvananthapuram and Kottayam. The Chengannur - Kottayam stretch of the MC Road is also part of the NH 220 which stretches between Kollam and Theni. Another major road is the State Highway 10, the Mavelikara – Kozhenchery road, which connects Chengannur to Mavelikkara and Sabarimala. Besides these two roads, there are also many arterial roads running across the length and breadth of the Municipality.



Figure 16:7 Major nodes of Chengannur Municipality

The major nodes Figure 16:7 in Chengannur are in the order:

- Bethel Junction – 1st Order
- ITI Junction – 2nd Order
- Railway Junction – 3rd Order
- Hospital Junction - 3rd Order
- Althara Junction - 3rd Order

Main roads were identified and prioritised based on their importance in regional & local level and traffic flow through them. Connectivity exists to all nearby areas through existing roads.

16.6 Existing spatial structure

The existing spatial structure of the Municipality is observed as shown in Figure 16:8 by considering major roads, nodes, activity pattern and eco sensitive areas like paddy/wetlands and water bodies. Municipality Centre, urban activities (Commercial, Public and semi-public) with high density residential developments, residential area, residential with home stead cultivation, (low density residential area cum agriculture area / residential agriculture mix area), public activities, agriculture activity, environmentally sensitive area and commercial nodes are the major components of existing spatial structure.

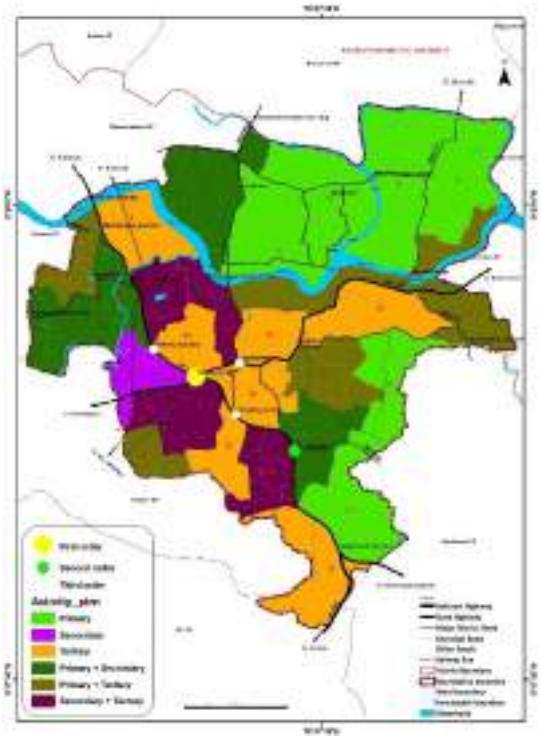

Figure 16:8 Existing Spatial Structure

16.7 Concept of future development

Concept for future development and land use is formulated by considering and coordinating the following different factors. Flood vulnerability assessment, Population distribution and environmentally sensitive areas in the Municipality are considered for formulating the development concept together with the consideration of the different sectors of possible future development in Municipality.

16.7.1 Concept based on Flood vulnerability and mitigation measures

The flood vulnerability assessment of the Municipality based on past 2018 flood occurred, has identified the high, moderate-high, moderate-low and low risk wards in the Municipality. These moderate high and high-risk areas of Municipality need to be considered before arriving at any future concepts for development. The flood prone areas and ward level flood vulnerability map of town is shown in Figure 16:9 and Figure 16:10.



Figure 16:9 Flood prone area of chengannur town

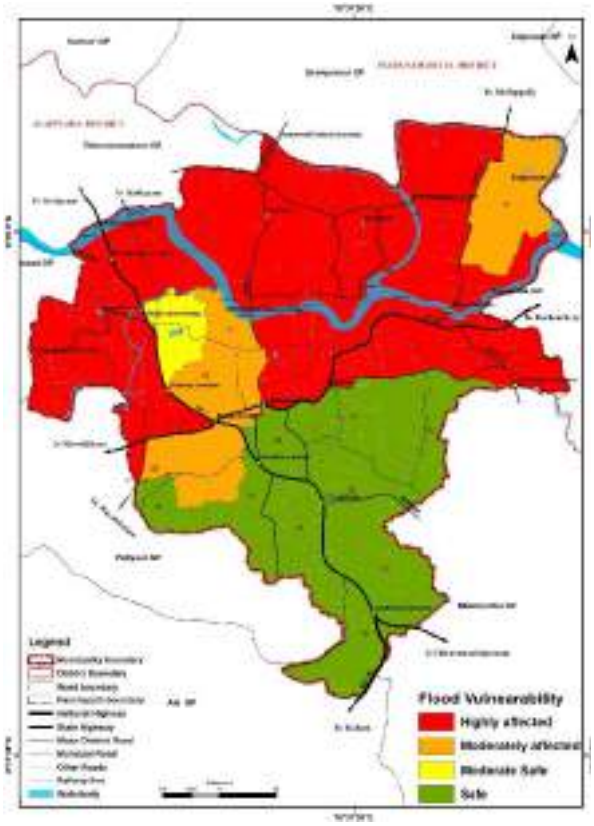

Figure 16:10 Flood vulnerability/ risk level of different wards

The northern side of the Municipality is highly prone to flood, whereas the southern side is comparatively free from the risk of flood. Though the southern area is not lying in the flood plain, flood water reaches these areas also because of the improper management of drains and channels. The high-risk wards and areas identified as flood prone are to be demarkated and it needs guideleines/measures to reduce the human intervension considering the vulnerability level.

16.7.2 Concept for Commercial Area Development

Existing commercial activities are seen along the sides of MC road and Mavelikara – Kozhenchery Road. The existing commercial area in the municipal core region is retained and considered as central business District (CBD) of the Municipality and the area around the CBD is proposed with mixed activity of commercial, public and residential with expansion mainly towards North-South direction along M.C. Road, and east-west direction along Mavelikara – Kozhenchery Road.

The commercial stretch is mainly seen along the MC road and SH 10. The major junctions are Anjilimood junction, ITI junction, Hospital junction, Bethel junction and Vellavoor Junction. Bethel junction acts as the main centre for the entire Municipality. Vellavoor and Hospital junction can be developed as sub centres for the area.

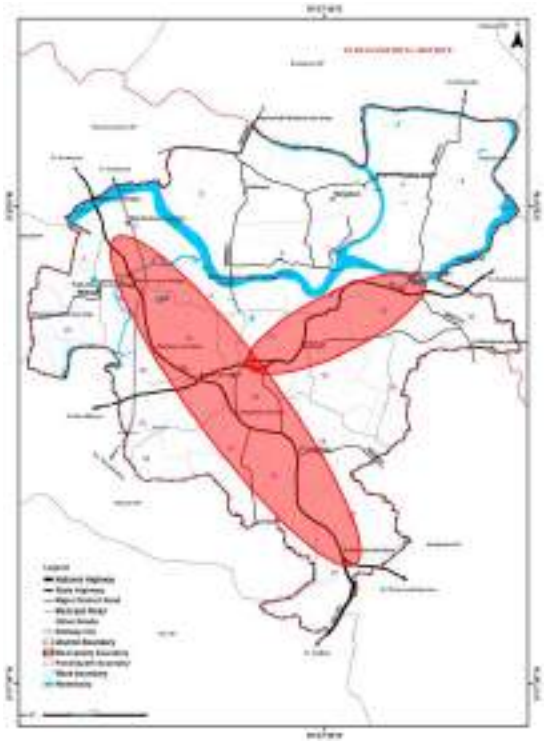

Figure 16:11 Concept for Commercial Area Development

16.7.3 Concept for Tourism Development

There is potential for tourism to be developed as a major economy generating sector in Chengannur Town. As Chengannur is an Edathavalam of Sabarimala pilgrims, Sree Mahadevar temple and other neighbouring temples can be developed as a seasonal tourism centre. The presence of other famous religious centres and cultural monuments with its importance can be added in tourism map. Pandavan Para in the town can be incorporated in a pilgim tourism map considering the various religious beliefs related to it and the scenic beauty of the place. All supportive basic infrastructure facilities should be developed around it with consideration to the local inhabitants. Presence of River Pamba in the town is a potential for water sports and related activities. River pollution should not be happened due to these activities. A tourism plan can be formulated considering the tourism potential of town and by integrating with the tourism sectors of Alappuzha, Kayamkulam and Kuttanad Area.

16.7.4 Concept on Agricultural Development

Agriculture sector contributes economy for the Municipality. In Kerala, for food products people are depending on neighbouring states. Usually imported food produces contains toxic pesticides and other harmful substances. People of Kerala are aware of harmful consequences of consuming these products which are commercially shipped from other states and started opting for organic food items. Demand for domestically cultivated vegetables and crops are on the rise. By promoting and propagating organic farming, economic status of the Municipality can also be elevated.

Mixed crop cultivation is active in the Municipality. Grow bag cultivation can be widened in the Municipality. The loss of wet land in the Municipality can be controlled through usage of proper agriculture data bank. The land development should be restricted by proper management system. In order to achieve the target, agricultural department has to provide training on various modern and innovative methods of cultivation to the unemployed youth and traditional farmers.



Figure 16:12 Concept for Agricuture Development

For the efficient and profitable paddy cultivation, it is suggested to strengthen the group farming activities in paddy lands. The growth in paddy cultivation can be achieved only by the collective efforts of the Municipality and farmers. Convert existing marshy lands into active paddy fields through group farming or through NGO's. Supplying high yield variety seeds, adopting new farming techniques etc. shall increase the productivity of agriculture. Create labour bank for using labours at necessity areas. Household agro industries are to promoted for agriculture activities. Revival of this sector can boost enthusiasm among unemployed and make them self reliant. The concept on agriculture development is shown in Figure 16:12.

16.7.5 Concept for Industrial Development

The major objective of developing Chengannur as an economically vibrant Municipality shall be achieved through house hold industrial development. There are no major industries in the Municipality. There is scope for starting household industrial activities and also agro based industries in the Municipality. The land use could be proposed as industrial promotional zone to cater mixed landuse development in the region with nonpolluting industries.

The concept of future industrial development is to promote non nuisance type service or engineering industries throughout the developable areas, which are not much prone to flood and doesn't harm the environment.

16.7.6 Concept for Transportation Development

Proper connectivity shall be ensured for the integration between different activity zones. A well-developed transportation network with adequate road capacity and grade separated intersections, over bridges at railway crossings where ever possible permitting continuous movement of vehicles is the concept of traffic & transportation of planning area. The M.C road and SH-10 are passing through the Municipality. Puthentheruvu Padi – Vigneswara Junction – Mangalam road is also a main arterial road.

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 organised parking facilities'.

The vehicular movements are mostly through the M.C Road. The Mundancavu to ITI junction road is having maximum traffic in the M.C Road. To bypass the unwanted traffic in the town introduction of a bypass road is also attempted. It has to be resolved by widening the existing road. By this proper mobility can be ensured. The existing junction's improvement and widening of existing main roads etc. can mitigate the existing traffic problems in the Municipality.



Figure 16:13 Transportation Development Concept

16.7.7 Concept on Recreation

Since there is a lack of recreation space in the Municipality prioritization is to create open spaces which create the ability to help manage future growth and development. The main proposals are creation of the Pachathuruthu scheme at neighbourhood level and recreational spaces such as open gym, beautification of river and related activities.

16.7.8 Conservation of Environmentally Sensitive Areas

Land use is proposed by considering constraints such as paddy/ wet land which are to be conserved, geographical character such as slopes which are undevelopable and other natural features which are to be preserved.

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.

The environmental has to be protected from pollution which includes waste disposals from residents and other forms of pollution. River tourism promotion is to be implemented without any water pollution. The conservation of sensitive areas is ensured through judicious planning. The main drinking water source of the town is Pamba River. This river is to be protected with side pitching, preferably dry rubble pitching and by declaring buffer area on its sides. Usage of plastic bags must be highly restricted or banned through adequate measures in the town.

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.

16.8 Development concept

The development concept for the planning area is formulated by physically overlaying all the above concepts on the existing spatial structure. Concept for future development and land use is formulated by considering the above factors and it can be summarised as expansion of urban activities, decentralising and decongesting of Town core, improving the economy, preserving agriculture activities and protecting environment.

The southern side of the Municipality is comparatively on the higher elevation, which is thereby less affected due to flood. More concentration of residential landuse, commercial landuse and semi public and public land use are seen on this side. The growth of commercial and public & semi-public land use can be proposed along the main road (MC road) and SH 10. On the northern side, it is seen that agricultural area is more predominant and is on the lower slope thus the chances of water entering the fields are high. The urban development of the Municipality is radially outwards in line with the major roads as shown Figure 16:15.

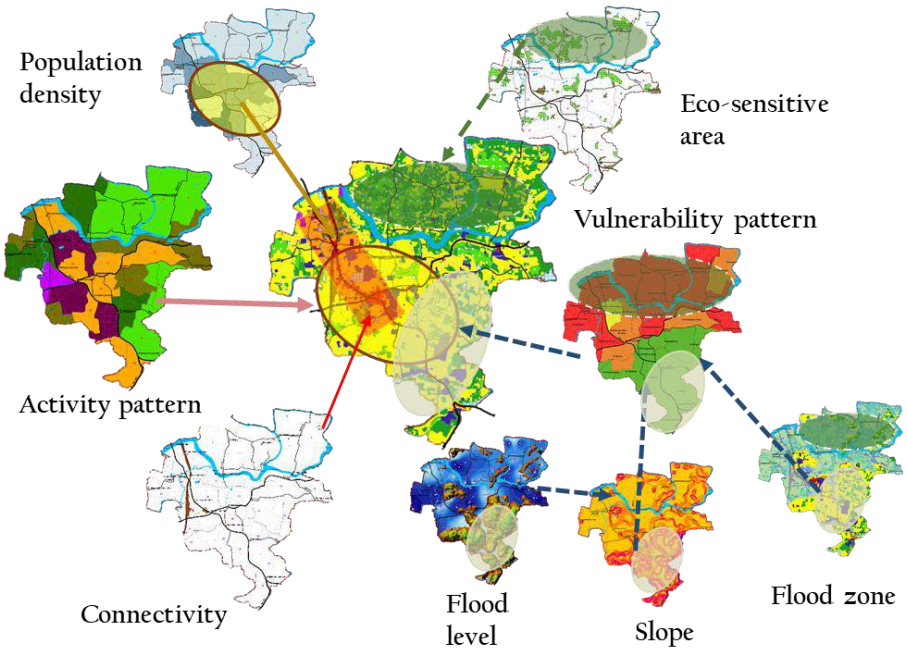

Figure 16:14 Evolution of Development Concept

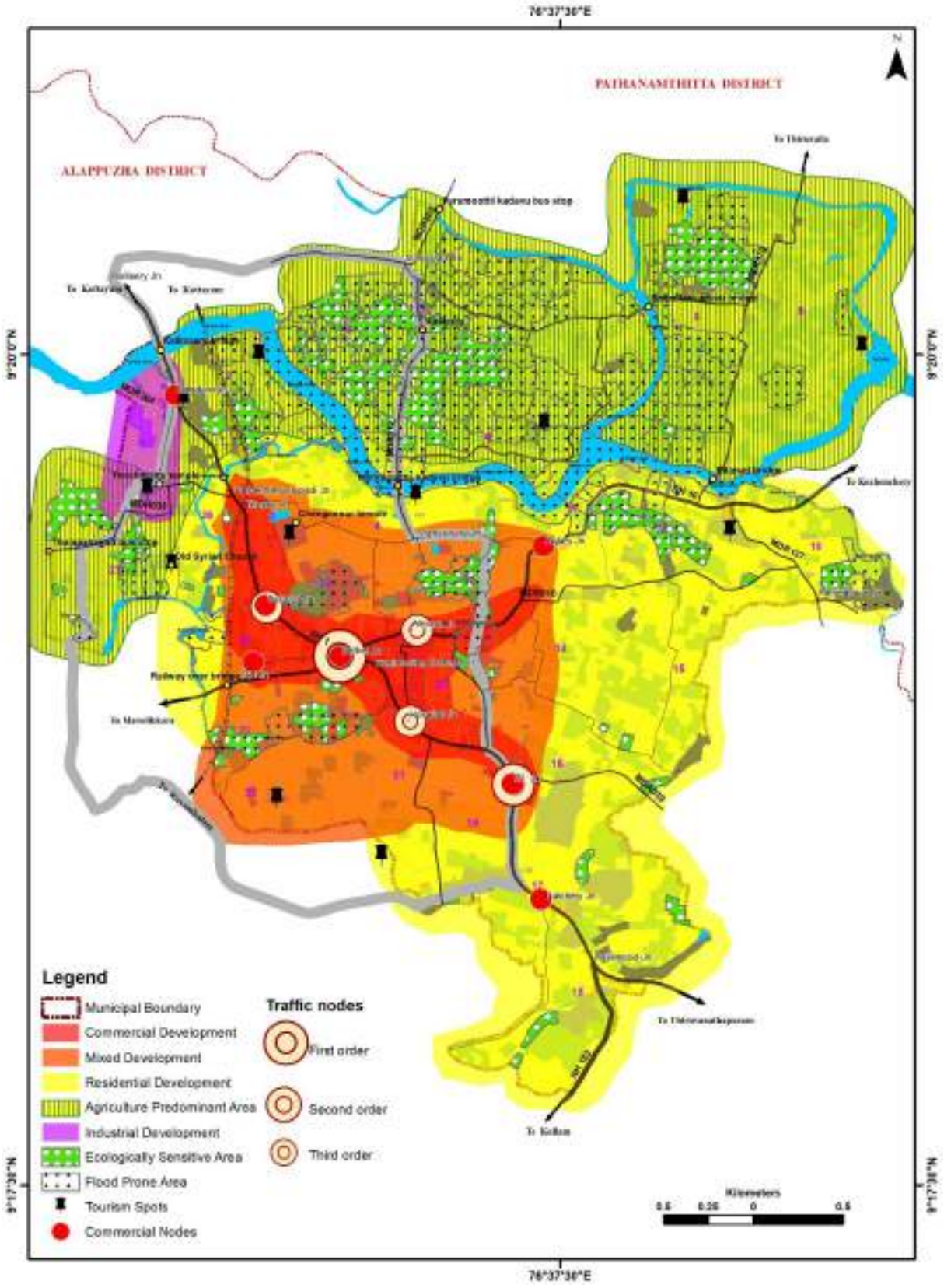

Figure 16:15 Development Concept for Chengannur Town

17 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.

17.1 General Development Policy

The general development policy is to develop Chengannur as an eco friendly town through various sectors with thrust on agriculture, trade and commercial sectors. In order to capture the potential of water bodies, promoting pilgrim tourism & water tourism is also envisaged through detailed plans. To preserve the aesthetics of the town, cultural heritage has to be maintained. The dry and wet agriculture land needs to be used properly for increasing agricultural productivity and for this agriculture promotion schemes can be envisaged. Home stead cultivation helps to promote the work participation rate as well as increases the living standard of people.

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.

As Chengannur was affected badly during flood 2018 & 2019, special attention must be given for making a flood resilient Chengannur. For that proper flood risk analysis has been conducted and updates are made for the change in land use in the flood prone areas. Proper flood plain zoning, flood forecasting and early warning system helps to reduce the impact of flood.

17.2 Sectoral Policies & Strategies

The sector wise policies and strategies for the major sectors identified for Chengannur Municipality are furnished below.

17.2.1 Tourism

Policy: *To promote Pilgrim 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 pilgrim tourist circuit at Chengannur and connect to the adjacent Tourist Places.
- Enhance the tourism potential by inter linking different types of tourism like pilgrim tourism and eco 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.
- 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.

17.2.2 Trade and Commerce

Policy: *In Chengannur, major commercial nodes are situated on the M.C. Road, main policy is to develop space for parking, loading & unloading near the major commercial centres & the enhancement of infrastructure facilities of main market situated at Bethel junction.*

Strategies:

- Improve the facilities of existing commercial centres in order to cater to the demand of service area.
- 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 produces.

17.2.3 Agriculture & 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.

- 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.
- Implement organic farming through various policy initiatives.
- Integration of homestead cultivation and animal husbandry sector.
- Improvement of existing Hatchery
- 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.

17.2.4 Industry

Policy: *To develop Chengannur as a destination for agro based industries utilizing the potential of availability of raw materials, land and labour, better connectivity, scope for exporting the products, etc.*

Strategies:

- Strengthening of marketing facilities.
- 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.

17.2.5 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, elevated corridors, scientifically designed junctions, widened roads, parking plazas, diverting through-traffic from the core town through bypass roads etc whichever is feasible for the area.

- Development and enforcement of an integrated traffic and transportation plan.
- Facilities and safety requirements of pedestrians.
- Encourage public transport system.
- Promote Non-Motorised Transportation.

17.2.6 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.
- Check on misuse of public taps, usuage of meterd connections wherever necessary.
- Restoration or conservation of existing water resources in the Municipality.
- Rainwater harvesting through well recharge and watershed management interventions.

17.2.7 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.
- Routine cleaning of drainage lines and maintain the flow in it. During 2018 mega flood, blocked drainage line raised the impact of flooding.
- 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. Creation of decentralised treatment units for solid waste management
- 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.

17.2.8 Education

Policy: *To improve the general education status of the town and diversification of courses in higher education sector so as to improve Chengannur 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 so that morestudents are attracted to governmentschools.
- 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.

17.2.9 Health

Policy: *To improve the general health condition of the people by preventive measures and to provide quality treatment through three systems of medicines.*

Strategies:

- Provide medical institutions as required per planning standards.
- Providing sufficient infra-structure facilities to the primary health centres.
- Upgradation and expansion of infrastructure facilities to the Chengannur District hospital
- Shifting of health care facilities from flood prone areas
- Providing trauma care and emergency facilities in existing health institutions.
- Arrest the spreading of epidemics through proper environmental hygiene measures.
- Introduce tele-medicine facilities with other major hospitals of the state so as to hand trauma / accident care effectively
- Health awareness Programmes.
- Centre for care of Aged and differentially abled.

17.2.10 Energy

Policy: *To provide sufficient quantity of energy and quality power to the existing consumers and new establishments.*

Strategies:

- Promoting non-conventionall source of energy like solar to the extent as possible.
- Provide uninterrupted power supply with sufficient voltage.
- Providing solar power facilities in institutions selected to act as relief camps.
- Electrification of the houses of socially and economically weaker section, especially in slums.
- Promote energy conservation practices.

17.2.11Civic Amenities and Recreational Facilities

Policy: *To provide civic amenities and recreational facilities as per standard to the residents.*

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.

17.2.12 Housing

Policy: *To improve structural condition of houses of economically weaker sections and to improve housing quality of substandard housing area.*

Strategies:

- Improvement of substandard housing area through different programmes.
- Provide adequate residential areas in land use plan.
- Introducing building codes to make houses flood resilient.
- 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.
- Housing programmes promoted should be cost effective and with environment friendly technologies and the concept of green building will be propagated

17.2.13 Environment

Policy: *To sustain environmentally sensitive areas through proper conservation mechanism and to ensure clean, green and hygienic living environment to make Chengannur Municipality an eco-friendly, disaster resilient and aesthetically pleasing town.*

Strategies:

- Strict enforcement of environmental protection acts
- Provide effective waste management system
- Monitor the waterbody pollution and maintain the pollution level within the permissible limit
- Developing parks and areas near to water bodies to promote tourism and recreational facilities.

- Environmentally fragile areas including paddy fields, ponds, canals, rivers and natural drains etc. are to be preserved/protected/restored.
- Various measures for eco restoration of environmentally fragile areas are to be adopted.
- Create awareness among local people about the importance of environmental conservation

17.2.14 Disaster Management & Mitigation

Policy: *To build a safe and disaster resilient Chengannur 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
- Capacity building including research and knowledge management.
- Preparedness to deal with disaster
- 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.

18 PROJECTED REQUIREMENTS

18.1 Population projection

The population projection for 2021, 2031 and 2041 of the town 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.

- Decreasing rate method
- Apportionment method

18.1.1 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 18-1 shows the projected population of Municipal area using decreasing rate method.

Table 18-1 Projected town population – Decreasing rate method

Decreasing rate method			
Year	Population	Growth rate	% Decrease in growth rate
1981	24862		
1991	25872	4.06242	
2001	25397	-1.836	-5.8984
2011	23466	-7.6033	-5.7673
2021	20313	-13.436	-5.8328
2031	16399	-19.269	-5.8328
2041	12283	-25.102	-5.8328

18.1.2 Apportionment method

In this method, the ratio of the Town population to the State population is found out and the same is projected to the next decades by assuming the change in ratio during 2011-2021, 2021-2031 and 2031-2041 is same the average of change in ratio during last few decades. The projected population of the town based on the apportionment method is shown in Table 18-2.

Table 18-2 Projected town population – Apportionment method

Apportionment method				
Year	District Population (x)	Municipal area Population (y)	Ratio (y/x)	Change in ratio
1981	1865580	24862	0.01333	
1991	2001083	25872	0.01293	-0.00040
2001	2109004	25397	0.01204	-0.00089

2011	2127789	23466	0.01103	-0.00101
2021	2205812	22637	0.01026	-0.0008
2031	2247042	21338	0.00950	-0.0008
2041	2295803	20042	0.00873	-0.0008

The projected total population by the above-mentioned methods differs slightly as shown in Table 18-3. The average of these two projected values is taken as the population figures of the Chengannur town.

Table 18-3 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	20313	22637	**21475**
2031	16399	21338	**18869**
2041	12283	20042	**16163**

So, it can be concluded that the total population of Chengannur town will be 21475, 18869 and 16163 on 2021, 2031 and 2041 respectively based on the projection. However, the town shall attract migration of certain population to it due to the development projects envisaged in some of the sectors. Hence, the population in the horizon year is considered to be 25000 for calculation purposes.

18.2 Sectoral projections

18.2.1 Estimation of labour force for 2031

Chengannur town is expected to accommodate 25000 populations by the year 2041. In 2011, 56 % of the total population of the district was in the age group of 20-59. As no up-to-date data of the age structure of the town is readily 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 14000.

Sex ratio for age group 0-6 in 2011 is 894. So, the working age group population can be divided into 7391 males and 6609 females.

In 2011 the percentage of female workers to the female working age group population is (2097/12532) x 100 = 16.7%. Assuming that this participation rate will improve to 25% due to the increased literacy rate and job opporunities, female workers as on 2041 will be 6609 x 25/100 = 1653.

Total number of workers = 1653 + 7391 = 9044

Proposed distribution of workers

Primary labourers:

In 2011 the number of primary labourers is 519. It is 7.15% of the total labourers. Considering the strengthening of agriculture sector, we can assume that 15% of total labourers will come under primary labourers.
9044 x 7.15/100 =**1357**

Secondary labourers:
In 2011 the number of secondary labourers is 235. It is 3.24% of the total population. Considering the strengthening of agro based industries in the area, we can assume that 7% of total labourers will come under secondary labourers.
9044 x 7/100 =**633**

Tertiary labourers:
In 2011 the number of tertiary labourers is 6508. It is 89.62% of the total population. Considering 15% workers in primary and 7% workers in secondary sector, we can assume that 78% of total labourers will come under tertiary labourers.
9044 x 78/100 =7054

18.2.2 Trade and Commerce

A total labour strength of 7054 is required to be accommodated in the Master Plan area. It is assumed that a density of 150 workers/hectare of land is required.

Area required = 47.02 Ha

As per existing land use survey commercial area in the town comes to 26.16 hectares.

Table 18-4 Commercial centres and population served

Sl No	Hierarchy of commercial centre	Population served	Requirement (by 2041)
1	Cluster centre	1000-4000	19 Nos with 36 shops each
2	Sector centre	5000-20000	4 Nos with 100 shops each
3	Community centre	25000-1 lakh	1 Nos with 450 shops

18.2.3 Water supply

Domestic purpose: requirement of water for domestic purpose for a population of 25000 for the year 2041 = 25000 x 150 = 3.75 MLD

Medical: requirement of water for 249 beds in the various hospitals at the rate of 455 per bed = 249 x 455 = 0.113 MLD

Educational:

Colleges: requirement of water for 2856 students in colleges = 2856 x 45 = 0.128 MLD

Schools: requirement of water for 3185 students at the rate of 45 lpcd = 3185 x 45= 0.143 MLD

Industries: water requirement for 633 workers in various factories at the rate of 30 lpcd

=633 x 30 = 0.019 MLD

Total = 3.75+ 0.113+ 0.128+ 0.143 + 0.019 = 4.153 MLD

Adding 25% (i.e., 1.038 MLD) for commercial, public institutions, park and open spaces, street taps etc. the total requirement of water for 2031 =4.153 + 1.038 = 5.19 MLD

Current water supply = 4.75 MLD

Additional Requirement is 0.44 MLD

18.2.4 Solid waste management

Waste generated = 6.50 tons/day

Waste generation in 2041 (20% Excess) = 7.8 tons/day

Waste collected/day = 5.0 tons

Hence additional 2.8 tons/day to be collected and treated

18.2.5 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 = 25000 KWH

Industrial use:

Workers in industries = 633

Power required = 633 x 4 = 2532 KWH

Total power requirement= 25000 + 2532 = 27532 KWH

Table 18-5 Energy availability and projected requirements

Category	Existing Nos	Standards recommended	Demand 2031
110KV substation	1	1 for 1,50,000 persons	1 Nos
Fire station	1	1 for 2 lakh persons	1 Nos
LPG Godowns	Nil	1 for 40-50,000persons	1 Nos
Petrol pumps	5	1/150Ha of gross residential and 1/40 Ha of industrial area	7 Nos

18.2.6 Traffic & transportation

Table 18-6 V/C ratio of road sections

Sl No	Name of Road	Existing V/C Ratio (2014)	Proposed V/C Ratio (2020)	Proposed V/C Ratio (2034)
MC Road				
1	Anjilimood - ITI Junction	1.42	1.91	3.78
2	ITI Junction - Hospital Junction	2.01	2.69	5.32

3	Hospital Junction - EC Junction	1.97	2.64	5.23
4	EC Junction – Bethel Junction	2.27	3.05	6.03
5	Bethel - Vellavoor Junction	2.22	2.97	5.89
6	Vellavoor Junction - Puthentheruvupadi Junction	1.94	2.61	5.16
7	Puthentheruvupadi Junction - Erapuzha	1.74	2.33	4.61
Mavelikara - Kozhenchery State Highway (SH 10)				
8	Perissery - SBI Junction	1.16	1.55	3.08
9	SBI Junction - Vellavoor	0.82	1.05	1.34
10	Bethel - Althara	0.74	0.94	1.20
11	Althara - Puthencavu (Kombanad)	0.97	1.24	1.58
12	Puthencavu (Kombanadu) - Puthencavu (Mulakuzha)	0.84	1.07	1.37
13	Puthencavu (Kombanadu) - Boundary	0.80	1.02	1.31
Puthencavu - Edanadu				
14	Puthencavu - Chelloor Bridge	0.29	0.33	0.39
Chengannur – Kidanganoor Road				
15	ITI Junction - Boundary	0.44	0.50	0.58
Venmony - Chengannur Road				
16	Anjilimood - Boundary	0.82	1.00	1.21
Chengannur - Parumala Road				
17	Puthentheruvupadi - Karuvelipadi	0.51	0.59	0.68
Mundencavu - Thrichittattu Temple Road				
18	Mundencavu - Thrichittattu Temple	0.37	0.44	0.51
Mithrapuzha - Kuttikkattupadi Road				
19	Althara Junction -Vigneswara Junction	0.26	0.32	0.38
20	Vigneswara Junction - Mangalam	0.60	0.72	0.88
Eraviperoor - Kallissery Road				
21	Mangalam - Kallissery LPS	0.28	0.34	0.42
Althara - MC Road (One way)				
22	Althara - EC Junction	0.55	0.70	0.89
Bethel Road				
23	Bethel Junction - SBI Junction	0.80	0.97	1.18
Puthencavu - Mulakkuzha Road				
24	Puthencavu - Boundary	0.61	0.71	0.82
Sabarimala Road				
25	Temple Junction - Chengannur Temple	0.75	0.88	1.01
26	Chengannur Temple - Vigneswara Junction	0.74	0.86	0.99
27	Vigneswara Junction -Rotary Junction	0.57	0.66	0.77
Suriyani Church Road				
28	Puthentheruvupadi - Boundary	0.36	0.41	0.48

18.2.7 Education

High School (8th Std to 10th Std)

As per the TCPO 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 Dist. is shown in the table below.

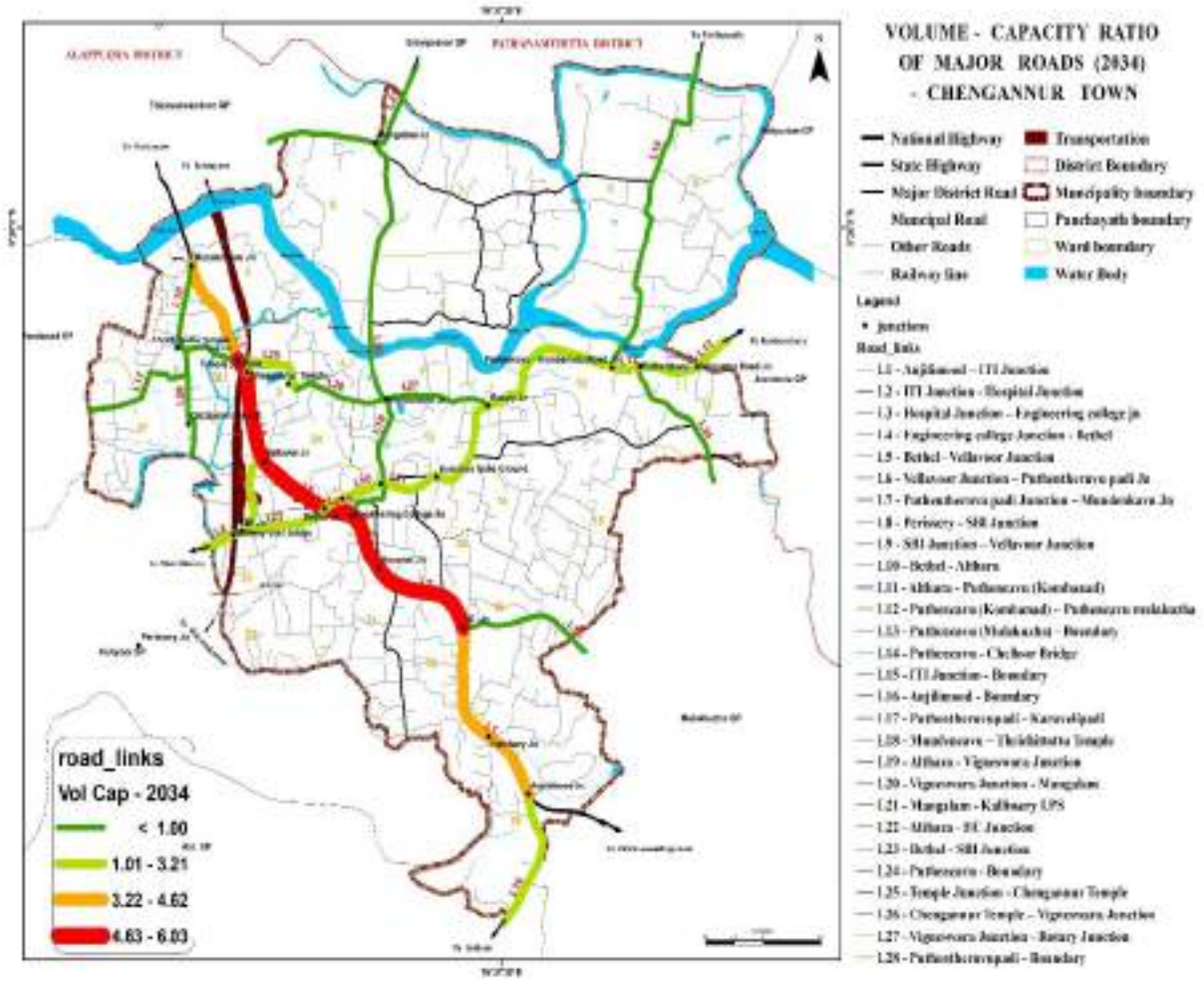

Figure 18:1 Projected V/C Ratio for 2034

Table 18-7Population Distribution in 0-19 Category of Alappuzha District

Percentage of People in various age groups Alappuzha District	
Age	Percentage
0-4	7.87
5-9	7.01
10-14	8.15
15-19	8.07

Total percentage of students in the age group (13-15) = (8.15x3)/5 = 4.89 %

Total number 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 schools needed = 25000/14000 = 1.78 schools with 700 strengths. i.e., schools with a capacity of 1246 (1.78 x 700) students are needed. Existing facility constitutes schools with a capacity of 1400 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 higher secondary school needed = 25000/14000 = 1.78 schools with 336 strengths. i.e., schools with a capacity of 600 (1.78 x 336) students is needed. As per secondary data there are schools with a capacity of 840 students in the town.

The existing higher secondary school 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 40% pass from the HSS, and majority of this (Say 37%) opt for college Education the number of students opting for College Education (including Professional Colleges) from within a population of 14,000 = 336 x 0.37 = 125

Assuming that 65% of the 125 students are opting for Arts & Science Colleges, the number of students opting for higher education from Arts and science college = 125 x 0.65 = 81. The total student's strength of an Arts & Science College = 500 (BSc-120, BA-120, BCom-120, Others-120).

So, the total number of populations having 500 students for Arts & Science College = 14,000 x 500/81 =86420 (Approximately 86,000)

For 86,000 populations 1 college with 500 student's capacity is needed. There is one arts and science colleges available in Chengannur.

So, the existing college education facilities are sufficient.

Professional College

One professional college for 2,50, 000 populations with student strength of 250 at the entry level is needed as per standards. There is one professional college available in Chengannur town.

So, the existing professional college education facilities are sufficient.

Other Professional Institutes (Polytechnic, ITI & ITC)

60% of the total students appearing for the HSS is failing i.e., 336x0.6=202. Assume that, of the failing students, a 10 % of this and 5% of the students passing HS and a 10% of students passing Higher Secondary Schools are opting for Polytechnic.

Total number of students opting for Polytechnic=20+21+13 (10% of 202+ 5% of 420+10% of 125) = 54; Total strength at the entry level of a polytechnic = 150

Threshold population of a Polytechnic = 14000 x150/54= 38,888 (say 38000)

Polytechnic needed = 25000/38000 = 0.66 (say 1); Polytechnic with student strength 150 is needed.

Assume that 20% of the students failing HSS and 1% 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 = 40+ 3+63+3 (20% of 202+1% of 280+ 150% of 420+ 2% of 125) = 109

Student 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 = 2500/38000 = 0.66 (say 1)

ITI/ITC with student strength 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 = 13 (10% of 125)

Total Strength at the entry level of a TTC

Threshold population of TTC = 14000x120/13 = 129230 = Say 1,20,000 population

For 1,20,000 population TTC with a strength of 120 is needed.

18.2.8 Health

At present there are 249 beds in various Allopathic hospitals. Out of 249 beds, 134 are in the private hospitals. Ayurvedic hospital contributes 10 beds. This is fully in the government sector. There are a total of 115 beds in the government sector.

Assuming a standard of 4 beds per 1000 population, the number of beds needed by 2041 = (25000/1000) x 4 = 100

18.2.9 Housing

As per the secondary data collected, the existing number of houses in Chengannur town is 9292. The number of households in the town is 6278. There is a no shortage of houses in the town at present. Average household size for the town is 3.74.

Number of houses needed by 2041 = 25000/3.74 =6685

But already there are 9292 houses available

Number of houses to be reconstructed = 567 (Kucha houses in the town)

1% removed due to developmental activities = 6278/100 = 63

Total houses to be built = 383+63 = 630 Nos

18.2.10 Recreational facilities

Table 18-8 Recreational facilities available and future requirements

Category	Standards recommended	Demand 2031
Park & open spaces (overall town)	10-12 sq.m /persons	25-30 Ha
Community level Park & Open spaces	2-3 community level Park & open spaces	Adequate feasible area
Open spaces (variations by size of settlement)	1.4-1.6 Ha/1000 persons	40 Ha
Community room	1/5000 persons	6Nos (660m^2each)
Community hall & library	1/15000 persons	2Nos (2000m^2each)
Recreational Club	1 for 1 lakh persons	1No (1Ha each)

19 DISASTER PREPAREDNESS AND MITIGATION MEASURES

19.1 Disaster Management Framework

The institutional and policy mechanisms for carrying out response, relief and rehabilitation after disasters in India had been well-established since Independence. The increasing frequency and ferocity, the rising extent and sweep as well as the mounting human and economic toll due to disasters necessitated a reappraisal of institutional and policy frameworks and development of new frameworks for holistic disaster management of disasters.

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.

So, for Chengannur town the disaster management has been attempted as a three-step strategy ie, Adaptation (Living with water), Resilience and Mitigation (Room for River).

19.2 ADAPTATION (Living with Water)

While modelling and vulnerability assessment can provide some insights, it is not possible to predict every potential condition for future infrastructure and systems. Hence, anticipating a range of possible future conditions, designs should be flexible to accommodate the possible risks.

The concept of 'Living with Water' can be adopted in developing a long-term vision for these areas. Apart from technical measures such as building of multi-storeyed housing to allow safe spaces during floods and mounts to where cattle can be evacuated, soft measures such as enhancing awareness of the risks, early warning and communication can be undertaken. Though Kerala disaster management authority have released a handbook on response measures, it is important to have a quick response team within the municipality to act first, before the arrival of other departments to reduce the impact of flood.

Construct and amend facilities in the identified potential relief camps and improve access to such shelters. Identification of safe spaces for livestock and parking of vehicles are other measures attempted for the adaptation of the situation.

19.2.1 Disaster Response Team

The 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.

Municipality level Disaster Response Team is to be created in levels with various duties like Immediate response, Shelter home and recue operation committee. The possible flow chart of the response team is shown in Figure 19:1. The steering committee of the municipality will lead the municipal response team which includes the steering committee members and experts from line departments.

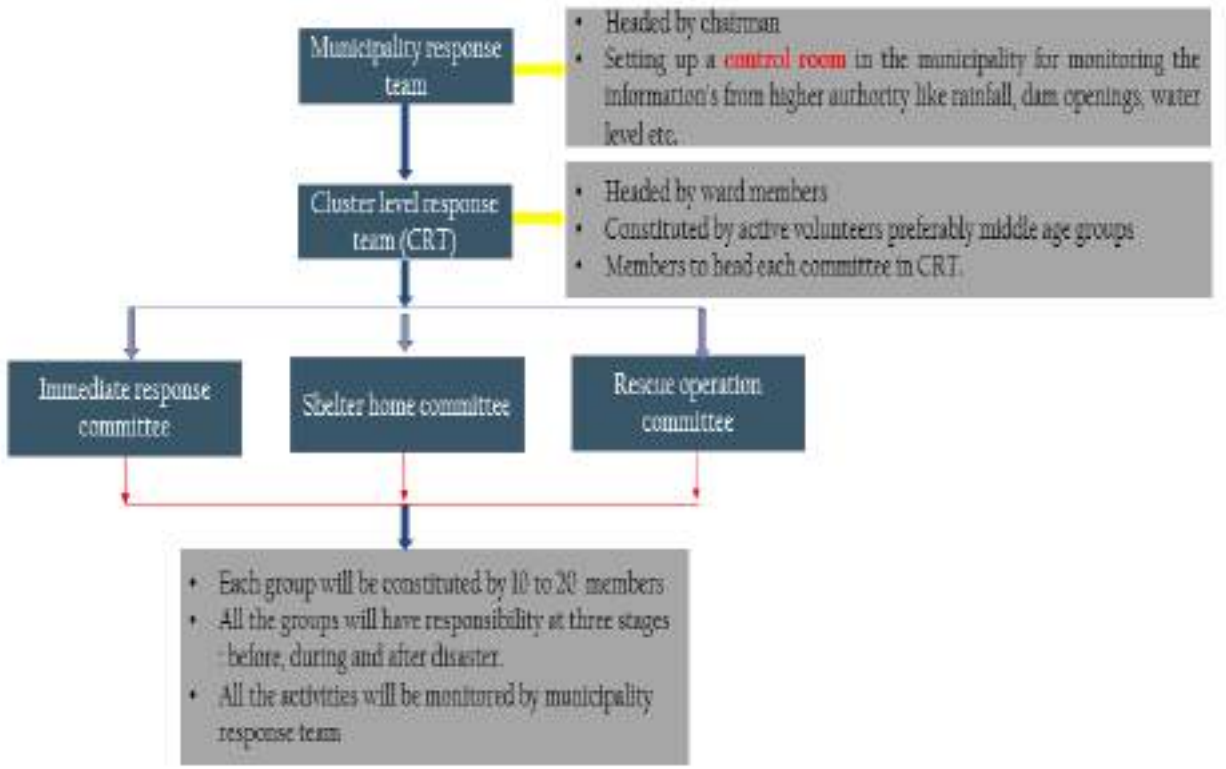

Figure 19:1 Municipality Response Team

The various duties for each committee are listed which is to be carried out before, during and after the onset of a disaster.

Table 19-1 Immediate Response Committee

Immediate response committee - Responsibilities	
Before disaster	1. Prepare the list of special categories of the municipality including pregnant ladies, kids, people with disabilities, older people. 2. Ensure their health is good 3. Keep first aid kit ready 4. Collect and stock up medicines, ORS packets, vitamin tablets, antiseptic liquids etc 5. Give proper information about the usage of medicines 6. Keep in coordinated with municipal level disaster management team
During disaster	1. Medical attention to those who have to be evacuated. 2. Ensure each and everyone affected by the disaster gets medical attention. 3. If medicines get stock out, inform the concerned response team. 4. Keep in coordinated with municipal level disaster management team
After disaster	1. Help the doctors for rescue operations 2. Take measures to control communicable diseases 3. Create awareness among the people to keep personal hygiene 4. Disinfect the shelter homes 5. Keep in coordinated with municipal level disaster management team

Table 19-2 Rescue Operation Committee

Rescue operation committee - Responsibilities	
Before disaster	1. Keep things like torch, rope, steel rods, anchor, first aid kit, life jacket, water floating items in the rescue operation kit. 2. Keep equipment like hammer, cutting blade, knife, nails etc. to evacuate people trapped under buildings 3. Help the affected people to keep their important documents and essentials safe before evacuation.
During disaster	1. Collect the information of rescued people correctly and document 2. Evacuate pregnant ladies, kids and old age people first and relocate to safe places 3. Keep in coordinated with municipal level disaster management team
After disaster	1. Give medical attention to those who are injured 2. Make the road networks clear from all debris for the smooth rescue operations. 3. Keep the information of missing persons and update it alongside after each rescue operation 4. Conduct mock drills for creating awareness among the people for rescue operations 5. With help of other teams complete the rescue works in a correlated manner. 6. Keep in coordinated with municipal level disaster management team

Table 19-3 Shelter Home Committee

Shelter home committee - Responsibilities	
Before disaster	1. Ensure the identified potential relief camps are safe 2. Do repair works if needed with the help of engineers. 3. Store essential items like food items, medicines, water, candles etc for 1 week 4. Ensure sanitation facilities are available 5. Promote community kitchen 6. Disinfect the relief camps at intervals
During disaster	1. Avoid leaving the relief camps before and during the disaster. 2. Store items like food, clothes, medicines, drinking water etc. 3. Keep in coordinated with municipal level disaster management team

After disaster	1. Convert relief camps /shelter homes to ration shops for providing essential items for the affected persons. 2. Re-stock all the essential items as and when required. 3. Promote individual kitchen. 4. Help the damage detail collection team 5. Keep in coordinated with municipal level disaster management team

A control room can be set up at Mini civil station for municipality level disaster response. The response teams will have to work both before and after flood under the guidance of the authority.

Disaster Response Measures

- Prepare and implement a capacity building plan linked to the local Civil Defence Volunteers, Community Rescue Volunteers and creation of community emergency response teams (CERTs) with a focus on women, children, the elderly, and people with disabilities.
- Design and implement a DRM awareness-raising programme for school students from class 1 to class 12 and ULBs at high risk
- Involve local communities in preparation of evacuation plans with a particular emphasis on evacuation of vulnerable groups like the elderly, women and children, and persons with disabilities; and components such as how early warning signals can reach them, whether they need assistive aids at the time of evacuation etc.
- Develop a programme for constituting Community-based Disaster Management Teams based on global best practices (e.g., Community-based Disaster Management practice of Cuba). It will include training and equipping the presently existing community organizations of students like the National Service Society (NSS) and Student Police Cadet (SPC) as well as community volunteer groups including fishermen. The trainings will cover detailed first aid lessons and life skills like swimming, rowing and climbing.
- An early warning system should be developed. The warning systems and operating procedures for various disasters are detailed in the Orange Book of Disaster Management – Kerala. This can be followed.

19.2.2 Potential Relief Camps

Relief camps outside flood prone region

The relief camps functioned during 2018 flood include temples, Churches, Auditorium halls, Schools, Colleges, etc. All of these can be used in case of possible hazards, but the nature of its usual purpose is a matter of concern while thinking of permanent relief camps for addressing any future possible hazard events. It is always good to avoid buildings on low lying areas while selecting for the flood relief camps. Buildings in elevated areas and those outside flood prone regions should be considered as a first priority. The school, college buildings, auditoriums, community halls, high rise buildings, public buildings in elevated areas and outside flood prone region can be developed as possible permanent shelters and its infrastructure facilities needs improvements as and when required with the consideration to

accommodate maximum number of people during any possible future hazards. The basic infrastructure facilities of these buildings are to be strengthened to attain the full functionality.



Figure 19:2 Location of Relief camps functioned during flood 2018 vs flood affected area

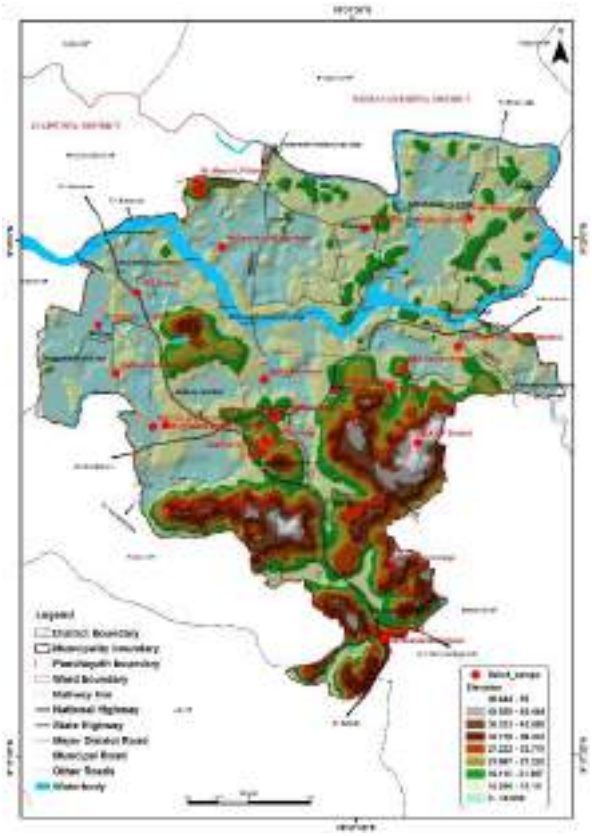

Figure 19:3 Location of Relief camps functioned during flood 2018 vs elevation profile map

On analysing the camps with respect to elevation map, it can be seen that the relief camps which were functional during 2018 flood were on comparatively elevated places or having multiple storeys. There were 29 rilief camps were opened during the flood hazard. But some of these were in flooded area. The relief camps which fall outside flood prone area are listed below:

Sl no.	Name of Camp	Sl no.	Name of Camp
1	St. Mary's LP School	9	SNDP Union Office
2	IPC Hall	10	E.A.L.P School
3	SBS Camp Centre	11	Govt. ITI
4	SCRV UP School	12	Christian College
5	Govt Boy's School	13	Govt. HSS
6	Govt. Girl's School	14	MMAR Residential School
7	IHRD College	15	St Annie's school
8	YMCA Hall	16	Pandavan Para Community Hall

Potential camp locations

The identified 14 potential camps in the Nammal Namukkayi report, 2020 are listed below, these includes both private and public owned buildings.

Sl no.	Name of Camp	Sl no.	Name of Camp
1	Govt. JBS Keezhcherimel	8	Govt LPS Chengannur

2	Govt. UPGS Kizhakkenada	9	Engineering College Chengannur
3	Christian College Chengannur	10	Govt HSS Angadikkal Thekk
4	Municipality Mini Conference Hall	11	Pulikunnu Community Hall
5	Pandavanpara Community Hall	12	Govt Boys HS Chengannur
6	Govt Girls HSS/VHSS Chengannur	13	Metropolittan HSS Chengannur
7	Saint Anns HSS Chengannur	14	Malayil E.A.L.P. School

In the above list, it is seen that Metropolitan HSS was flooded during 2018 floods. So, it is not recommended as a relief camp and is excluded from the potential camp locations. The list of those potential camps with their capacities are given in Table 19-4 and location of these potential relief camps is shown in Figure 19:4.

Table 19-4 Potential Relief Camps

Sl No.	Name of Camp	Extent/Capacity
1	St. Mary's LP School	114
2	IPC Hall	100
3	SBS Camp Centre	130
4	SCRV UP SchooL	321
5	Govt Boy's School	152
6	Govt. Girl's School	100
7	IHRD College	2500
8	YMCA Hall	150
9	SNDP Union Office	83
10	E.A.L.P School	25
11	Govt. ITI	640
12	Christian College	2400
13	Govt HSS	300
14	MMAR Residential School	657
15	St Annie's school	190
16	Pandavan Para Community Hall	360
17	Govt. JBS Keezhcherimel	2300
18	Municipality Mini Conference Hall	100
19	Govt Relief LPS Chengannur	200
20	Govt. UPGS Kizhakkenada	200
21	Pulikunnu Community Hall	100
22	Mangalam Orhodox Church Auditorium	300

While assessing the interconnectivity of various infrastructures in the town, there is a better connectivity between various infrastructures is visible due to the presence of the existing well connected road network. The public owned potential camps need improvements in basic infrastructure and waste management facilities. Also, the identified private owned institutions need strengthening of all basic infrastructure facilities.

All relief camps should be equipped with solar panels to avoid disruption of electricity These should have basic amenities like toilets, wash area, water supply to provide for the

evacuated population. Bio toilets, mobile medical facilities should be provided when the relief camps are in operation.

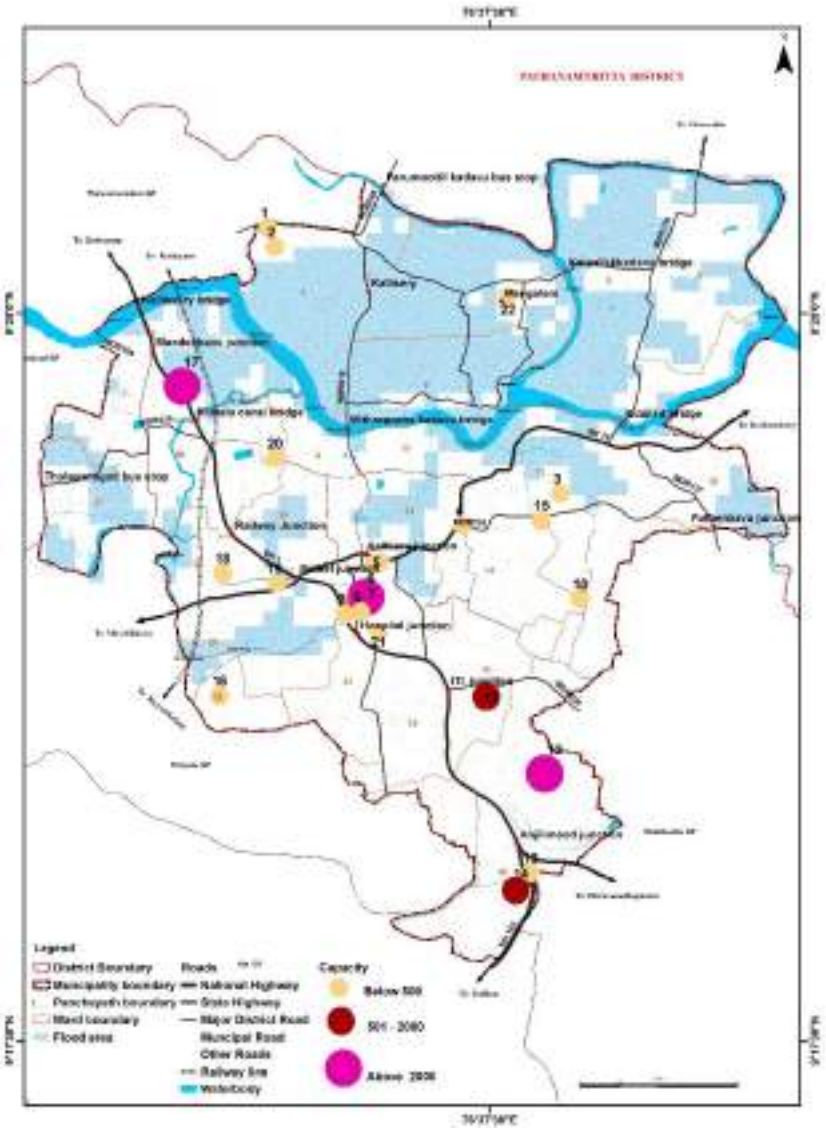

Figure 19:4 Potential relief camp location in Chemgannur municipality

Catchment area of potential Relief Camps

22 potential relief camps were identified to house the public in case of another flood within the municipality. The camps can be used to serve the wards around it within its capacity. Table 19-5 shows the different camps and its serving wards. High risk and moderate risk wards which are shown in Figure 19:5 are chosen for temporary evacuation in case of floods. Priority is given to the high-risk wards at the time of floods and the public must be evacuated immediately to the identified relief camps. There are 12 high risks wards and 5 moderate risk wards within the municipality. The relief camps catering for each ward is identified based on it's carrying capacity and its closeness to the area.

Table 19-5 Relief camps and its Serving wards

Sl no.	Catchment Camps/ Potential camps	Serving wards	serving population

1	St. Mary's LP School	5	350
2	IPC Hall	5	
3	SBS Camp Centre	12	480
4	SCRV UP SchooL	12	
5	IHRD College	27,25,12,24	2128
6	E.A.L.P School	10	700
7	Govt. ITI	10	
8	Christian College	5,6,7,8	2110
9	Govt. HSS	9	550
10	St Annie's school	9	
11	Pandavan Para Community Hall	23,4	550
12	Govt. JBS Keezhcherimel	1,2,26	2313
13	Municipality Mini Conference Hall	24	600
14	Govt Relief LPS Chengannur	24	
15	Govt. UPGS Kizhakkenada	4	200
16	Govt Boy's School	11,13	1370
17	Govt. Girl's School	11,13	
18	MMAR Residential School	11,13	
19	Pulikunnu Community Hall	11,13	
20	mangalam chruch	6	300
21	YMCA Hall	6	85
22	SNDP Union Office	6	150

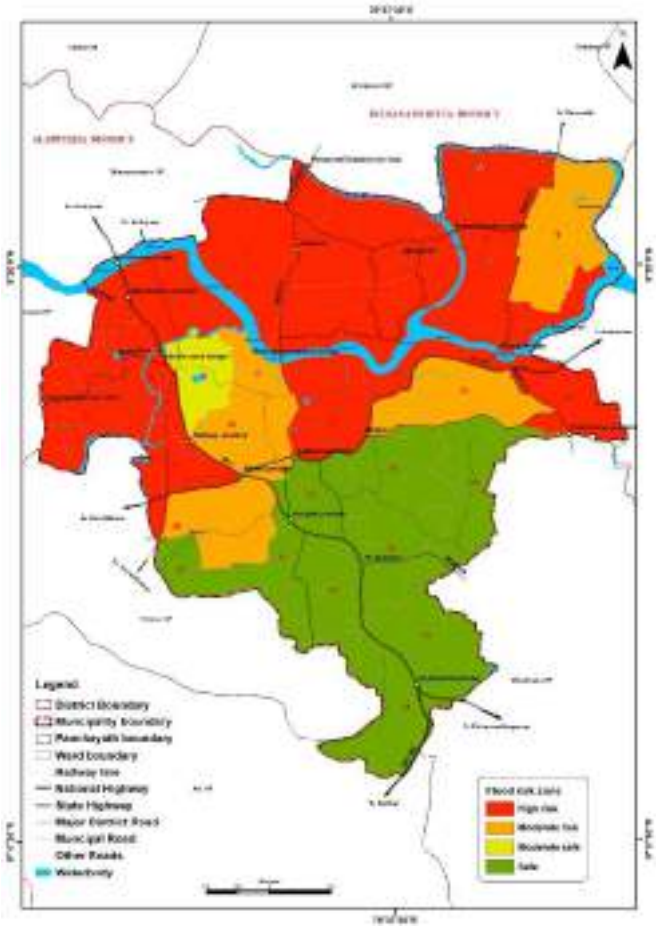

Figure 19:5 Flood Hazard zones and relief camp locations

The catchment wards for each relief camps were shown in **Error! Reference source not found.**. The desired routes which can be used during evacuation process to the relief camps is shown in **Error! Reference source not found.**. Evacuation must be carried out before the rise of water to adverse flood levels to ensure maximum safety and smooth procedures. Highly/moderately affected wards are to be evacuated first to the relief camps.



Figure 19:6 Catchment wards of Relief camps

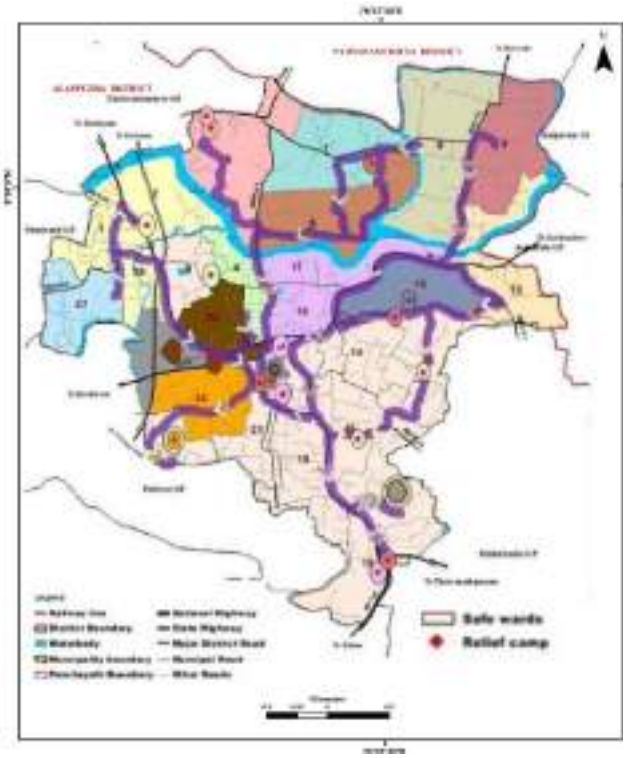

Figure 19:7 Desired routes during evacuation to Relief camps

19.2.3 Safe Zone Parking

When floods and heavy rain are in the forecast, people tend to scramble to save lives and their nearest pocessions. Vehicles are often unattended and water can be extremely harmful to many components of the vehicle, and it can compromise its safety even years after the initial damage occurs. This can be prevented with proper prior precautions to reduce the loss. Parking the cars on elevated grounds at the time of warning would be beneficial, and when the condition gets worse people can be evacuated in an orderly manner to the respective relief camps without being worried about their vehicles, cattle and other pocessions. Safe zones for parking are identified within the municipality. These areas are open grounds of public or semi-public institutions, which are outside flood prone area that can be used as parking lots in case of floods.

Multilevel parking proposed in the municipality can also be used for this purpose in addition to thse identified spots.

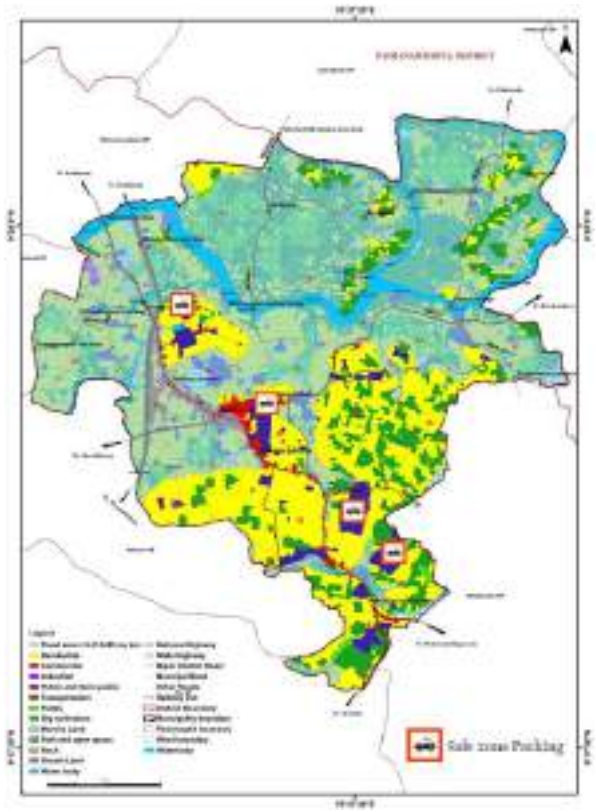

Figure 19:8 Safe zone Parking

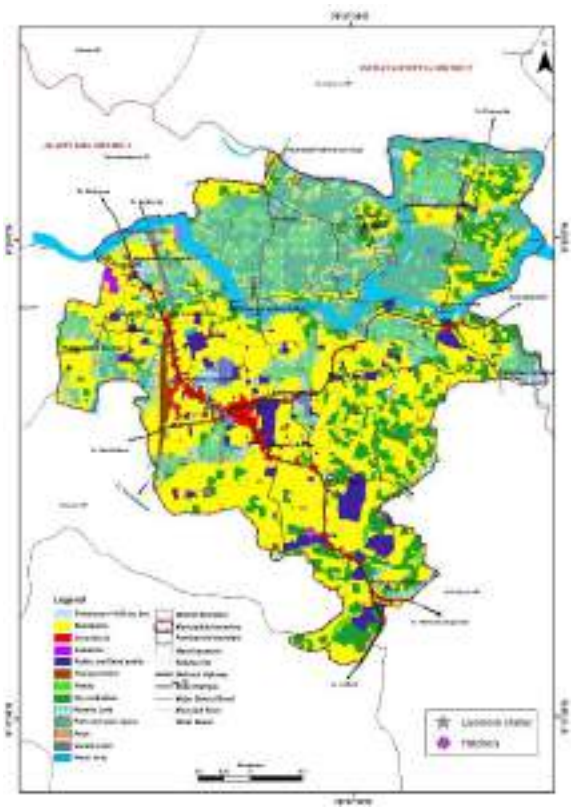

Figure 19:9 Livestock Shelter Locations

19.2.4 Livestock Shelter

In Chengannur, there was a huge loss of livestock during the floods. Prior planning and evacuation of the animals can drastically reduce the loss. Various vacant areas that are in the vicinity of relief camps and outside the flood prone zone are identified to shelter the livestock of the municipality. Poultry can be sheltered in the Central Hatchery of Chengannur, which is one of the largest Government controlled hatchery in the area.

19.3 RESILIENCE (Building with Nature)

Building with nature is a concept where natural phenomena are leveraged to cope with climate change risks posed in the form of storm surges, sea-level-rise (SLR), and floods. It is also called eco-engineering. Eco-engineering could be an option for bund and embankment protection, and natural bypasses to enlarge the river's discharge capacity and thus keep floodwater levels lower.

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 meaures.

Develop awareness materials on safe construction practices for different zones and make them available at the municipality. 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 subsidised or be paid for by the government. People may be incentivised 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.

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 take into account 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.

19.3.1 Elevated Buildings

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 defence 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.

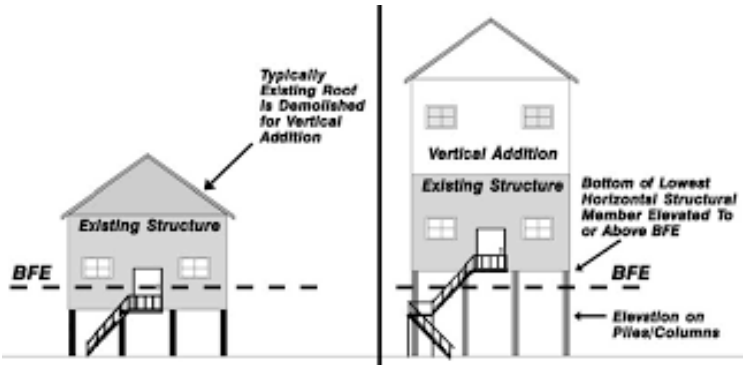

Figure 19:10 Freeboard Flood design

Freeboard should be provided according to the flood levels of the area. From the flood hazard analysis of the Chengannur town, we can categorise area into four zones according to the flood level occurred during 2018 flood. ie. ‹ 0.6m, ›0.6m to 1.5m, ›1.5m flood levels. These zones according to flood level are shown in **Error! Reference source not found.**. So, the f reeboard necessary for those areas will be as listed below.

- ‹0.6m: Freeboard of atleast 90cm
- ›0.6m to 1.5m: Freeboard of 1.8m needed
- ›1.5m : Freeboard of atleast 1.8m needed

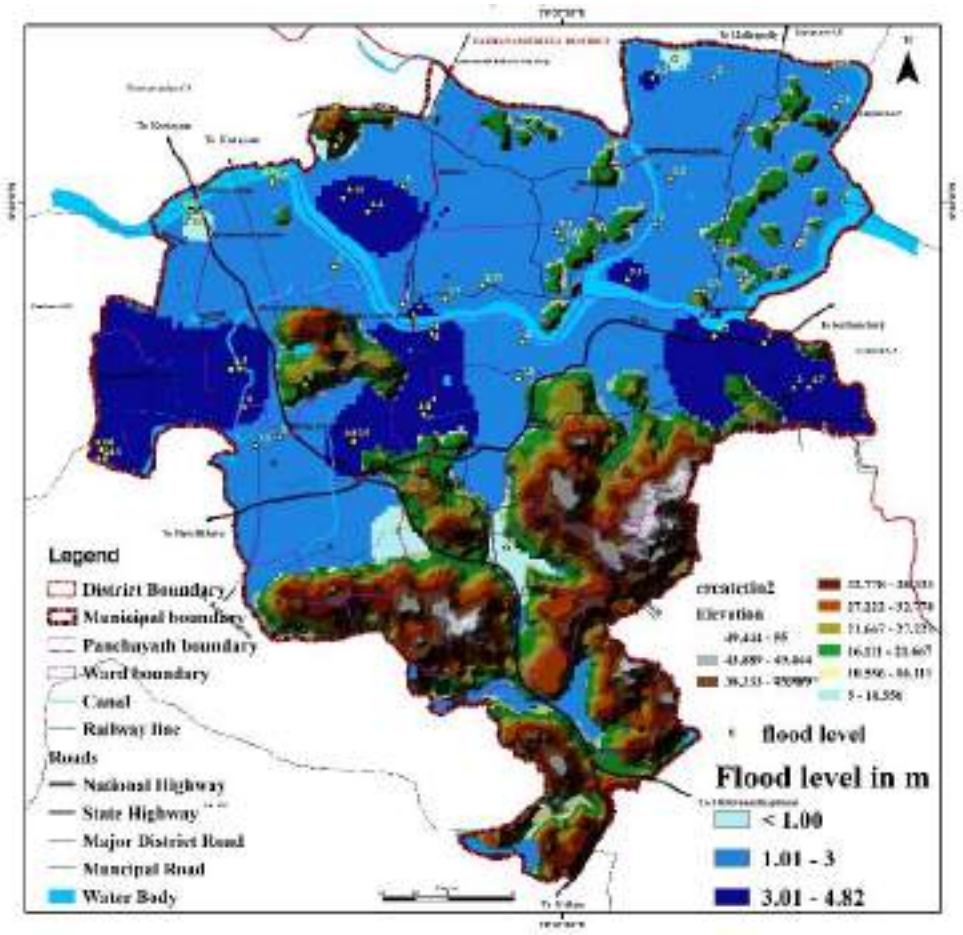

Figure 19:11 Flood Level Mapping (2018)

19.3.2 Flood-Resilient Construction

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 floodproofing," 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 resistent materials below the Base Flood Elevation (BFE), protection of mechanical and utility equipment, and use of openings or breakaway walls.



Figure 19:12 Dry Flood Proofing Techniques

19.3.3 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 19:13 Identified Roads to be upgraded as All-weather Roads

19.4 FLOOD MITIGATION (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 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 meaures that can be adopted for the providing 'Room for River'.

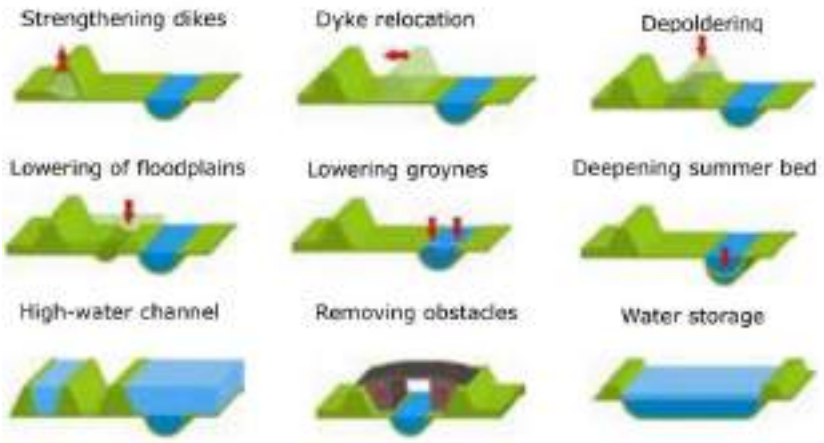

Figure 19:14 Room for river Principles

19.4.1 Channel Widening Proposal

The study conducted by LSGD Planning, Alappuzha during 2018, has identified, 3 of the major rivers (Pamba, Achankovil and Manimala) draining through Alappuzha district is concentrating in the flood plains of Chengannur. The flow accumulation analysis shows that the best way to expel this water from Pampa River is through Thottapally spillway. For this the capacity of spillway should be increased and the channel leading to this spillway has to be widened and deepened as per scientific and engineering inputs.



Figure 19:15 Area for Channel widening

In order to maintain a natural healthy ecosystem in any river basin, the environmental flows (E Flows) should be maintained. The scientific assessment of E flows requirement of the basin should also be considered as an important step in the comprehensive rejuvenation of this basin. It includes the identification of the quantity, quality and distribution of flow patterns along the length of the river and it provides a balance between the use and protection of natural water resources for people and biodiversity.

19.4.2 Restoration of Streams & Channels

Stream restoration or river restoration, also sometimes referred to as river reclamation, is 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 aproaches 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 river & De-silting of the river
- Recreational urban space in embankments

- Removal of clay and deepening of waterbodies will improve the water holding capacity and infiltration.

There were many natural streams or drains existed in our town, which helped to drain out the water to nearby river or other waterbodies. But on examining the existing landuse, we can see that most of these natural drains are missing now or reduced its width due to encroachents. In the 'Nammal Namukkayi' report prepared by the municipality also, the streams which were existed in the town but not found now are mentioned. Streams identified in 'Nammal Namukkayi' report is shown in Figure 19:16.



Figure 19:16 Streams identified by 'Nammal Namukkayi' Report



Figure 19:17 Flow Accummulation Map

So, to identify the natural drainage channels that were existed in the town, Flow Accummulation Analysis was done and the result of this analysis is shown in **Error! Reference source not found.**. on analysing the both figures, it is observed that, all the streams identified by 'Nammal Namukkayi' report is there in the flow aaccumulation map. In the flow accumulation map more drainage channels are visible. These drainage channels have tobe restored and revived for the proper draining out of flood water/ rain water from each watershed. Streams identified for the restoration is marked in Figure 19:18**Error! Reference source not found.**.

Streams 3, 4, 5, 9, 11, 13 and 14 were identified by 'Nammal Namukkayi' report. Streams 1, 2, 6, 7, 8, 10, 12, 15 & 16 are additionally identified through flow Accummulation Analysis. For streams 9,10 & 11, continuation after the municipal boundary should be traced to discharge the water to nearby waterbody.

19.4.3 Flood water Retention & Management

River basin management with a 'room for the river' approach emphasises ecological conservation and restoration. This approach aims to lower flood levels in the rivers by increasing the wet areas of the rivers, giving them more room and space. Recommendations for recovery centre around protecting natural river flows and giving room to the river, concepts

that inform the citizen education programmes, preparation of basin-wide master plans linking upstream, and downstream zones should be prioritised.

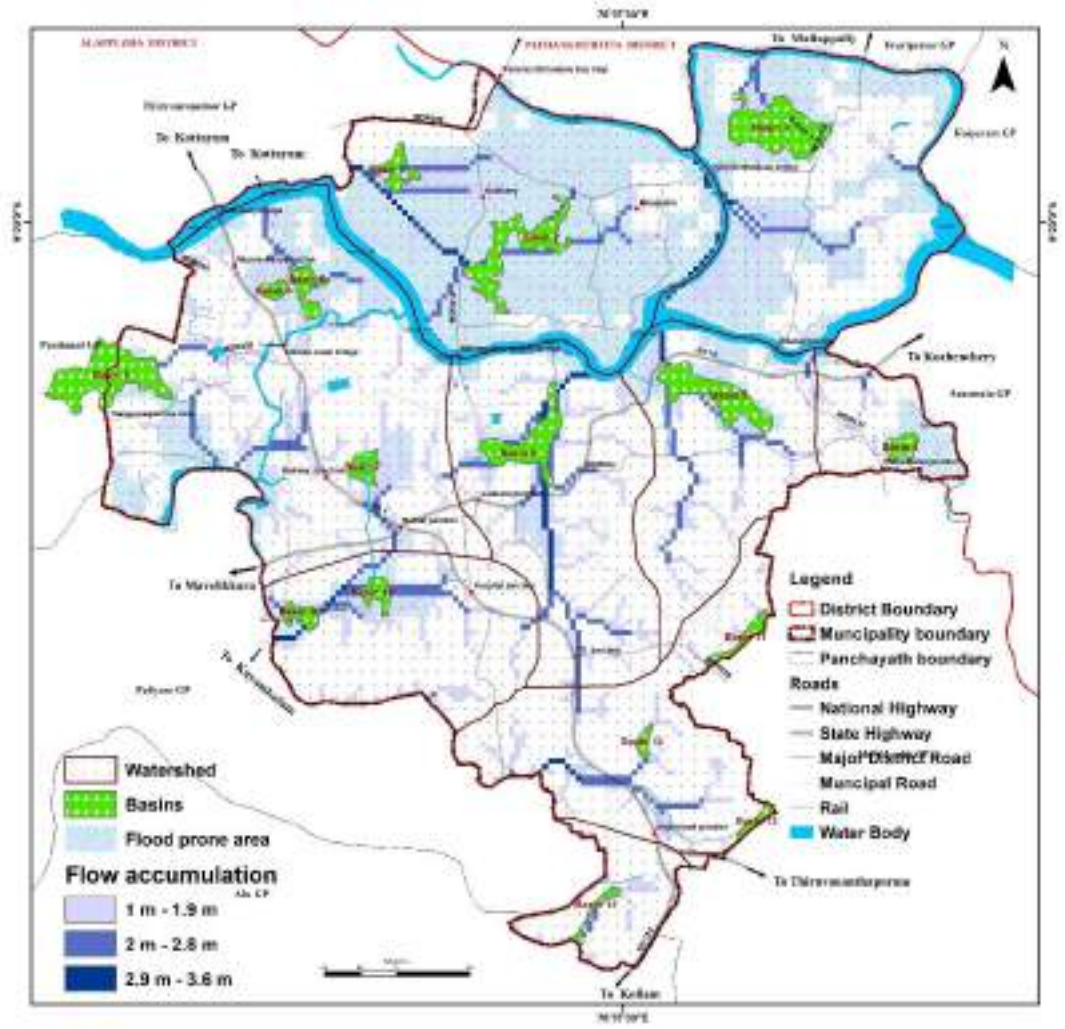

Figure 19:18 Streams identified for Restoration

A new land-use policy which enables the re-deployment of available land to maximise 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.

Basins for Flood Water Retention

So, for the retention of flood water, several basins were identified in each watershed. These are existing paddyields or marshy areasin 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 activities in these areas. During flood, these basins will retain some amount of water and allow this drain the restored channels to the river. This will prevent the flooding of adjacent land or reduce the flooding in those watersheds. Basins identified for water retention are shown in Figure 19:19 and Figure 19:20.

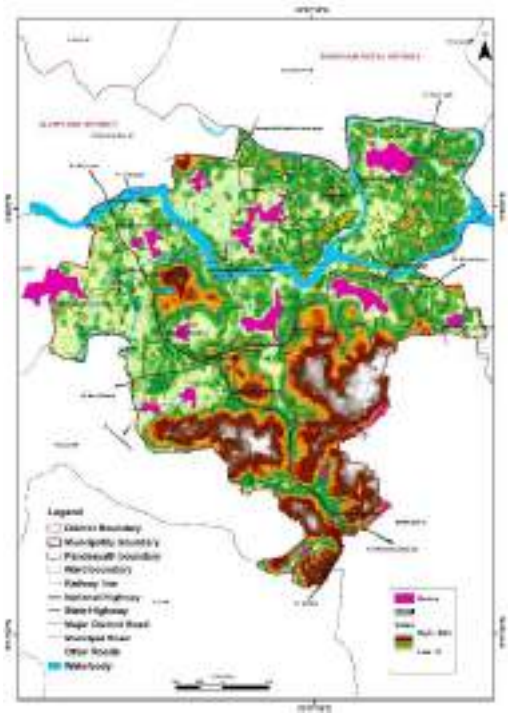

Figure 19:19 Flood Water Retention Areas vs DEM

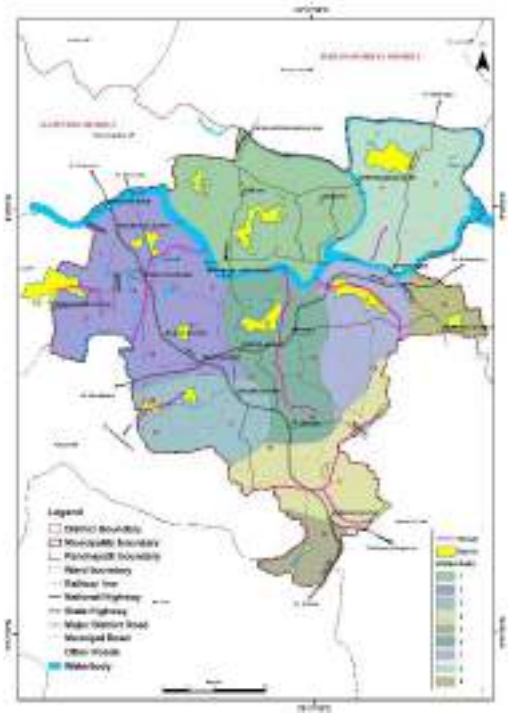

Figure 19:20 Flood Water Retention Areas vs Watersheds

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. This will also address the lowering of water level in wells.

Terracing of Slopes

Terracing is a soil conservation practice applied to prevent rainfall runoff on sloping land from accumulating and causing serious erosion. Terraces reduce both the amount and velocity of water moving across the soil surface. This greatly reduces soil erosion. Terracing thus permits more intensive cropping than would otherwise be possible.

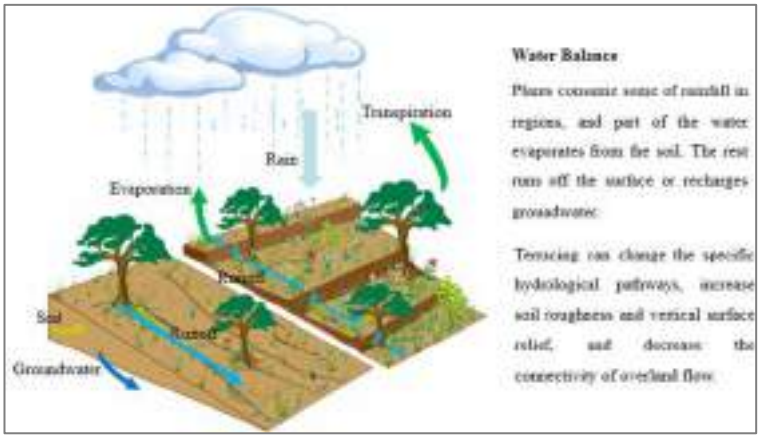

Figure 19:21 Terracing of Slopes

In elevated areas with slope more than 18 degrees, terracing of land can be attempted to decelerate the flow of run off. This will also help in preventing soil erosion and also increase the percolation of water which in turn helps in ground water recharging. Areas identified for the terracing of slopes is given in Figure 19:22.

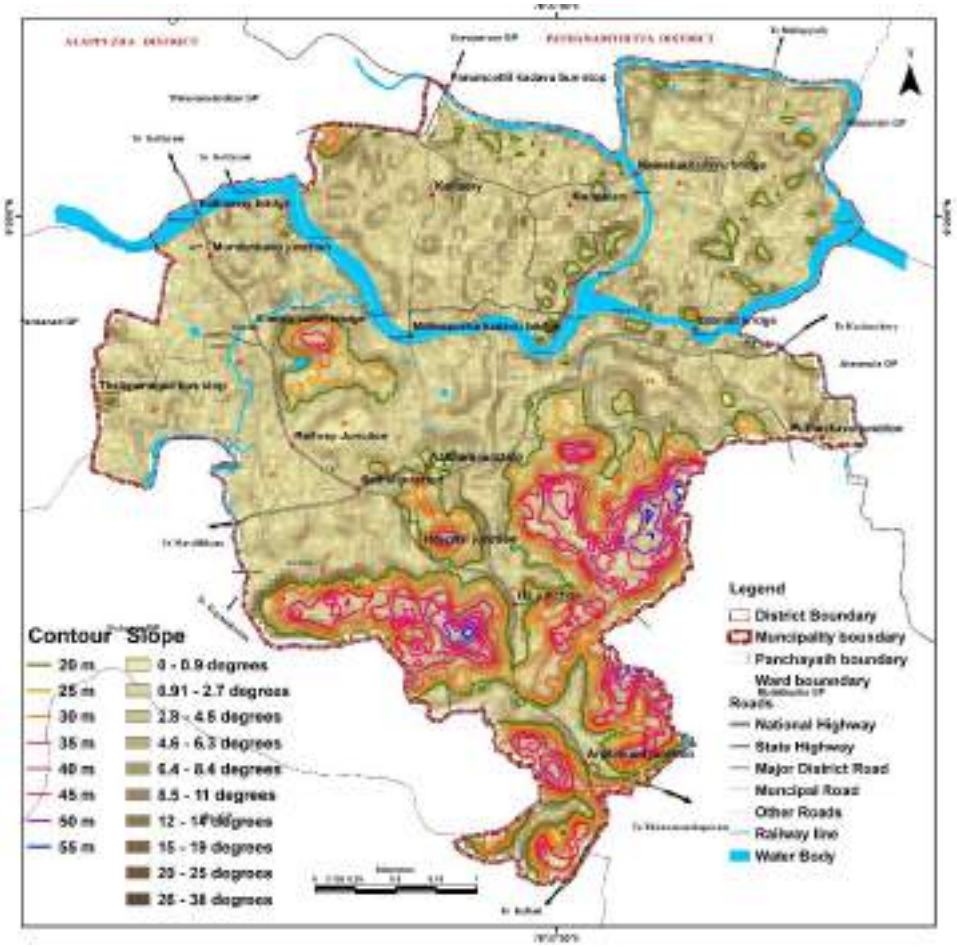

Figure 19:22 Areas identified for Terracing of Slopes

19.5 Hazard Zoning

For regulating the development activities, 25-year Return Probability (RP) data published by KSDMA is considered and the area extent in 25-year RP map is taken as the flood prone area (Figure19-23).

Based on flood inundation levels, the 25-year RP data is classified into Low Flood Prone Area (Areas likely to be inundated to a depth upto 0.6m), Medium Flood Prone Area (Areas likely to be inundated to a depth of more than 0.6m and upto 1.50m) and High Flood Prone Area (Areas likely to be inundated to a depth of more than 1.5 m) as shown in (Figure 19-24).

Resurvey boundary of Chengannur town is overlaid in the flood prone area map of 25-year RP. All resurvey boundary with 75 percent and above flood prone area coverage is extracted for zoning purpose (Figure 19-25) These survey boundaries are categorised into two classes based on inundation level of 25-year RP. The survey boundaries with low flood inundation level is excluded. The survey boundaries with Medium flood inundation level is named as Flood prone area I and the survey boundaries with High flood inundation level is named as Flood prone area II (Figure 19-26).

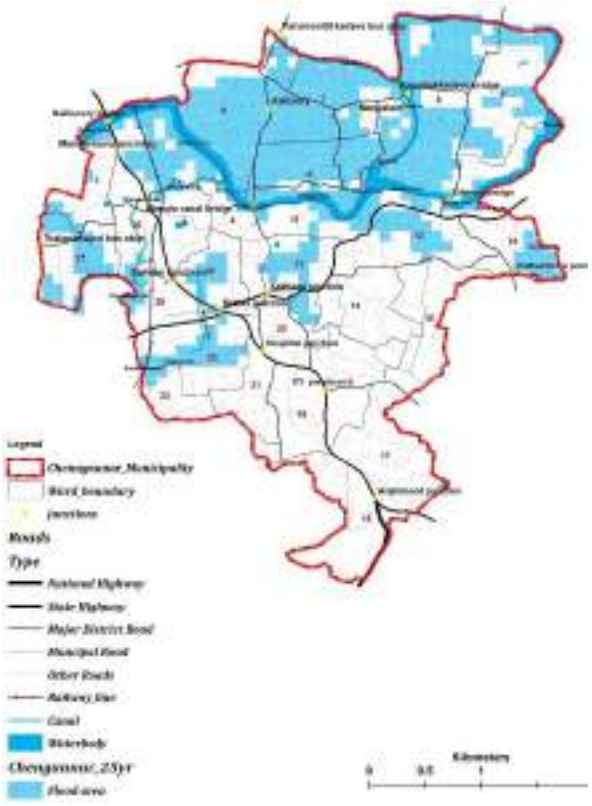

Figure 19:23: Map showing the Flood Prone Area as per 25-year Return Probability (RP) Map of KSDMA

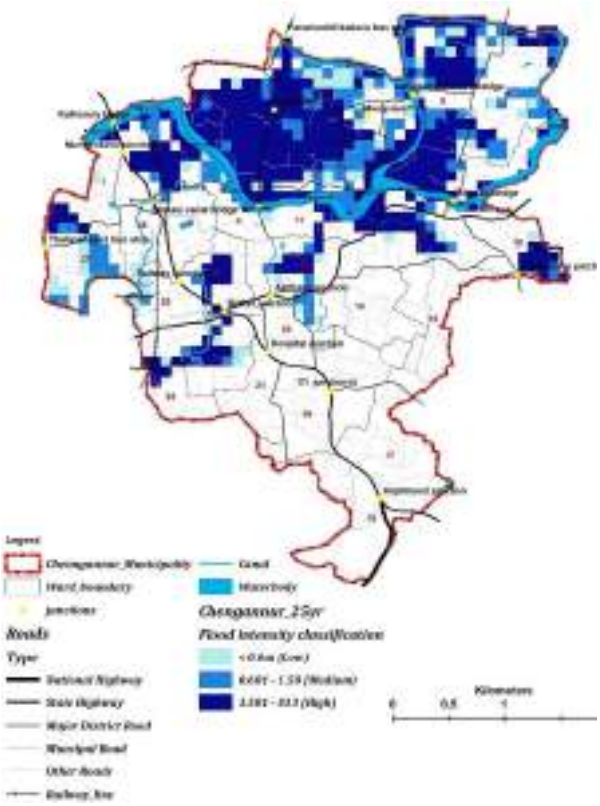

Figure 19:24: Map showing various classes Flood Prone Area based on flood intensity levels



Figure 19:25: Map showing the resurvey boundaries coming under 25yr RP with intensity classification

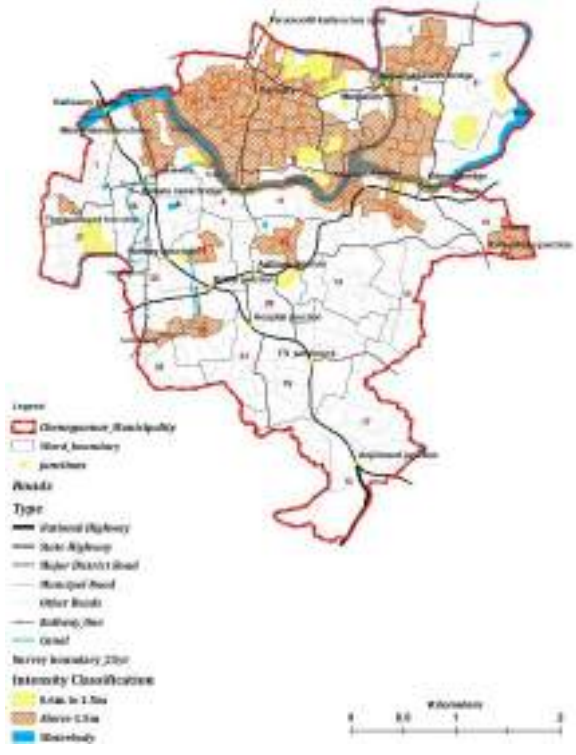

Figure 19:26: Map showing the resurvey boundaries coming under 25yr RP with intensity above 60cm

19.6 Way Forward

Aspect	Issues	Way forward
Flooding	• Urbanisation and sprawl into the flood plains • Loss of wetlands, marshlands and reclamation of water bodies • Unpredictable rain patterns • Silted and garbage laden canals	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. 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 they need 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 by the DDMA is advised, to handle further disasters like extreme rainfall events, landslides, floods and pandemics which are of recent occurrence. A hazard vulnerability assessment and developing a muncipal 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.

20 TRAFFIC AND TRANSPORTATION PLAN

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. The concept of future Traffic and Transport Network of the town, evolved based on finding of studies and analysis related to the sector as well as the prospects of other sectors. The road network of the municipality has fairly good coverage. But the road width is inadequate in most of the stretches. The projected traffic volume for 2034 far exceeds the capacity of the road network in certain stretches. Hence widening of the existing roads to cater to this increase in volume and a bypass to divert traffic is attempted.

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. 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. 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.

20.1 Proposed road network

The state highways SH-1 and SH-10 are passing through the town. The SH-1 is MC Road which is also part of the NH 220 and SH-10 is Mavelikara – Kozhenchery road, which connects Chengannur to Mavelikkara and Sabarimala. Both roads have existing width of about 10.00 – 12.00 m at various stretches. At present volume capacity ratio of these roads is equal or greater than one. So, widening of roads is necessary. Also, to reduce the traffic volume in town a ring road is proposed with width of 18 metres as per NATPAC 2014 study. This proposed ring road covers the junctions such as Pulimoodu, fire force, railway station, Puthiyakavu, Bishop Hodge, Arattukadavu etc. There are two new connections required in the proposed ring road. These connections on the western side are passing through residential areas and does not seem feasible for a 18m widening. There is a recent Bypass proposal for Chengannur which has a stretch on the western side of MC Road. This can be incorporated with the NATPAC road proposal thus forming a feasible ring road connectivity to decongest the town centre area. For this awidth of 12m is proposed.

On the basis of the projected volume of traffic and alternative network development schemes considered, a road development plan has been formulated for the town. As per the future road development plan for the town, the proposed network conforms to a pattern similar to a mix of radial and grid iron pattern. Four categories of roads are proposed for Chengannur town. These are as follows:

- Primary distributor road – Providing connectivity to state and district headquarters. In Chengannur, MC road and SH 10 are the primary distributor roads.

- Secondary distributor road – Providing connectivity to neighbouring towns within and outside district. In Chengannur, Mulakkuzha road, Kombanad Road, Kidanganoor Road, Parumala Road and Venmony 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.

The proposed road development plan for Chengannur town is shown in Figure 20:1. 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 roads are only indicative, and are subject to modifications based on actual ground conditions at the time of detailed engineering surveys.

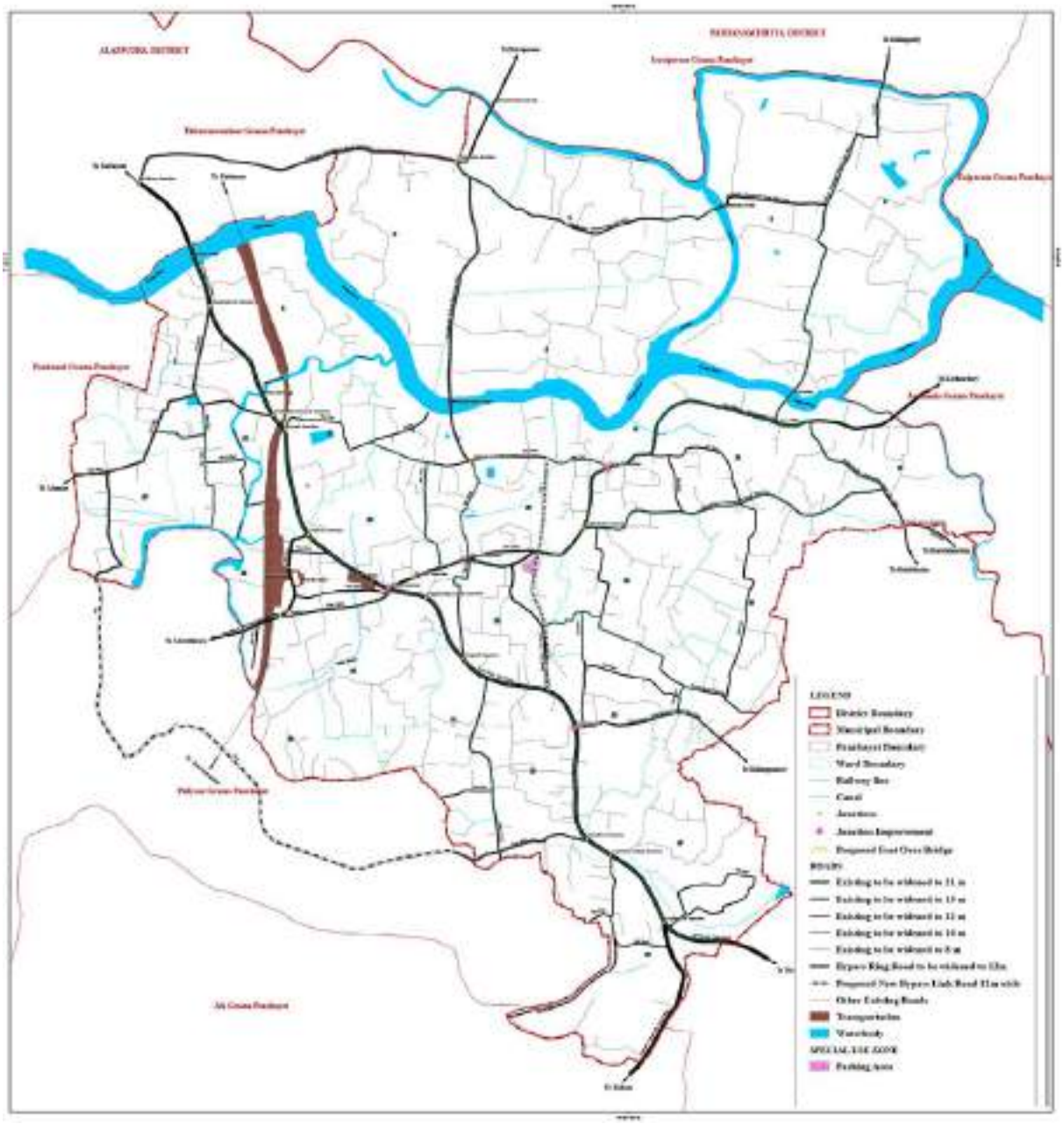

Figure 20:1 Proposed Road development plan for Chengannur Municipality

20.1.1 Road widening and elevation

The main stretch of roads passing through the Municipality is MC Road, Mavelikara - Kozhenchery State Highway (SH 10) and Venmony - Chengannur Road. Most of the parts of these roads were inundated during the flood that occurred on 2018. Therefore, selected stretches of these roads and also inner road which are identified as part of evacuation route are proposedto be elevated. The height of the road from the base can be raised to avoid the entry of flood water into the road making the evacuation easier.

The road sections which need widening are shown below.

- *MC Road*
- *Mavelikara - Kozhenchery (SH-10)*
- *Venmony – Chengannur Road*
- *Bethel Junction – SBI Junction Road*
- *Chengannur Temple – Rotary Junction (Sabarimala Road)*

The details of road stretch to be widened to 10m or above are shown in Table 20-1. There are other roads which are proposed to be widened to at least 8m. They are shown in Proposed Road Development Plan. All other existing roads in the town should be maintained for smooth flow of vehicular and pedestrian traffic. Proper drainage facilities shall be provided while constructing new roads or widening the existing roads anywhere within the Municipality.

Table 20-1 Roads selected for widening

Sl.No.	Name	Existing width	Proposed width
1	M C Road	12	21
2	Mavelikkara - Kozhenchery Road	10	15
3	SBI Junction – Velavoor Junction	8	12
4	Kallisseri- Eraviperoor road	8	12
5	Chengannur-Othera Road	7	12
6	Ganapathy Temple jn - Channathil junction Road	7	12
7	Mundancavu jn - Thrichittat jn rd	6	12
8	Hatchery jn - Proposed by pass Road	6	12
9	Channathil jn - Netaji Road		12
10	Mundencavu jn - Hatchery jn		12
11	Puthenkavu - Iraviperoor Road	9	10
12	Mulakkuzha - Puthenkavu Rd	8	10
13	Angadikkal - Puthenkavu Road	8	10
14	Chengannur- Parumala Road	8	10
15	Mampatta - Ummathil Road	7.5	10
16	Altara junction - Hospital junction Road	6	10
17	Chengannur - Kidanganoor Road	6	10
18	Aaltara jn - Lion's club Road	5	10
19	Netaji Road	5	10
20	Edanad - Mangalam Road	3	10
21	Puthenkavu - Kurichimuttom Road	3	10



Figure 20:2 Typical Section of 18 m Wide Road



Figure 20:3 Typical Section of 21m Wide Road

20.2 Intersection improvements

Intersections are the vehicle conflict points and are prone to accident risks. Therefore, there is a need to properly design the intersections for streamlining traffic flow and minimizing conflict points. 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 junction improvements would include improvement of junction geometrics such as provision of channelizing islands, acceleration/deceleration lanes, traffic signs, lighting etc., and provision of appropriate traffic control systems. The following Intersection points are identified for detailed design considering the existing traffic flow and the need for future road widening. Importance shall be given to Foot Bridge, Foot path, Bicycle tracks etc. during junction improvements or road development activities.

1. Bethel Junction
2. Althara Junction
3. ITI Junction
4. Puthencavu Junction
5. Rotary Junction

20.3 Terminal facilities

The existing KSRTC and private bus stand located in the town needs renovation. The entrance and exit of the present terminals are presently congested due to lack of required road width. Water flooding in the stand also needs to be addressed and tackled with proper drainage facilities. Both terminals require good buildings to meet the demand of facilities for passengers. Toilets, waiting hall, drinking water, women friendly rooms, office rooms, halting room for officers etc. are required in the building.

20.4 Pedestrian prioritization

Chengannur, which is the gateway to Sabarimala pilgrims from other states, is heavily congested especially during the months of November to January. Challenges for the management of such facilities include knowing the number of visitors, determining the source of congestion, localizing the different points of interest, the design of the facility and possibly defining timetables in the case of transport hubs.

The following facilities can be provided after a proper study of the pedestrian characteristics of the town.

- Designation of pedestrian paths with raised kerbs to prevent unauthorized parking
- Introduction of pedestrian signals with traffic signal systems
- Provision for barricades to prevent direct entry of pedestrians to road at unsafe junctions and highways
- Provision for pedestrian infrastructure like benches and lights

The pedestrian facilities that need to be considered are:

Sidewalks or walkways:

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 Chengannur town, considering the existing pedestrian demand, sidewalks with a width of 1.50 m to 2.00 m is proposed for all types of roads including arterial, sub-arterial, collector and local roads.

Marked crosswalks and enhancements:

Marked crosswalks indicate optimal or preferred locations for pedestrians to cross and help designate right-of-way for motorists to yield to pedestrians. Crosswalks are often installed at signalized intersections and other selected locations. Marked crosswalks are desirable at some high pedestrian volume locations (often in conjunction with other measures) to guide pedestrians along a preferred walking path. For Chengannur 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, religious places, hospitals, bus stops and commercial centres.

Pedestrian Overpasses or Underpasses:

Pedestrian overpasses and underpasses allow for the uninterrupted flow of pedestrian movement, separated from the vehicle traffic. However, they should be a measure of last resort, and it is usually more appropriate to use traffic-calming measures or install a pedestrian-activated signal that is accessible to all pedestrians. This is also an extremely high-cost and visually intrusive measure. Such a facility must accommodate all persons. These measures include ramps or escalators. Extensive ramping will accommodate wheelchairs, but results in long crossing distances and steep slopes that discourage use. Studies have shown that many pedestrians will not use an overpass or underpass if they can cross at street level in about the same amount of time. Overpasses work best when the topography allows for a structure without ramps. Underpasses work best when designed to feel open and accessible. Grade separation is most feasible and appropriate in extreme cases where pedestrians must cross roadways of high speed, high-volume arterials.

Pedestrian underpass/overpasses are proposed at selected locations in Chengannur town which have high concentration of commercial establishments and pedestrian volume. The locations are shown in Fig.20.4 and are listed below.

- KSRTC Stand,
- Railway Station,
- Market Road,
- Bethel Junction,
- Vellavoor Junction
- Hospital Junction

Figure 20:5 shows the proposed pedestrian path from KSRTC bus stand to Private Bus stand. This path can be converted to Non-Motorised Path during festival season for easy movement of pilgrims. Detailed engineering surveys need to be carried out before finalizing the exact location and design of the pedestrian facilities at the proposed sites.

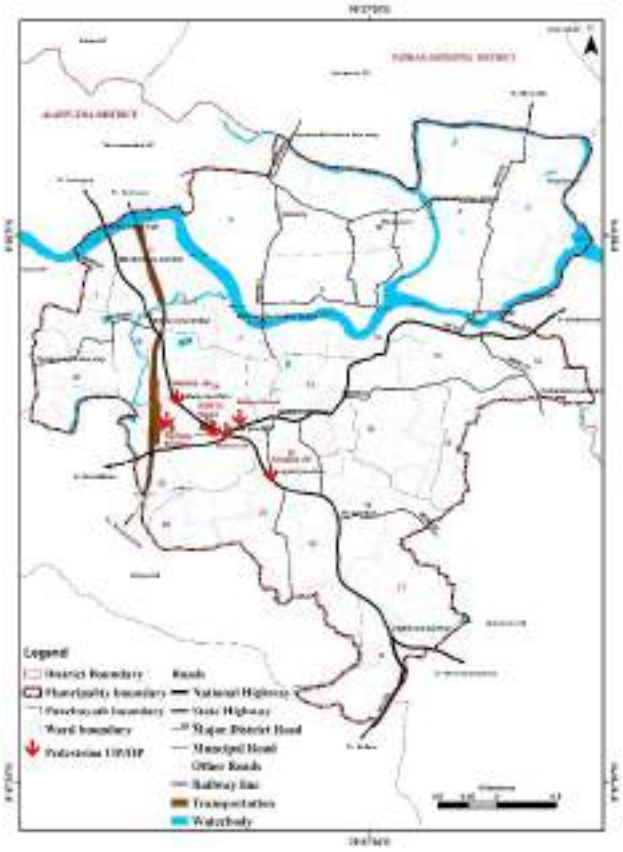

Figure 20:4 Map showing the location of pedestrian overpass/underpass

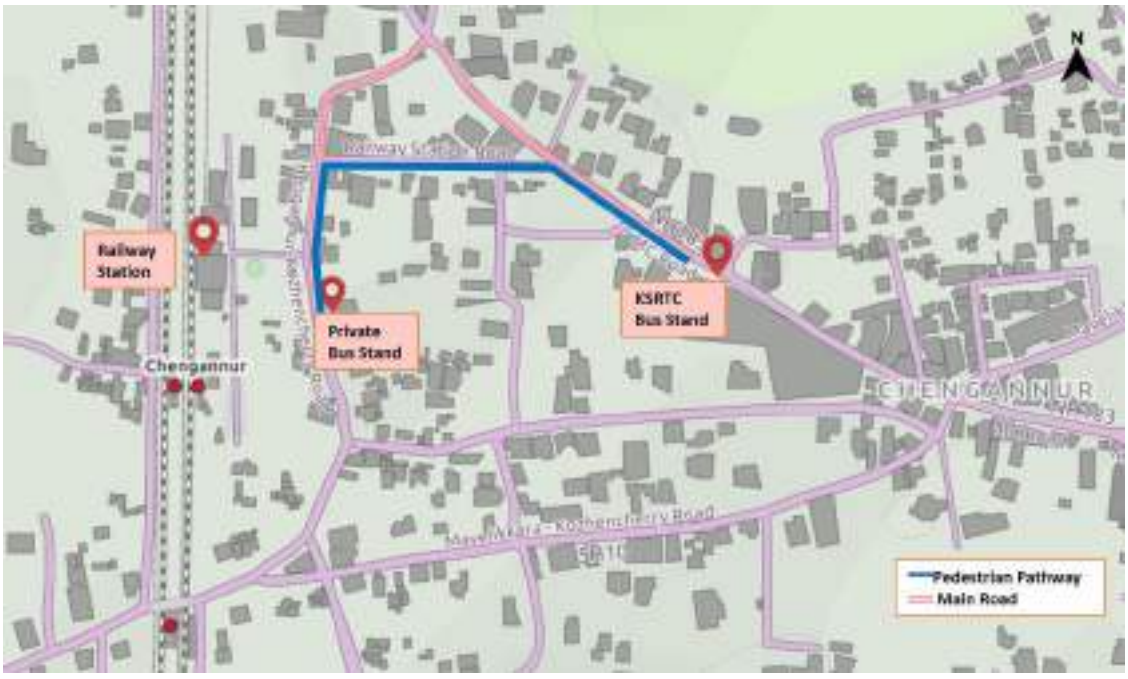

Figure 20:5 Proposed pedestrian path connecting KSRTC and private bus stand

20.5 Parking facilities

As most of the commercial activities are cantered along the main road, as a short-term measure, a parking management plan need to be prepared for the main roads with earmarking of parking spaces for various categories of vehicles utilizing the available road spaces. A progressive parking fee need to be considered to restrict long haul parking with low fee for short duration parking and relatively high fee for long duration parking. Organized on-street parking can reduce the parking problems in CBD area. Whereas considering the heavy parking demand along the major commercial roads, suitable off-street parking lots need to be developed at suitable locations.

Considering the parking demand observed at many of the road stretches, a combination of commercial cum automated parking system is proposed for Chengannur town. The tentative locations for provision of these facilities are given below;

1. KSRTC Stand
2. Railway Station
3. Market Road
4. Bethel Junction
5. Vellavoor Junction
6. Hospital Junction



Figure 20:6 Multilevel Parking

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. Recently in Trivandrum, a six-storey 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.

A Multi level Parking is proposed near by the town centre which can be used as pay and park. This can be managed by the Municipality if possible. This parking facility can decongest the vehicular traffic and road side parking in the town centre.

20.6 Truck Terminal

In the site identified for the multilevel parking, a truck terminal is also proposed. This is within 1 km from the Chengannur market.

The location of the site identified for multilevel Parking and Truck Terminal is shown in Figure 20:7.

20.7 Improved street design and regulatory measures

Carriage way design should be such that it should maintain a constant width, thereby ensuring the smooth flow of vehicles. The width should not increase on stretches where a wider right-of-way is temporarily available. Wider carriageway segments cause traffic jams where the width narrows again. Clear boundaries of carriage should be defined through curbs

and material differences. Width ofcarriage way shouldbe defined by the function of the street rather than available right-of-way.

Wider footpaths can accommodate street vending and larger seating areas and are recommended in areas with large pedestrian volumes. A proper traffic signal system should be implemented and Rickshaw and taxi stands should be mainta ined in authorized spaces. Traffic related rules and regulations should be strictly followed & monitored and training & awareness programmes on road safety should be conducted.

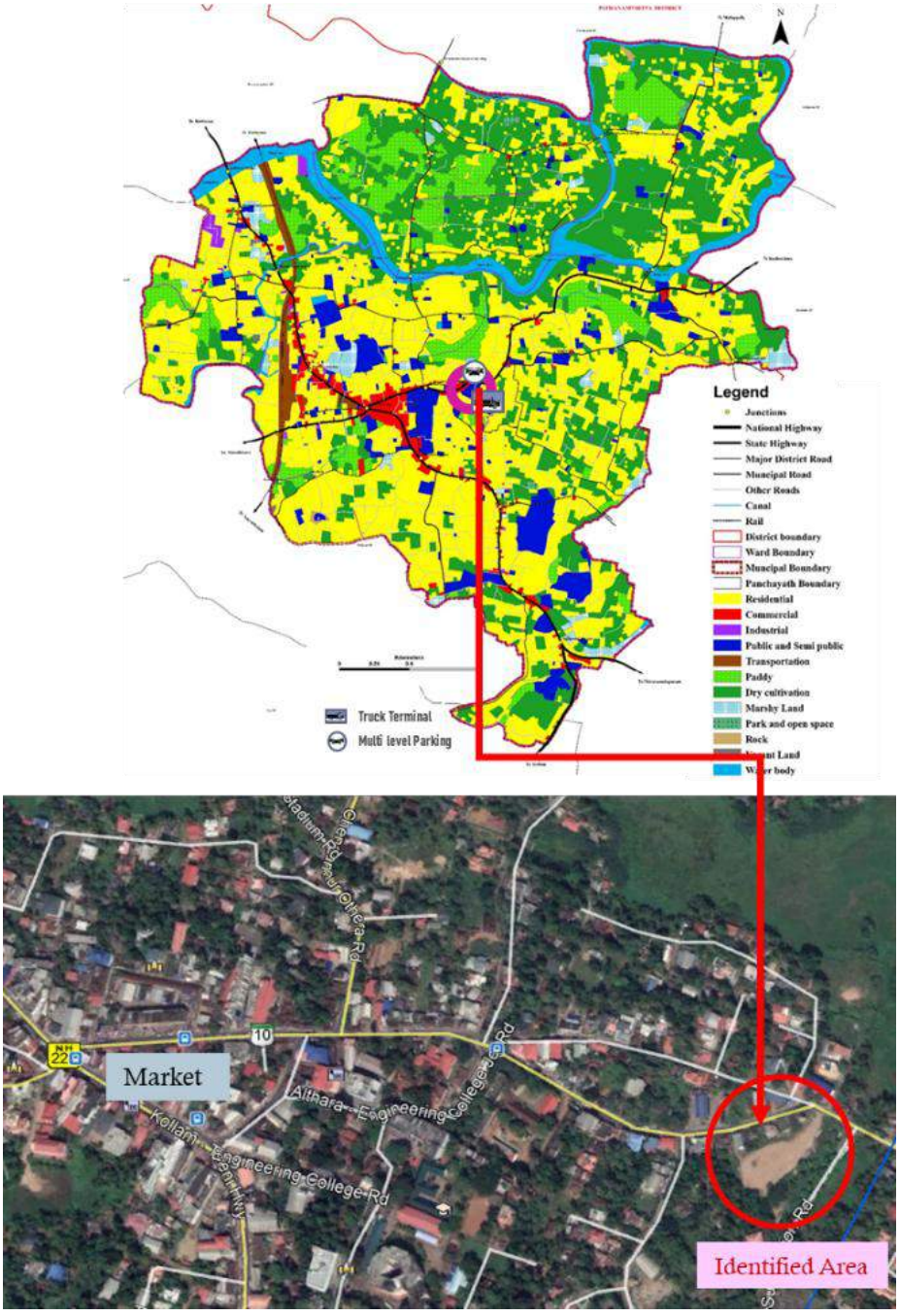

Figure 20:7 Location of Multilevel Parking & Truck Terminal

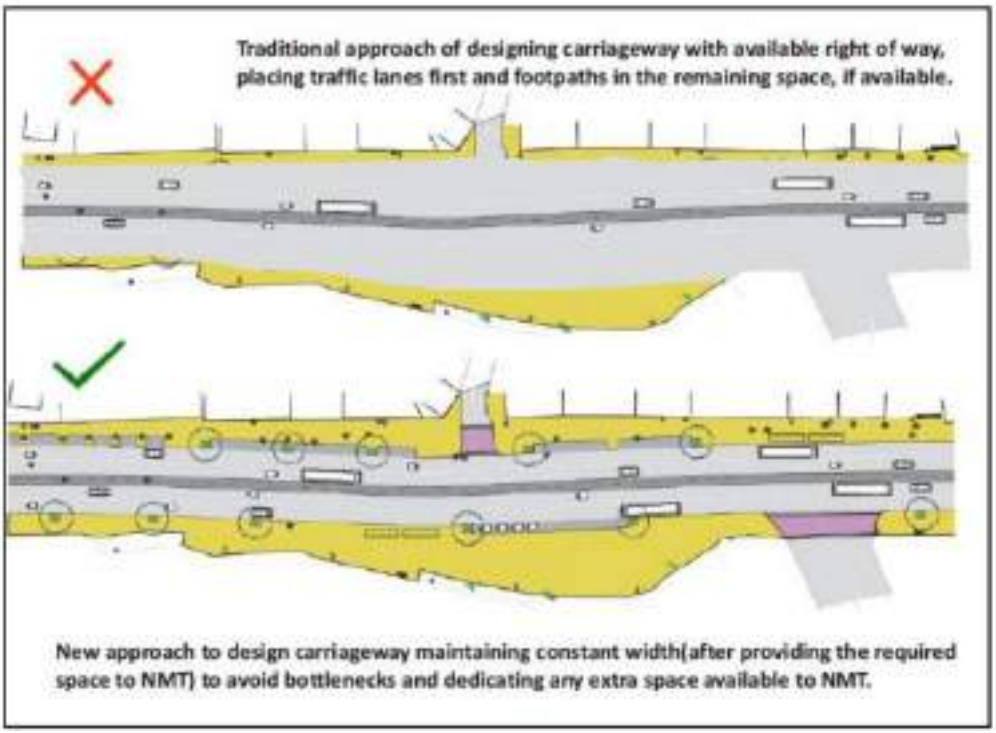

Figure 20:8 strategy to provide even road width

Traffic calming tools

The increased use of private vehicles necessitates traffic calming to ensure that streets remain safe for pedestrians and cyclists. Traffic calming elements are particularly important in places where large numbers of children are present, such as schools, parks, and residential areas. Traffic calming uses physical design and other measures to improve safety for motorists, pedestrians and cyclists. It aims to encourage safer, more responsible driving and potentially reduce traffic flow. Urban planners and traffic engineers have many strategies for traffic calming, including narrowed roads and speed humps.

Traffic calming can take different forms depending on the context, and is most effective where two or more mechanisms are combined. Typical forms of traffic calming include speed humps and raised pedestrian crossings, both of which rely on vertical displacement to reduce vehicle speeds. Severe speed bumps are uncomfortable for cyclists, rickshaws etc. Roundabouts have the benefit of improving both safety and traffic flow.



Figure 20:9 Traffic calming tools like central medians and diverter

20.8 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.

Major roads that lie within the flood prone area can be elevated and design as all weather roads, after detailed study and analysis. 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.

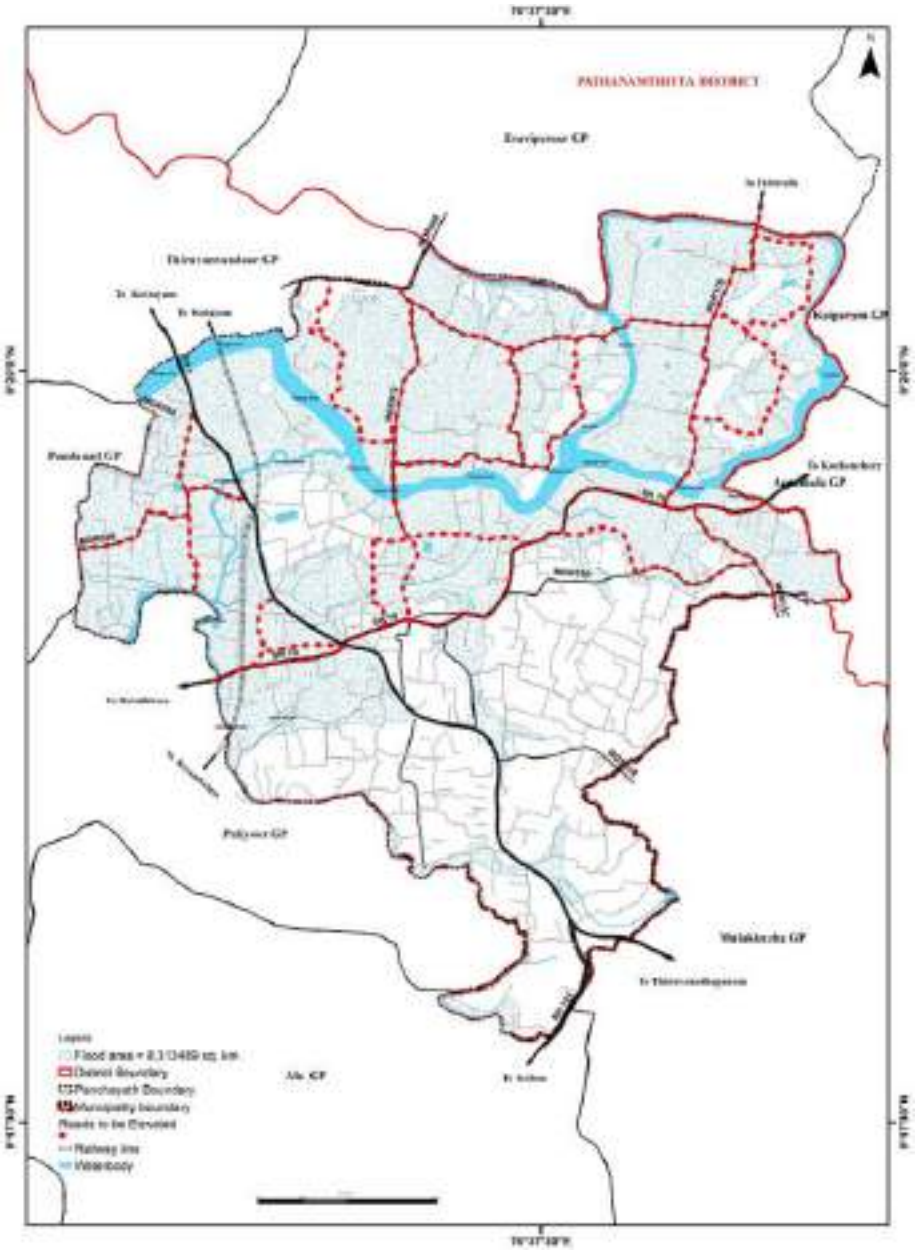

Figure 20:10 Identified Roads to be upgraded as All-weather Roads

21 SECTORAL PROPOSALS

21.1 Trade & Commerce

The development of this sector is ensured by the land use policies and projects to be taken up by the municipality. The major proposals for developing commercial facilities include development of higher order commercial centres. Higher order commercial facilities are permitted on the sides of roads with higher width. These zones are intended for the boosting up of commercial activity.

21.1.1 Market Redevelopment Project

The present market cannot carry the increasing pressure and thus needs upgradation. The market structures are old and are in dilapidated conditions. There are no proper infrastructural facilities and amenities, lorry stands and parking facilities in the area. The improper organization of spaces and haphazard development has created congestion and havoc in the place. Thus, it is a must that it is to be properly planned for city's future development and proper order.



Figure 21:1 Existing Chengannur Market

The project aims at redevelopment of urban space to accommodate a planned urban organized space. Decongestion of core area can also be attained with proper parking and thus ease the flow of the area. The renovated market should provide all modern facilities to cope up with the pressure. The major Project components are:

- Open Plaza
- Stall Units
- Toilet Complex
- Drinking Water Kiosks
- Integrated Solid waste and liquid waste Management
- Space for street vendors
- Parking Area
- Office Spaces

Stalls are to be given individual numbers and weekly minimum rent can be collected. Rotation of stalls and rent renewal to be done accordingly.

21.1.2 Street Vendors Zone

Street vendors are an integral component of urban economies around the world. Distributors of affordable goods and services, they provide consumers with convenient and accessible retail options and form a vital part of the social and economic life of a city. 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 21:2 Conceptual Image of Street Vending Zone

21.2 Tourism

For efficient utilization of available tourism potentials within the planning area several development proposals are suggested. The present attraction of the town is mainly the pilgrim tourism. It is related with Sabarimala Makaravilakku festival. Chengannur Mahadeva Temple is the edathavalam for pilgrimmers.

21.2.1 Pilgrim Amenity Centre

A pilgrim Amenity centreis proposed in the town to facilitate the needs of pilgrims especially the Sabarimala visitors. Facilities include

- Rooms
- Dormitory
- Restaurant
- Locker facilities
- Toilet blocks
- Drinking water outlet

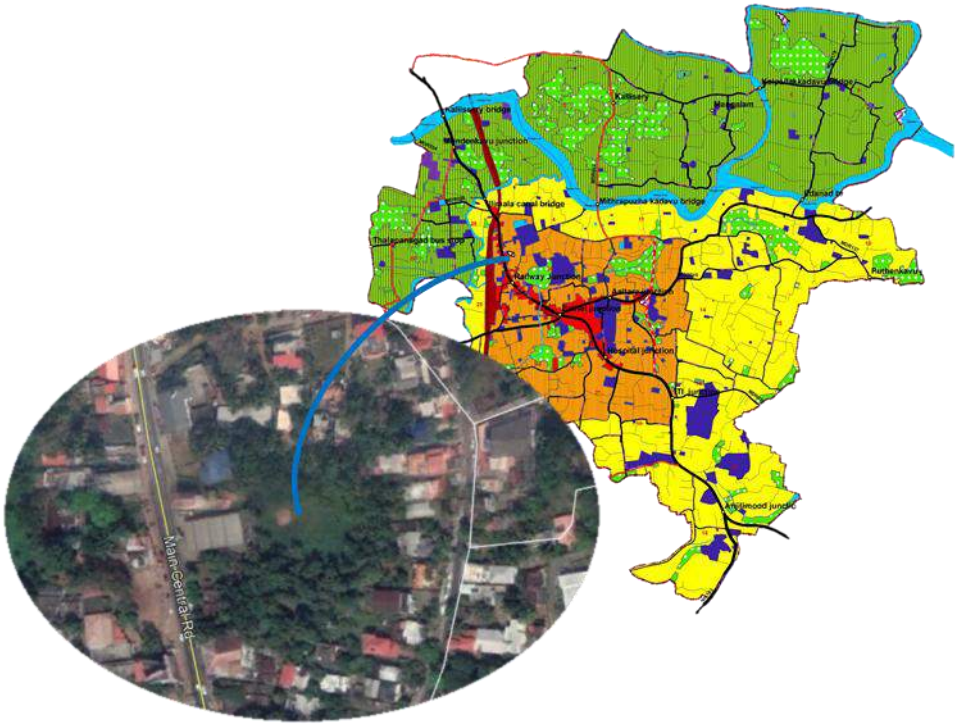

Figure 21:3 Proposed Location of Pilgrim Amenity Centre

21.2.2 Tourism Circuit

Tourism circuit is composed of various tourist destinations. It is defined as route having at least three major tourist destinations which are distinct apart. Circuit should have well defined entry and exit points. A tourist who enters should get motivated to visit most of the places identified in the circuit.

Developing tourism circuit connecting major attractions like Chengannur Mahadeva Temple, Mithrapuzha Palliyodam, Edanadu Palliyodam Kallari Para, St. Mary's Orthdox Church, Noottavan para, Pandavan para, Old Suriyani Church, Thrichittatt Panchapandava Maha Vishnu Temple, Vadasserikkavu Bhagavathi Temple, & Mundankavu Palliyodam can enhance the tourism status of Chengannur. This is shown in Figure 21:4.

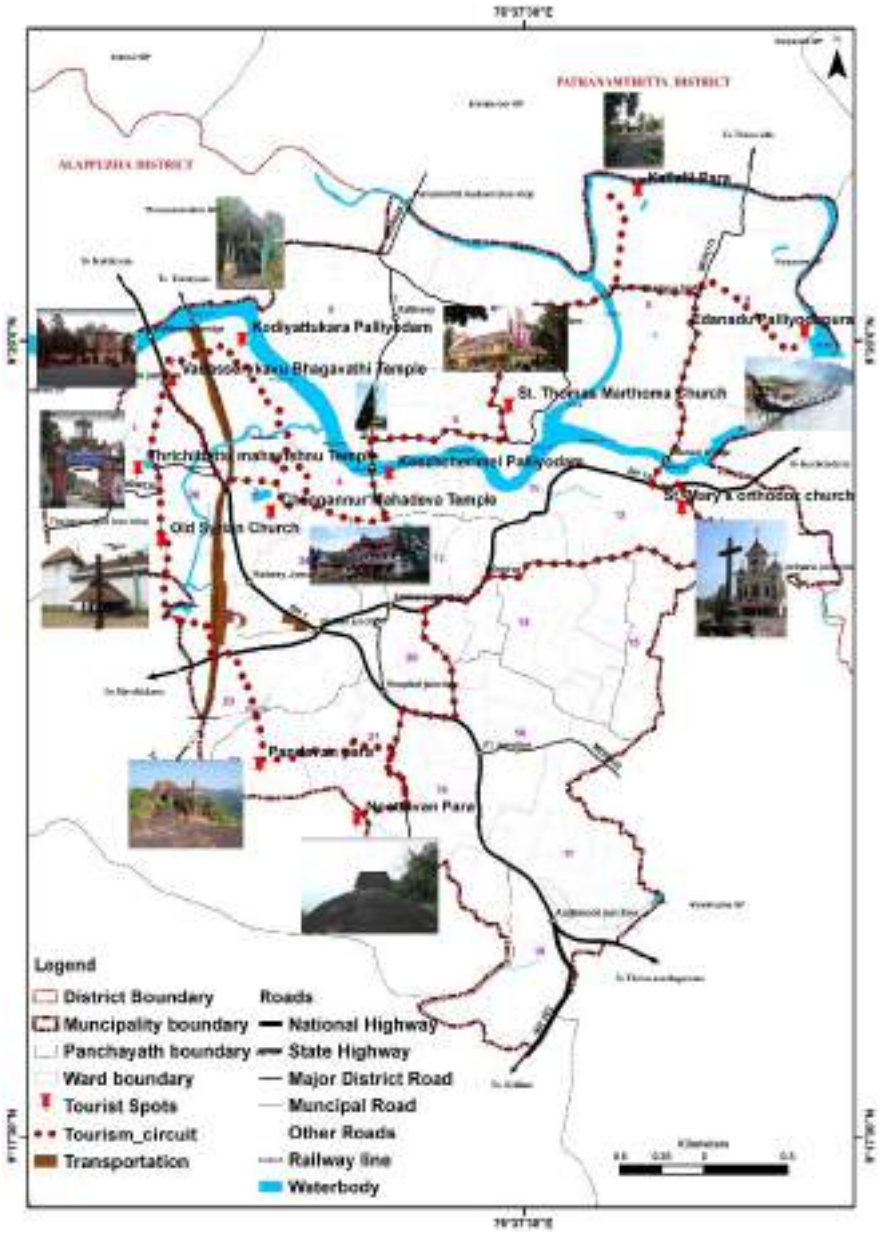

Figure 21:4 Tourism circuit Map of Chengannur

There are also five famous temples in and around Chengannur, believed to be consecrated by the Pandavas in their names and dedicated to Lord Krishna. Dharmaputra the first born among the Pandavas, is idolized in Thrichitatt, close to the town, Arjuna in Aranmula temple six miles away, Bhima in Puliyoor temple two miles away, Nakula in Thiruvanvandoor temple two miles away and Sahadeva in Thrikodithanam temple ten miles away.

There is great scope and need to develop tourist activities on specific themes to attract tourists having special interest in visiting such places. Such theme-based tourist circuits should be developed in a manner that supports communities, provides employment and fosters social integration without compromising upon the environmental concerns and provides unique experience to the tourists.

21.2.3 Tourism Spots

Pandavan Para to be developed as a pilgrim tourist centre with basic amenities. The rock 'Kallarippara' is proposed to be developed as a recreational open space with temporary seating arrangements without altering the character of the area.

21.2.4 Improvement of existing facilities

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.

21.2.5 Infrastructure development of Tourist areas

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

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. should be promoted. 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, service and part time job opportunities for the local youngsters can boost the responsible tourism and local employability.

Chengannur was badly affected during the 2018 flood, hence tourism development should encompass adequate safety measures for evacuation of tourists to safe places.

21.2.6 Greening the Tourism Sector

Revenues from tourism, if used creatively, can bring in funds and reasons for maintaining environmental resources in a better manner. Management of solid and liquid wastes, for instance, is a major issue in most places of tourist attraction. A comprehensive approach to greening the tourism sector, including an eco-tax for tourists could be a major step towards making Kerala's tourism green. Similar measures could also apply to major pilgrim destinations.

Currently the pilgrim visiting Sabarimala mostly will be in Chengannur only for one day. Further, due to the additional facilities and infrastructure being created, the average

spending of a pilgrim would increase as also his length of stay a site. The indirect benefits arise out of the multiplier effect of pilgrims spending in the region as the different segments of the tourist industry are to purchase various commodities and services from other sectors of the economy to meet the demand. Establishing a tourism pilgrim circuit will be a major revenue income source from the tourism sector.

21.3 Agriculture

In addition to increase the production in agricultural sector, the rejuvenation of agriculture sector of planning area is necessary as measure to ecological conservation also. In the proposed land use, these factors are considered and the agricultural area has proposed in with certain restriction on other activities. Similarly, in the low-density areas there is ample scope for home stead cultivation. A combined action in agriculture, animal husbandry and solid waste management will improve the self-sufficiency and health standard of inhabits.

21.3.1 Promotion of Agriculture

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 reasons for not cultivating 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 MGNREGA workers can also be adopted during the initial stages of land preparation, for creating micro irrigation canals around the 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. Cultivation in the uncultivated land by leasing out the land to interested cultivator's groups may also be promoted.

It is proposed to promote the production of value-added products 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.

21.3.2 Home Stead Cultivation/ Rooftop 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. Low residential density areas can be promoted with home stead cultivation. Residential area is available with large plot size. 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.

21.3.3 Promote Organic & Integrated Farming Systems



Figure 21:5 Homstead Farming

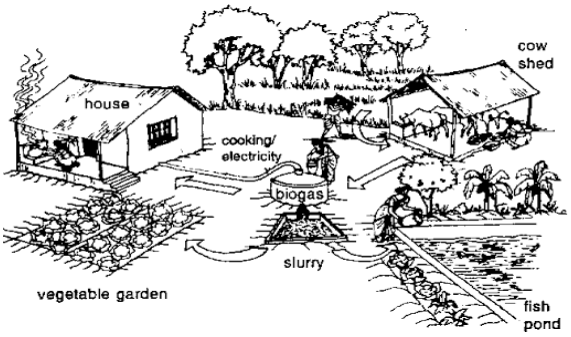

Figure 21:6 IntegratedFarming

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.

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. It is recommended to encourage multi-cropping, fish farming cum rice cultivation, or inter-cropping pepper, banana, nutmeg, clove, heliconia, and pineapple in coconut/areca nut plantations to enhance the unit productivity of land.

21.3.4 Agro Service Center

Agro service center 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 equipment's, 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 importance in productivity improvement.
- Farmers may also be made aware through ASC about the latest scientific agricultural practices available.

21.3.5 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.

21.3.6 Formation of 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.

Non-Workers can register to the labour bank and required agricultural labours can be allotted based on the demand from the cultivators. The infrastructure facilities can be improved and production of seedlings can be increased and activities can be extended to more area. Cultivation in the uncultivated land by leasing out the land to interested cultivator's groups may be promoted. Training programs for various agricultural activities, such as Paddy cultivation, Tapping, coconut climbing etc. can be done. Some incentives for the agricultural workers can be introduced such as Pension schemes in coordination with Municipality.

21.4 Animal Husbandry

Animal husdandry has an important role in the development of a town. When the animal husbandry is active, town will get fresh egg, milk, and meat. It also helps to earn income for the families. Now this sector is not influencing the farmers due to higher price of cattle feeds, diseases for cattles, etc. The town can overcome this through by giving subsidies to cattle feeds, promoting fodder cultivation, supply of high yielding cattles etc. Though Meat stalls are present in the town, there is no proper slaughter house.



Figure 21:7 Elevated Shed

Major Proposals are upgradation on existing Hatchery, Establishment of DiaryFarms and Slaughter House and promotion of fodder cultivation.

Considering the risk of flood in the area, elevated sheds can be promoted for the livestock.

21.4.1 Upgradation of Central Hatchery

Upgradation & modernisation of Central Hatchery is proposed.

21.4.2 Dairy Farms

A modern dairy farm should be developed in Agriculture cum Residential zone to boost the animal husbandry sector in the town.



Figure 21:8 Dairy Farm

21.4.3 Slaughter House

Proposal for a slaughter house in the renovated market complex. It includes 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 21:9 Slaughter House

21.4.4 Promote Fodder Cultivation

Fodder cultivation has become an immediate necessity for promoting dairy development activities and to support the development of Livestock Sector. For this, 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.
- 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.
- 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.



Figure 21:10 Fodder Cultivation

21.5 Fisheries

Considering the waterbodies present in the town, Chengannur has a scope of inland fish farming. All existing streams and ponds in the town can be protected, deepened and used for fish cultivation/ farming. The proposals to develop inland fishing includes:

21.5.1 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 for extra income.



Figure 21:11 One PaddyOne 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.

21.5.2 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 skills 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. 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.



Figure 21:12 Brackish Water Aquaculture

21.6 Industry

House hold industries with thrust on agro based industries can be promoted in the town. It will help the progress of economic status of the households. In addition to this, MSME industries shall be allowed in all zones considering the surrounding developments. Municipality should take necessary actions to promote the development of industries in the town. Existing Industrial Estate site can be used for the development of small-scale industries.

Priority is given to value addition of produces from agriculture, animal husbandry and fisheries sector.

21.6.1 Proposal for Skill Development & Training Center

Skill Development and Training centre is proposed as 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.

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, LCD bulb assembling units can also be incorporated in training programme.

21.7 Environment

21.7.1 Conservation of Wetland

Wetland conservation is aimed at protecting and preserving areas where water exists at or near the Earth's surface, such as swamps, marshes and bogs. Wetlands cover six per cent of the Chengannur municipality and have become a focal issue for conservation due to the ecosystem services they provide. Wetlands are also one among the three major factors that makes Chengannur less viable to floods and other natural disasters.

According to the Kerala Conservation of Paddy Land and Wetland Act, 2008, it is mandatory to conserve the paddy land and wetland and to restrict the conversion or reclamation thereof, in order to promote growth in the agricultural sector and to sustain the ecological system, in the state of Kerala. Using the provisions in this act, the wetland of the municipality is proposed to be conserved. Cultivation of paddy and other intermediary crops without changing the ecological nature of the wetland is promoted.

Wetland conservation prevents the vulnerability of flooding and water logging without changing the infiltration/ settlement characteristics of soil. Paddy cultivation improves the

agricultural sector with increased number of employment opportunities thereby improving the primary sector. Paddy cultivation also increases the income from the agricultural sector.

According to the Kerala Conservation of Paddy Land and Wetland Act, 2008, the Government, shall take suitable measures, from time to time, in order to assist the farmers to augment the production of paddy. Funding can be from the Municipality budget and in accordance with various central and state schemes promoting agricultural activities.

The proposal can be implemented by (i) Padasekhara Samithis or Joint Farmers Societies; (ii) Self Help Groups; (iii) the Kudumbasree Units functioning in the Grama Panchayat/Municipality where the wetland is situated and (iv) Krishi Bhavan.



Figure 21:13 Spatial Distribution of Wetlands

21.7.2 Restoration of Rivers and Channels

Protecting and restoring water-related ecosystems including mountains, wetlands, rivers and lakes are key drivers to making a difference when it comes to sustainable development goals (UN SDG 6.6). Strategy involves not just uplifting the water quality, but also improving the physical dimensions of the river. We can establish a replicable model for the city & improve ground water. Reviving the river and channels takes care of flooding to some extent. The steps for restoration of river and channels are as follows:

- Demarcation of river's boundaries to stop further encroachment
- Sewerage Treatment points & Water quality check point should be installed in order to stop pollution
- Dredge sedimentation basin at suitable depth, Construct natural filter bed with dredged mud, & boulders
- De-weeding river & De-silting of the river, by dredging the river & increasing the depth.
- Construct embankments along the river
- Construct fence along the river & promote afforestation in river periphery for natural filtration & percolation.
- Can adopt floating treatment wetland.
- Recreational urban space in embankments. CCTV installations to prevent pollution.

- Monitoring and maintenance should be given to local community group

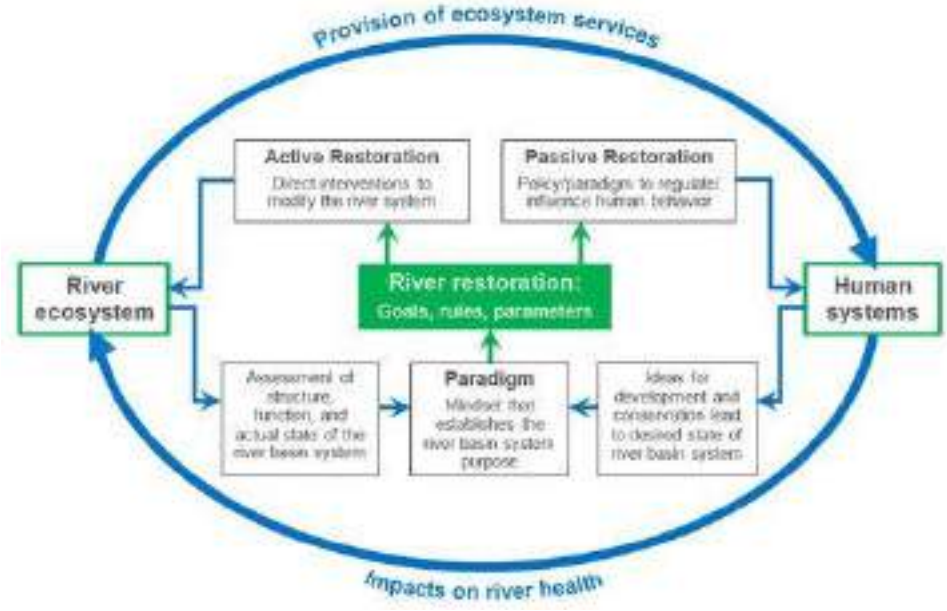

Figure 21:14 River Restoration

Varattar rejuvenation Campaign during 2017 was one of the best example for restoring the waterbodies so as to achieve the sustainable development goals. This channel was revived after 30 years. This process should be done every year pre and post monsoon so as to become resilient against the effects of climate change.

21.7.3 Green forestry – Pachathuruth

The scheme of Pachathuruth aims to identify unused areas including public places and to create and preserve natural forest patterns, including unique trees and native plants. The local bodies are the leading institutions for this purpose. Land, backyards, vacant places in the hearts of the city and other places of government/private institutions are all ideal places for green fields. Green fields are being created with the cooperation of Biodiversity Board, Agriculture Department, Mahatma Gandhi Employment Guarantee Scheme, Social Forestry Division of Forest Department, Environmental Organizations and Educational Institutions.



Figure 21:15 Proposed Location for Pachathuruth Project

Green fields can be placed on land spawning from at least half a cent to more. Green fields can play a major role in reducing

the harmful effects of climate change and combating global warming caused by the presence of greenhouse gases.

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).



Figure 21:16 Areas for Pachathuruthu

Suitable locations have to identify with the help of concerned authorities. In Chengannur Municipality, various spots can be developed under this scheme, promoting a greener environment.

21.7.4 Rock Site Protection

Chengannur is home for a few rock sites with historical importance like the Pandavanpara, KallariPara, etc. Legend says that the Pandavas, during their exile, resided at Pandavanpara and the brothers used to offer worship at the nearby temples. The hillock has some remnants which the locals associate with the stay of Pandavas.

A temple at the hilltop is dedicated to the Pandavas and has Lord Krishna as the presiding deity. There are several curious rock structures like those shaped like a frog (called 'thavalapara' in local parlance) and like the musical instrument maddalam ('maddalapara' in local parlance). These rock structures and temple have the potential to be part of the pilgrim tourism network for Chengannur. The structures have a historical importance and the temple is of religious significance thus making it a key spot for visiting pilgrims and also the general public.



Figure 21:17 Pandavan Para Rock Sculptures

Kallaripara is a beautiful rock site on the banks of Varattar. But there are residential buildings on the top of these rocks. This can be conserved and converted to an eco tourism spot by rehabilitating the households there. The sites identified for pachathuruth is also adjacent to this site.



Figure 21:18 Images of Kallaripara

21.7.5 Conservation of Sacred Groves

Identify and conserve Sacred groves/Kavu within the municipality which has possessed by public as well as private ownership by planting medicinal plants.

21.8 Recreational facilities & civic amenities

21.8.1 River side Park

River side recreational activities like kayaking, ziplining can be promoted for a small stretch in Pampa, Chengannur. Pampa lies in the flood zone; thus, construction of various other infrastructure would not be feasible along river side and would cause more damage to the environment. Therefore, promoting seasonal temporary activities would help in the economic development of the area.



Figure 21:19 Riverside Park

21.8.2 Open Gym

With health issues on the rise due to the changing lifestyle, people are aware about staying healthy and fit. but the exorbitant fees charged by private gymnasiums in the city were keeping many of the health enthusiasts away. The open Gym initiative carried out in Palakkad, Kollam etc can be replicated in Chengannur town as well. The facilities at the gym can be availed for free and without any time restrictions. There would be an instructor to guide people to use the equipment that is installed. The gym can be established near by the any of the proposed Pachathuruth in the municipality as the area is easily accessible.

21.8.3 Hanging bridge

There is already a hanging bridge across Pamba in Chengannur, this can be developed as a recreation spot for visitors to the area. A pedestrian walkway can be provided towards the hanging bridge to facilitate joggers, walking public, cyclists etc.



Figure 21:20 Existing Hanging bridge

21.8.4 Upgaradation of Public Libraries

Upgradation and standardization of existing public libraries including facilities like Digital library, access to published papers and journals, etc. is proposed. Develop Public 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. Data includes, census data, published reports, projects by the departments (Government and Nongovernmental), various data from various departments like Tourism, Commercial, Industrial, Houses, etc. Data have to be saved in soft as well as hard copies. The soft copy data can be saved and uploaded in a web portal, which can be accessed only through the permission of librarian. The main advantage of the UDBC is everybody can get almost all data form a single point, especially research scholars, students, even government departments and also publics. The detailed feasibility study of the project has to be conduct in the lights of concerned authorities.

21.8.5 Public Toilets and other Amenities

Basic amenities like restrooms, toilets, etc must be provided at public stations like the municipality building, bus stands, railway station. All future public buildings must be equipped with such amenities. During the rush of Sabrimala season, additional bio toilets can be installed near by the railway station and bus stand. Comfort stations for the pilgrims could also be constructed in the municipality.

21.8.6 Crematorium

Since, there is no public crematorium is available in the town, at present, a new crematorium with modern facilities is proposed.

21.9 Water Supply

21.9.1 Water Supply Proposal

The proposed water supply project funded by KIIFB covers entire area of one Municipality and Six Panchayaths and Part of Chengannur Municipality. The scheme is designed to cater the water demand in the ultimate year of 2052 with year 2022 as base year with a per capita demand of 150 lpcd for Municipal area and 100 lpcd for Panchayath areas except Cheriyanad Panchayath where the demand-supply gap of 60 lpcd is considered. The pumping hours is taken as 20 hours per day. This project envisaged to improve the production of water by constructing a new water treatment plant of 35.00 MLD capacity at ultimate stage for year 2052.

The major AC lines in the town are now replaced using DI/ PVC pipes. The Scheme also consists of existing 10 metre diameter intake well, overhead storage reservoir (8 No's) of total capacity 88.5 Lakh liters, Pump sets of total capacity 810 HP, sump tanks of 16.6 Lakh liters' total capacity. Total distribution lines of 788.50 km. 200mm to 700mm diameter ductile iron pipes are using for the distribution purpose. Total estimated cost of the proposed project is Rs 199.13 Crores. The total project area is 114.06 km2. Total of 40 Crores included in State budget provision, the proposal is in the starting stage.

Proposal for booster pumps and Over Head Tanks is also done for elevated areas like Pandavanpara to provide uniterrrupted supply of drinking water.

21.9.2 Rainwater Harvesting & Groundwater Recharging

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 harvesting as a massive movement.

Rooftop Rainwater Harvesting

As per notification of GoK 2004, rooftop rainwater harvesting arrangements shall be provided as an integral part of all new building constructions. The rooftop water be allowed to pass through recharge unit/filtration unit and recharge existing well/abandoned well. The cost involved for execution of this structure is about Rs 15000/- for each house. Varsha Scheme of KWA to construct rainwater harvesting structures for low income families can be promoted. Here beneficiaries contribute 10% & Government 90% of the total cost.

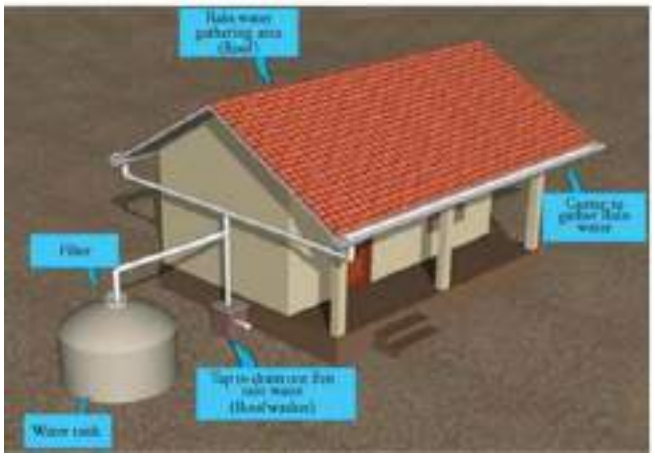

Figure 21:21 Rooftop Rainwater Harvesting

Storm water Runoff Collection and Recharge

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.



Figure 21:22 Storm water collection to recharge wells

The storm water runoff generated within an area can be utilized for groundwater recharge by diverting it into suitably designed structures near pavements, parking lots, municipal parks, play grounds, stadiums, airports etc., and by earmarking some open spaces exclusively for the purpose.

For the above-mentioned measures, Mazhapolima Project implemented by Thrissur can be replicated.

21.9.3 Affordable Water Availablity Project

- Installation of water vending machine at Chengannur Municipality, K.S.R.T.C Stand and other public spaces.
- Revival of reservoirs and initiate a hassle-free water distribution scheme
- Strengthen the water quality surveillance system, including feedback mechanisms and timely follow-up to improve drinking water safety.



Figure 21:23 Water Kiosk

21.9.4 Protection & Restoration of wells and other Water Resources

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. Building resilience in household dug wells is a priority, especially in flood-prone areas. While this activity is the responsibility of the owner, it is advisable that the departments of water and health, together with LSGD, form a joint mechanism to rehabilitate/improve wells, and also set clear guidelines to ensure that the investment serves the objective.

These should be eco-sensitive and built upon the principles of integrated water-resource management, incorporating a water safety and security component. Technical options could be: (i) further sanitising shallow wells (covering, lining, raising platform, and wall); (ii) promotion of rainwater harvesting at household level (can also be used to recharge wells); (iii) utilising unutilised capacity of (solar powered) piped water supply systems with treatment; and, (iv) other alternatives such as spring development, where appropriate.

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.

21.10 Drainage

Natural streams once existed in the towns are missing now due to encroachment. Revival of these streams are necessary to drain the rainwater so as to avoid flooding. Drain mapping should conduct for identifying all drain networks, so that gaps in the existing system can be identified. Proper networking of drains has to be develop in such a way to drain out water from all water logged areas especially occurring in heavy rainy times. Storm water

management should be made mandatory for road development or any other development projects in the town.

21.10.1 Restoration of Drainage Channels

In **Error! Reference source not found.** shows the different stream which are identified f or the restoration. These streams are now not functional and is should be restored as these small streams are vital for other reasons both in flood mitigation and recharging groundwater supplies. Because these tiny streams have the most surface area in contact with the soil not only do they absorb significant amounts of rain thereby preventing downstream flooding but also contribute to groundwater as water within the stream interacts with the soil and is absorbed.

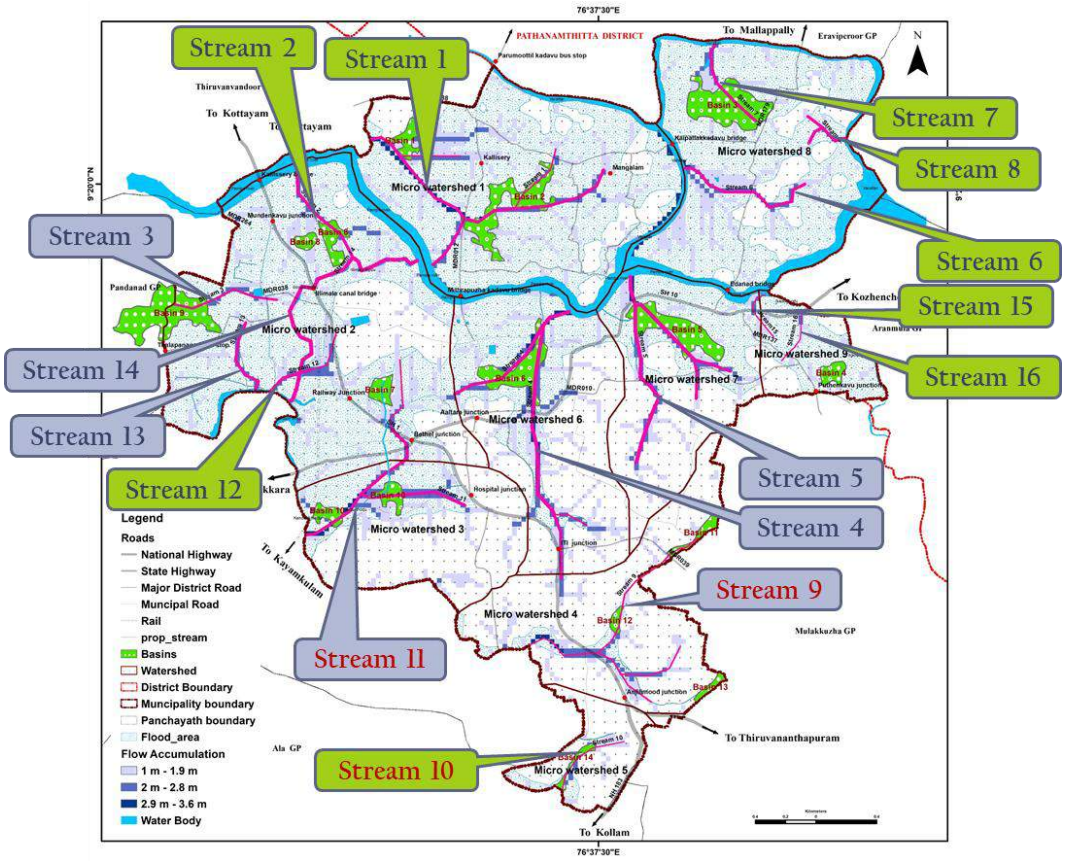

Figure 21:24 Streams identified for Restoration

21.10.2 Restoration of Vettuthode

The Vettuthodu channel passes alongside the city and is now in a deteriorated state. The passage is clogged with waste and other unwanted matter and is not maintained. This causes many social problems to the locals, and also the environment. The channel links with the roadside drains in certain area causing even more environmental hazards. The channel has to be well maintained, allowing smooth flow and not clogged or used as dumping site for waste.



Figure 21:25 Existing Condition of Vettuthodu

Restoration by methods such as desilting, diversion of waste water, and de weeding can be carried out. Restoration of such channels helps in channelizing the flow of water during the monsoons.

21.11 Sewerage

The waste water recycling is a better solution for the waste water management in urban areas. The treated water can be further used for non-potable uses like WC flushing, and irrigation purpose or also can be used for ground water recharge. Waste water management in individual houses can be done as,

- Dual plumbing systems to segregate wastewater (grey & black) should be provided in households will enable the separation of grey and black water at the source of generation.
- The grey water (sullage) constitutes about 70% of the wastewater generated, which can be treated by using simple and cost-effective systems.
- The treated water can be directly discharged into nearby water body, so that the rate of pollution of the river can be reduced.

The Rain water harvesting along with Storm water collection and recharge and Wastewater management will result in better management of open spaces, surface waterbodies and ground water.

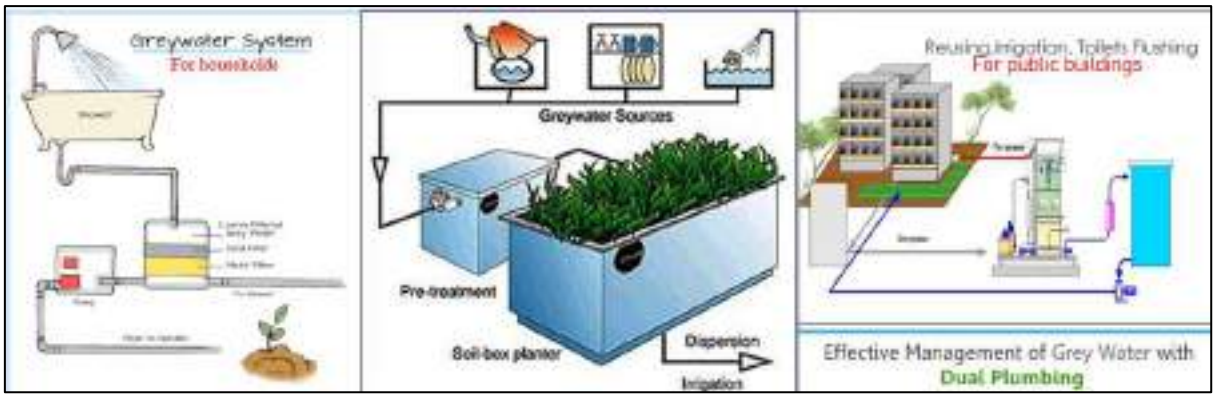

Figure 21:26 Representative image of Liquid waste Management

21.11.1 Sewage Treatment Plant

A centralized sewage treatment plant of capacity 1.5 MLD is proposed in 1 acre land in Ward 8. The site is relatively flat without any undulations. The area is seen as dry agriculture land on the banks of Pampa River. Re-use options shall be formulated for this location itself. Since Pampa River is adjacent to the land identified for the Sewage Treatment Plant, care must be taken not to discharge untreated waste water to this waterbody. It is proposed to lay sewer network for the town to collect the liquid waste to the treatment plant. Intermediate Sewage Pumping Stations (IPSs) should also be proposed at different locations so that the depth of sewers through the town restricted to 6.0 m generally.

21.11.2 Flood Resilient Latrines

It is proposed to design and build flood-resilient latrines in flood-prone areas, with realistic financing options. Flood-resilient latrines should be designed for the Kerala context (can be adapted from existing models in the state and other parts of India such as Assam, Gujarat and Bihar). They should include water-sealed septic tanks (in case not connected to sewer system), to avoid contamination of nearby wells. Suchitwa Mission should hold awareness campaigns for the public on the importance of the latrine model.

21.12 Solid Waste Management

The municipality has initiated various projects for a Clean Chengannur Drive, involving different social groups. Chengannur Municipality is linked with the Clean Kerala company that aims to ensure comprehensive management of all harmful rejections in the state, thereby ensuring that the hygiene of the state is never compromised.

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.
- Promote HH level waste management systems like Biogas, Bio bins etc.
- 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.



Figure 21:27 Biodegradable waste management measures

Collection of Plastics and other such non bio degradable waste is now the duty of the Kudumbasree units and their disposal is done by the company. Proposed to establish material recover facility (MRF) and non-biodegradable processing centres.



Figure 21:28 Plastic waste collection process

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 should be done 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 find 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.

21.13 Energy

21.13.1 Maximise Use of Solar Energy

Given the potential for solar energy generation round the year, town should aspire to be fully solar powered at least in housing, offices, and commercial establishments by 2030. As an interim measure, the government may stipulate that all new building construction, have built in solar panels. Provide tax reduction, subsidies and other benefits to the public to promote sustainable energy. Awareness programs at ward levels need to be conducted. Saura

Project of KSEB where cost of installation of the plant is shared between the consumer and KSEB can be promoted.



Figure 21:29 Saura Project of KSEB

21.13.2 Waste to Energy

Waste-to-energy (WtE) is the process of generating energy in the form of https://en.wikipedia.org/wiki/Electricity electricity and/or heat from the primary treatment of waste, or the processing of waste into a fuel source. It offers an efficient means of managing waste that fits ideally with the needs of large population centers, while providing a source of alternative and renewable energy.

- Promoting installation and use of bio-gas in all households and commercial establishment.
- Waste to Energy Plant can be adopted as a long-term solution to manage municipal garbage.

21.13.3 Promotion of Green Technologies

Every household in Kerala has many opportunities to apply green technologies in household composting, domestic sewage management, solar energy, and resource recycling. Young people can be trained in green technology installation and maintenance and hired at 'green technology centres' developed as cooperative societies. In addition to improving environmental quality, these centres can create thousands of high skilled jobs in the community.

21.13.4 Sustainable Building Guidelines

The new trend of constructing buildings which are not suitable for local weather conditions and then creating a climate-controlled environment within it, is causing high

energy consumption. Kerala could adopt a set of locally sustainable building guidelines, similar to those in the United Kingdom, whereby each building is systematically analysed for its carbon footprint based on its construction and operation. The use of locally available materials is maximised, and the need for energy for cooling and lighting is minimised. This will also create thousands of new 'green jobs' in the state.

21.14 Education:

According to the planning standards the education facilities are adequate for the town. Infrastructure facilities are to be improved.

21.14.1 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 21:30 Smart Class

21.14.2 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 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.



Figure 21:31 Digital Library

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.

21.14.3 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 21:32 Incinerator

21.14.4 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. Vidya Samunnathi scheme of Kerala State Welfare Corporation for Forward Communities Ltd. Can also be utilised for this purpose. 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 who are undergoing training for various competitive exams.

21.14.5 Green Schools

The education sector proposes green schools that create a healthy environment conducive to learning and environmental protection. Efforts will be made to strengthen existing biodiversity parks in all schools and develop greenbuilding infrastructural designs for schools and educational centres suitable to the topography, climate, and local conditions. School buildings will be constructed or refurbished keeping in mind the notion of green and safe schools. Children's Committees and Home Committees should be established and local governments should receive support for drawing up timelines for building back safe and

violence free schools with participation from the community and the children. The main pillars of these schools are good sanitation, waste management, water and energy conservation.

21.14.6 Upgradation of schools and their infrastructures

Upgradation of all the government schools within the town incuding various infrastructure facilities are proposed.

21.15 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:

- Emergency facilities within the municipality should be improved
- Trauma care centres should be initiated with good facilities in all hospitals
- Govt Ayurvedic Hospital, Homeo dispensary & Veterinery hospital is now in flood prone area. This is to be shifted to safe zone.
- Connectivity to medical facilities should be made resilient

21.15.1 Redevelopment of District Hospital

It is proposed to transform hospitals into patient-friendly high-tech centers by setting up facilities such as breathing clinics, relief clinics, cancer detection, gymnasiums, immunization rooms, toilets, modern beds and pre-check-up areas. Chengannur District Hospital is to be upgraded to a modern standard by equipping all the treatment units will be equipped with modern treatment facilities. Trauma care centre and multi speciality block which includes Orthopedics, Radiology, General Surgery, Audiology, Gynecology, Pediatrics, Nephrology, Neurology, Ophthalmology, Oncology etc. should be included in this redevelopment proposal.

21.15.2 Safe & Green Hospitals

The emphasis in the medium term is on improving health care access by restoring health facilities, improving capacities of the health workforce, and promoting Disaster Risk Reduction. The long-term plan is to promote ongoing health sector reforms, strengthen health facilities, and the health information system.

Safe and Green Hospital' initiative, which is more than just protecting buildings. 'It's about ensuring that health facilities are accessible and functional, at maximum capacity, immediately after a disaster strike. Making hospitals and health facilities safe from disasters is not just an economic requirement, but also a social, moral, and ethical necessity.

Building location, design specifications, and resilience of the materials used, all contribute to a hospital's ability to withstand natural hazards. Protection is ensured in the designing of hospital beds, protection to health workforce, equipment, and basic lifelines and services: such as electrical power, water and sanitation, and waste management and disposal.

Architectural spaces need to be properly designed for laboratories and operating theatres, medical records, medical and support services, and administrative processes. All steps including contingency planning, improved organisation and stafftraining are necessary to prevent a functional collapse. The reconstruction of health facilities in flood-affected areas under the 'safe green hospital' practice would include:

- Planning the service area and warehouse based on the maximum height reached by the floodwaters;
- Reinforcing roofs and windows to resist hurricane-force winds;
- Using energy-efficient LED light bulbs;
- Replacing old air conditioners with newer, more energy-efficient models;
- Making the premises mobility-friendly for the disabled and the geriatric patients;
- Ensuring piped water supply;
- Setting up hybrid solarisation; and,
- Installing rainwater harvesting structures.

The number and types of essential equipment should be identified and acquired with adequate buffer for emergencies. The focus must continue on strengthening surveillance of communicable diseases and prompt action to prevent any outbreaks. Emergency transport system of patients to be established, including air ambulances in case of extreme emergency. Mission Aardram under implementation as part of the Nava Keralam initiative to be supported. It includes transformation of primary health centres into family health centres, standardisation of the facilities of district and taluk (sub-divisional) hospitals with super-specialty and patient-friendly outpatient transformation, and ensuring protocol-based case management at all healthcare institutions.

21.16 HOUSING

The housing shortage in Chengannur Municipality can be addressed through various central and state funded schemes.

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.

21.17 Social Welfare

21.17.1 Women Empowerment

Initiatives within the Municipality should be made for improvement of the Kudumbasree programs. Women must be made aware of such initiates and schemes at

neighbourhood levels. Women can be encouraged to run tea stalls and small shops within the municipality complex building. Provide Skill training for women: Tailoring, Computer applications, Handicrafts making etc. Encouraging more Women entrepreneurs in Household Small scale industries/ Micro Enterprises through financial and social support, which would help in bringing the women to the forefront.

21.17.2 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. Special trained nurses and JPHNs are available for the service.

Vayomithram co-ordinators provide help desk service to the needy senior citizens in the area. They can avail the help from the vayomithram office. Counselling service with the consultation of Medical Officers are also available. Special Medical Camps can be conducted in project area for aged.

21.17.3 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.

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 meet and melas should be conducted in all CDSs. Geriatric councils consisting of pensioner's organizations, Kudumbashree, palliative / health workers should be established. Geriatric friendly environments in hospitals should be created.

21.18 Projects Identified

1. Formulation of Municipal level Disaster Response Team & Setting up of Control Room.
2. Upgrading facilities in identified Potential Relief Camps.
3. Demarcation and provision of facilities in Safe Zone Parking & Livestock Shelters.
4. Formulating guidelines for Flood Resilient Construction
5. Upgrading selected roads as All Weather Roads
6. Channel widening, deepening and side protection of Pampa River upto Thottappally Spillway.

7. Restoration of Streams & Channels.
8. Developing water basins for flood water retention and management.
9. Terracing of slopes
10. Development of Bypass Ring Road
11. Widening of identified roads
12. Intersection improvements
13. Multilevel Parking Area development
14. Development of Truck Terminal
15. Pedestrianisation of selected stretches & improvement of facilities for pedestrians
16. Constructing overpass/ underpass for pedestrian crossing at identified locations.
17. Identification & Development of Auto/ Taxi stands
18. Improvement of Street Design & Traffic calming measures.
19. Redevelopment of Market
20. Identification and development of street vendor's zone.
21. Development of Pilgrim Amenity Centre.
22. Establishment of Tourism Circuit connecting tourism spots in the town and making them a part of regional tourism circuit.
23. Conservation of rock site and development of Kallaripara as an eco tourism spot.
24. Redevelopment of tourism spot at Pandavanpara.
25. Conservation of Palliyodams & providing museum facilities for them.
26. Improvement of existing tourism infrastructures.
27. Promotion of mixed crop cultivation in dry land
28. Promotion of Paddy cultivation by group farming
29. Promotion of Homestead cultivation
30. Promotion of organic and integrated farming system.
31. Development of agro service centre.
32. Establishment of weekly markets for agriculture produces.
33. Formation of Labour Bank
34. Upgradation of Central Hatchery
35. Setting up of Dairy farms
36. Establishing modern slaughter house
37. Promotion of fodder cultivation
38. Promotion of 'One Paddy One Fish' program
39. Promotion of Aquaculture
40. Establishment of Agro based industries
41. Setting up of Skill Development & Training Centre
42. Conservation of wetlands
43. Development of Pachathuruth
44. Conservation of Sacred Groves
45. Development of Riverside Park
46. Development of Open Gym
47. Restoration of Hanging Bridge and provision of recreation facilities.

48. Upgradation of public libraries
49. Constructing new comfort stations and public amenities and improving existing ones.
50. Providing Public Crematorium
51. Commissioning of water supply scheme
52. Promotion of Rain water harvesting & Ground water recharging
53. Providing water kiosk in public areas
54. Protection and restoration of wells and other water resources.
55. Drain mapping & networking of drains.
56. Enforcement of solid waste management policies.
57. Setting up of Liquid Waste Treatment Plant
58. Provision of flood resilient latrines in risk areas
59. Promotion of Saura Project to maximise the use of solar energy
60. Promoting waste to energy concept and installation of waste to energy plant.
61. Promotion of Green Technologies & Sustainable building guidelines
62. Upgradation of facilities in educational institutions
63. Establishment of Smart classes and e-libraries
64. Providing electrical incinerators for girl's toilets
65. Special Coaching Centres for economically backward students.
66. Upgradation of schools and their infrastructures.
67. Redevelopment of District Hospital
68. Development of Trauma Care & Emergency facility in hospitals
69. Promoting Safe & Green Hospital initiative
70. Relocation of govt. Ayurvedic & Homeo hospital
71. Upgradation of low-income residential colonies
72. Empowerment of women through skill upgradation and financial back up.
73. Implementation of Vayomithram Projects
74. Implementation of Pakalveedu/ Geriatric Care facilities.

22 LAND USE PLAN

The land use plan is prepared considering the flood vulnerability, Environmental sensitive areas and other existing land uses, Traffic and Transportation network, Spatial distribution of activities, and future development concept of the town. The existing land uses such as Industrial use areas, Public and Semi-Public use area, Park and open spaces, Rock, Paddy and Low-lying areas and Water bodies are retained in the proposed land use zoning.

The flood prone areas in the town is again divided into three based on the possible inundation level, and is categorized as High, Medium and Low Flood Prone Areas. The flood prone areas with high flood inundation level including Waterbodies, Paddy and low-lying areas is zoned as areas with limited human interventions. The flood prone areas with comparatively lesser flood inundation levels that falls ouside the high flood prone areas of the town are categorized as areas with regulated human intervention. The remaining land which falls outside high and medium flood prone areas of town are the areas open to human activities.

The different categories of land uses proposed are:

- Residential Use Zone
- Residential Mix Use Zone
- Commercial Use Zone
- Industrial use Zone
- Public & Semi-Public Use Zone
- Agriculture cum Residential Use Zone
- Traffic & Transportation Use Zone
- Park & Open Spaces Use Zone
- Ecological Conservation Zone
- Water Bodies
- Special Use Zones

22.1 Areas open to limited human intervention

The areas that are to be conserved or protected with limited human interventions includes Pampa River and other water bodies (an area of 73.494 Ha which is 5.61% of total land area), paddy and low lying marshy lands (an area of 117 ha which is 8.94% of total land area), flood plains with higher inundation level (an area of 80.9 Ha which is 6.15% of total land area). The different Zones under this category include Water Bodies, Ecological Conservation Zone and other low-lying areas with high flood inundation depth. These areas can act as infiltration points for ground water recharging. Considering the high flood vulnerability level of these low-lying areas, all the future developments in this zone should be made flood resilient. High priority is to be given for conservation of these sensitive low-lying areas and water bodies by limiting human interventions because they collectively act as a large reservoir area for accommodating the flood water and there by making a passive flood mitigation measure.

22.2 Areas with regulated human intervention

Flood prone areas with medium inundation levels can be included in this zone. In this area regulated human interventions can be permitted with all future developments proposed to be flood resilient in nature. The existing Park and open spaces, proposed Agriculture cum Residential Use Zone and remaining flood prone regions of town are included in this zone.

22.3 Areas open to all human intervention

All other areas that are not included in the above two categories can be included in this safer zone in terms of flood vulnerability and all human interventions can be allowed in this safe area. It is proposed to divert the development activities to these regions considering its less vulnerability in terms of flood by augmenting water supply schemes to reduce the water scaricity problems.

22.4 Land Use Zones

The different areas categorised based on the land use proposed is listed below.

22.4.1 Residential Use Zone

Residential use zone is proposed outside the residential mix use zone which falls in the east, west and southern regions of the town. The residential activities of higher density are promoted in this zone. This zone comprises an area of 359.45 Ha which is 27.45% of the total extent of the town. In order to facilitate the development of housing sector in future, the existing dry agriculture and other developable land parcels in this area are also included in residential use zone along with existing residential areas.

22.4.2 Residential Mix Use Zone

According to the future development concept for future, the areas suitable for residential purposes in the planning area are identified with consideration of existing flood prone area in town. In order to facilitate the development of housing sector in future, the existing dry agriculture and other developable land parcels are also included in Residential Mix Use Zone along with existing residential use areas. Mixed uses of residential, commercial and industrial activities are proposed in this zone.

As per the development concept of Master Plan for Chengannur, industrial sector shall be promoted by encouraging house hold industries and agro based industries. Only MSME category industries which are of non nuisance nature have a scope for development in the town area. In addition to this area, provisions in zoning regulations are made to provide small scale industrial units in other areas. Municipality should take necessary actions to promote the development of industries in the town since lack of industrial development is evident here. All existing industrial land use other than those included in industrial use zone is included in this zone. To maintain a livable environment, hazardous / nuisance causing activities cannot be permitted in this area.

The Residential Mix Use Zone comprises an area of 181.63 Ha which is 13.87% of the total extent of the municipality. Hence, the land required for housing in the future shall be adequate and the net residential density shall remain below the values stipulated for a small town throughout the plan period.

22.4.3Commercial Use Zone

According to the development concept, the central area of the town with vibrant commercial activities is retained in this zone. In this zone, commercial activities are promoted together with residential activities. This zone comprises of 16.2 Ha which is 1.2% of land. In addition to this area, commercial uses are permissible in both sides of roads according to the access road width and in the Residential Mix Use Zone. Considering the existing urban growth pattern and for optimum use of land resource, it is proposed to promote development of similar nature on both sides of MC Road, National Highway and Mavelikkara-Kozhenchery Road in the town to a depth of 100m. More details are given in Zoning Regulations.

22.4.4 Industrial Use Zone

Existing major industrial land use area is retained in Town and it constitutes Industrial Use Zone. A land area of 3.64 Ha which constitutes only 0.28% of total area falls under this zone. Industrial activities of non nuisance nature have a scope for development in the town area, and industrial sector shall be promoted by encouraging house hold industries and agro based industries in this zone. In addition to this area, regulations are made to provide small scale industrial units in other zones like Commercial Use Zone and Residential Mix Use Zones considering the lack of industrial activities and need for promoting them in achieving more economic generation activities of town area. Municipality should take necessary actions to promote the development of industries in the town since lack of industrial development is evident here. To maintain a livable environment, hazardous / nuisance causing activities cannot be permitted in this area.

22.4.5 Public And Semi Public Use Zone

All existing public and semi-public land use are retained in this zone. The total area is 70.89 Ha which constitutes 5.41% of total land area. In this proposed land use no additional land for public and semi-public use is marked. Specific requirements of land for any public or semi-public use will be met at the time of project implementation through locating within other permissible zones. Priority is to be given for accommodating additional facilities like new buildings for hospitals, schools, community hall etc. in the existing public and semi-public zones by utilizing the land optimally. No specific location can be set for higher level institutions since the point of time and nature of ownership of these institutions cannot be ascertained at present. So, provision for these is provided in other areas of mixed use, with certain regulatory measures.

22.4.6 Agriculture Cum Residential Use Zone

The existing land use distribution for the town has identified the north-eastern parts of the town as agriculture predominant area and also is major flood prone area. Hence these areas are proposed to be conserved and zoned as Agriculture Cum Residential Use Zone. A total area of 419.07 Ha which constitute 32.01 % of total land use is zoned under this category.

The north western part of town area which can be considered as a lower region with its three sides made by flowing waterbodies with a comparable high residential density area is also included in this zone. The presence of Pampa River on northern side and Illimala Moozhikkal thodu on east and south sides together with low lying areas and paddy fields and its direct connection with major waterbodies also contributes to high risk and flood vulnerability. The terrain condition with eastern side of Illimala Moozhiiakl thodu on higher elevation and presence of low-lying land on the western side will affect these regions to a severe hazhard situation in terms of flood proneness. So, these areas are also included in this zone for conservation and mitigation.

Any new buildings proposed to be developed in this zone should be built with due considerations of flood proofing and other methods to reduce the effects of any possible flood hazards. Measures to minimize the flood proneness of existing buildings and other infrastructures shall be initiated with the support of municipality.

22.4.7Traffic & Transportation Use Zone

An extent of 61.93 which is 4.73% of land is coming under the traffic and transportation zone. The major share of this extent is area covered by roads, railway line, KSRTC terminal and private bus stands. The municipal road network has been experiencing traffic problems at the town centre. Hence widening and alternate routes are proposed to bypass the inter city traffic. Detailed traffic and transportation plan is given in chapter 20.

22.4.8 Park & Open Spaces Use Zone

From the analysis of the existing land use, it is found that parks and open spaces constitute only 0.29% of the total land use. It mainly consists of existing Park and play grounds. The existing land under Park and Open Space is proposed to retain as such under this zone in the proposed land use for its protection and maintenance. There appears to be a conspicuous shortage of land under this category. The open grounds available within Public & Semi-public land use, recreational facilities proposed as special zones, water side parks proposed in buffer areas and existing water bodies make up for this deficiency to an extent. But the recommended standards in a small town for recreational activities propose to reserve 12 to 14 % of total land area. So apart from these there is a need for development of new parks and open spaces in the town.

22.4.9 Ecological Conservation Zone

The existing paddy land and low-lying marshy land in town are included in this zone. Nearly 100 Ha land is under Paddy land use which constitutes 7.12 % of total area, and 23.8 Ha

land is marshy land which constitutes 1.81 % of total area. Hence this zone constitutes 8.94% of the total land use in town. Conservation and proper utilization of paddy fields are necessary for maintaining a strong economic base for the community. Conservation of these areas is essential for maintaining quality of environment and the other use in these areas are to be strictly regulated. Wetland and paddy land reclamation should be prohibited. Paddy cultivation shall be promoted through strong interference of municiplity. The uses permitted in this zone are in accordance with the provisions in the Kerala Conservation of Paddy land and Wet Land Act, 2008 and other wet land conservation acts relevant for the area.

This zoning designates land reserves in environmentally sensitive areas such as paddy and wetlands. It not only accommodates flood storage and reduces flood risk; but also enhances livelihoods from ecosystem services and provides urban passive recreational spaces. These can be used as a green infrastructure network which can typically form part of newer flood resilience plans. Ecosystem services from these spaces can reduce risks at lower costs and can enhance livelihoods.

22.4.10 Water Bodies

Chengannur is blessed with the presence of River Pampa and several small natural streams running through the town. These natural drains, thodu, chal, and other water bodies like chira, ponds, etc are included in this zone. The water bodies together have an area of 73.49Ha which is 5.61% land. All the existing water bodies are to be conserved, considering its environmental values and the present scenario of flood hazhard. Pre-monsoon cleaning of Pampa River Basin should be ensured to increase its carrying capacity thereby reducing flood risk.

22.4.11 Special Use Zones

Two rock sites, area zoned for liquid waste treatment plant, Pilgrim Amenity Centre and Parking Area are categorized as Special use zones. The total area of Special zone is 2.01 Ha within the proposed land use of Chengannur Municipality.

1. Eco Tourism Spot-I

The rock 'Kallarippara' is proposed to be developed as a recreational openspace with providing temporary seating arrangements without altering the character of the area. Large infrastructure developments are to be prohibited in this area and special measures are to be taken for the sustainable development and management of the area. The ecological disturbances and problems of bio-deterioration are creating havoc in the preservation of rock structures.

2. Eco Tourism Spot-II

The rock 'PandavanPaara' is proposed as a pilgrim tourism area considering its mythical values and the scope for pilgrim tourism in the Town. This rock is included in the proposed pilgrim circuit and proposed tourism circuit developed for the town area. This rock site of the

municipality is categorized as Special use zone to promote the ecology of the area and decrease unwanted human intervention.

3. Liquid Waste Treatment Plant

This identified site is proposed to be developed for the liquid waste treatment plant for the Town. This constitutes an area of 0.28 Ha near Municipal Stadium in Ward 24.

4. Pilgrim Amenity Centre

This constitutes 0.25 Ha area identified for the construction of a Pilgrim Amenity Centre. This facilitates the needs of pilgrims especially the Sabarimala visitors.

5. Parking Area

This is the area identified for multilevel parking and the site for truck terminal. It constitutes an area of 0.41 Ha.

The percentage splitup of these proposed land uses is shown in Figure 22:1.

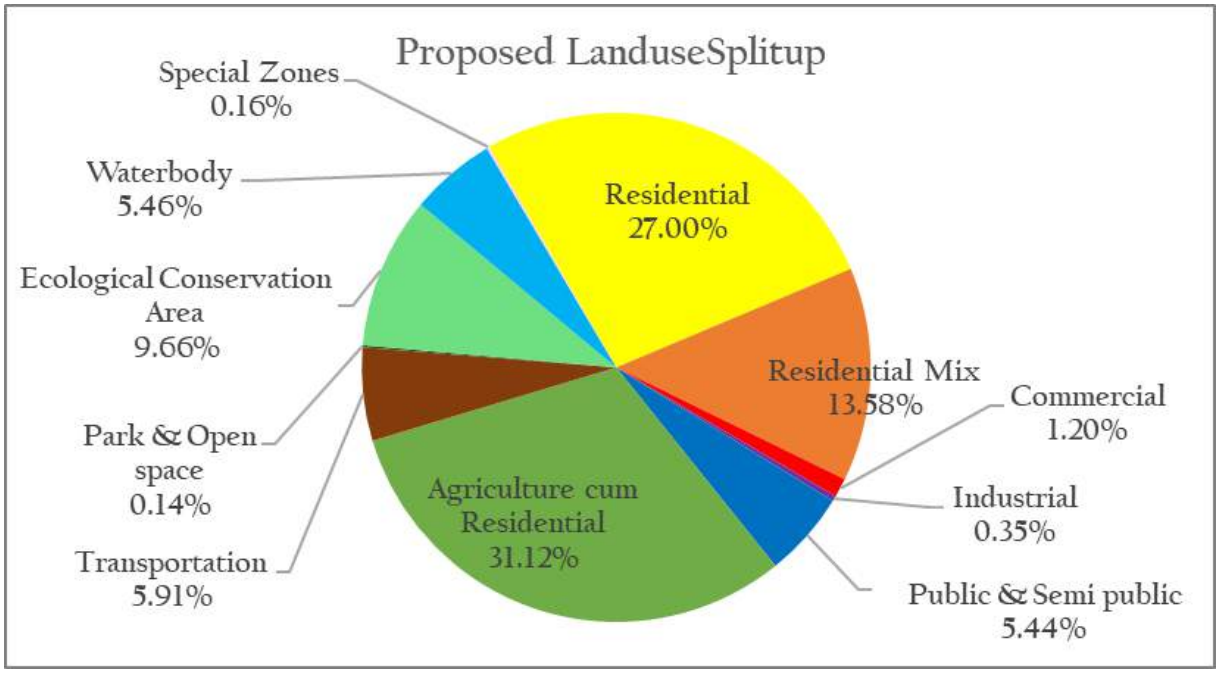

Figure 22:1 Proposed Land Use Split up

22.5 Flood Prone areas

For regulating the development activities, the flood prone area of Chengannur town as per the 25-year Return Probability (RP) data published by KSDMA is divided into three, based on the possible inundation levels. ie: high flood prone area (inundation level >1.5m), medium high flood prone area (inundation level more than 0.6m upto 1.5m) and low flood prone area (inundation level below 0.6m).

Resurvey boundary of Chengannur town is overlaid in the flood prone area map of 25-year RP. All resurvey boundary with 75 percent and above flood prone area coverage is extracted

for zoning purpose. These resurvey boundaries are categorised into two classes based on inundation level of 25-year RP. The resurvey boundaries with low flood inundation level is excluded. The resurvey boundaries with Medium flood inundation level is named as Flood prone area I and the resurvey boundaries with High flood inundation level is named as Flood prone area II. These areas are clearly demarcated in the proposed Land Use map for Chengannur town as shown in Figure 22:2.

22.5.1 Flood prone area I

These are areas expected to have an inundation level more than 60cm and upto 1.5m. This area comes under regulated human intervention. Permitted and Resticted activities in these areas are described in Zoning Regulations.

22.5.2 Flood prone area II

These are flood prone areas with inundation level more than 1.5 m. These areas are zoned as regions with limited human interventions. Permitted and Restricted activities in these areas are explained in Zoning Regulations.

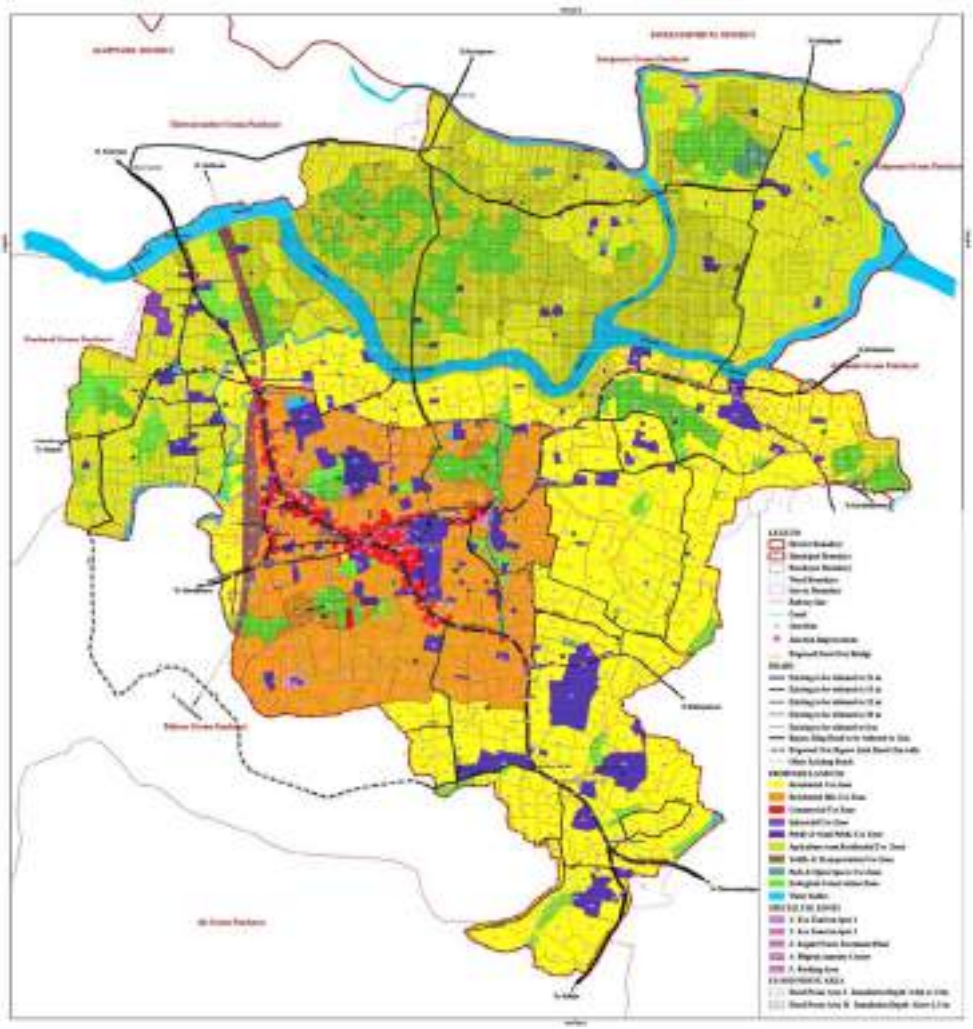

Figure 22:2 Proposed Land Use Map- Chengannur Town

23 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.

To achieve the desired development vision for the town, priority is 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. In addition to this, the projects in all sectors shall be integrated to achieve the desired goals in every aspect. 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 use zone may be acquired or arranged by Land pooling method, or through PPP.

23.1Restoration of Streams & Channels

Chengannur town had a large number of natural streams, through which the storm water flows to nearby river or other water bodies. Now, most of these natural streams are missing or reduced its width due to encroachments. Flow accumulation studies shows that these drainage channels have to be restored and revived for the proper draining out of flood water/rain water. Two streams, which flows through the heart of the town are identified for restoration. ie. Vettuthodu and Illimala-Moozhikkal thodu. The location of these two streams are shown in Figure 23:1. Existing condition of these streams are shown in the following figures.



Figure 23:1: Satellite Image showing the sreams – Illimala thodu & Vettu thodu



Figure 23:2: Existing condition of Vettuthodu



Figure 23:3: Existing condition of Illimala – Moozhikkal thodu

23.1.1 Location & Ownership Details:

The location of the Vettuthodu and Illimala thodu identified by reconnaissance survey is shown in Figure 23:4 . Vettuthodu originates from the Northern side of Bethel Junction in the Town Centre and flows towards South-West direction and meets Kandam thodu. It then flows in Northern direction and then to Illimala thodu towards North –Eastern direction and meets with Pampa river near Mithrapuzha.

Vettuthodu has a length of around 1.200 km in resurvey numbers 303, 301, 295, 131, 133, 181, 182, 183, 178, and 151 of Chengannur village. Illimala thodu and Kandam thodu covers a length of around 3.500 km in resurvey numbers 148, 147, 104, 103, 102, 101, 1 00, 99, 98, 65, 64, 58, 59, 57, 94, 91, 88, 84, 78, 17, 16, 21, 22 and 23 of Chengannur village. These locations are demarcated as Water body, Ecological Conservation Zone and Residential Mix Use Zone in the proposed land use map. The land is under the ownership of Chengannur Municipality.

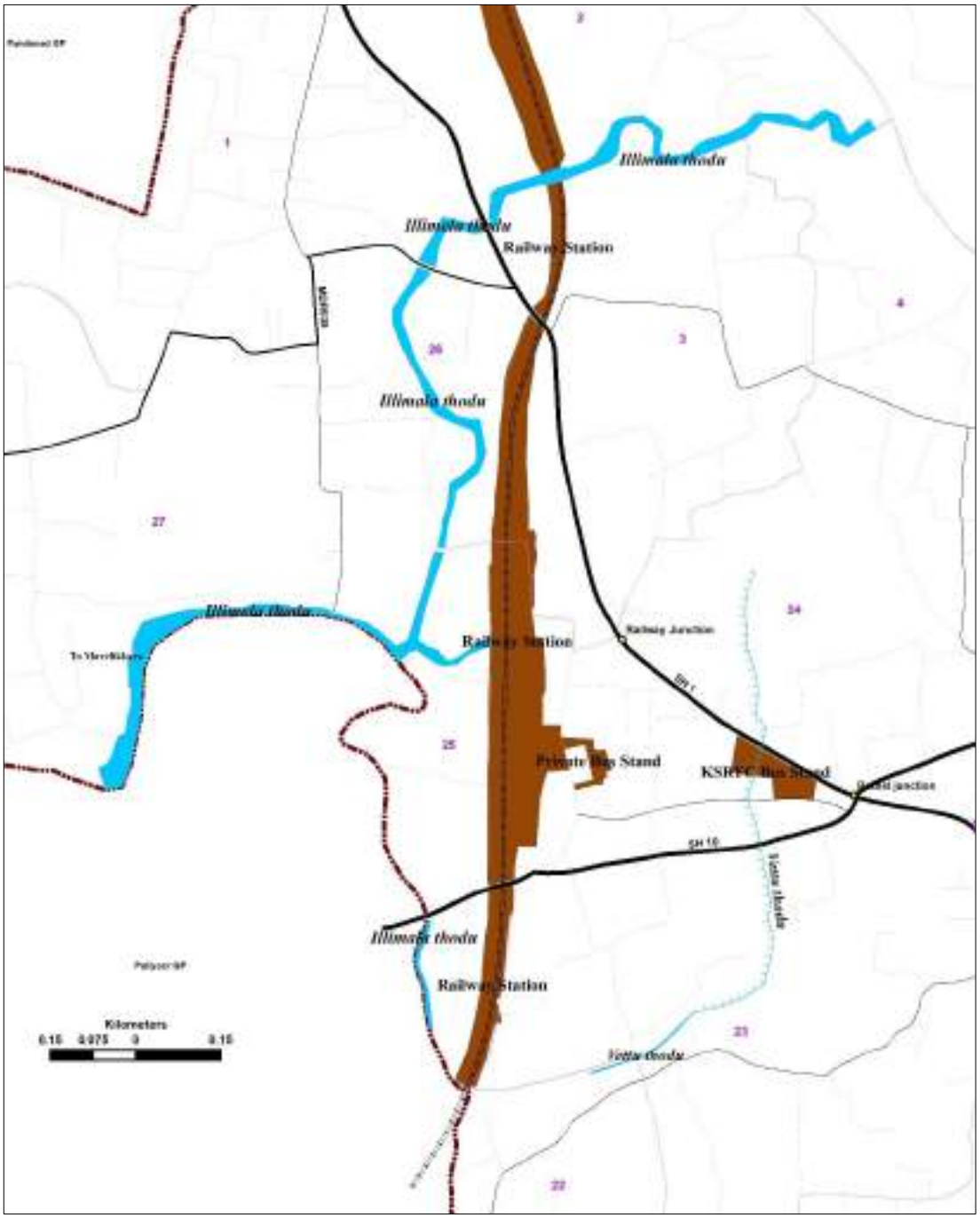

Figure 23:4: Location of Vettuthodu & Illimala – Moozhikkal thodu

23.1.2 Project Brief

Aim: To improve the Canal network of the town and adapt to climate change and manage flood risk more sustainably.

Objectives: The proposed intervention aims to achieve the following:

- Conduct a detailed land survey to delineate the canal stretch and boundary with the help of land revenue department.

- To map the civil engineering features including the longitudinal and cross sectional profile of the canal stretch and estimation of cross section based flow accumulation studies.
- Survey of encroachment area, acquisition and restoration of missing links of the canals.
- Construction of canal side protections, bridges, culverts, fencing and beautification of canal precinct.
- Provide proper waste management facilities to the adjacent buildings of the canal banks.

Components of Project:

- Estimation of cross section based flow accumulation studies.
- Detailed Survey for demarcating Vettuthodu and Illimala thodu, land acquisition for connecting missing links and eviction of encroachments if any.
- Cleaning of present waste in the Vettuthodu, Desilting & deepening of sections.
- Diversion of waste water by construction of separate drainage line.
- Restoration of missing links to connect Vettuthodu to Kandam thodu and then to Illimala thodu.
- Construction of culverts, bridges, check dams, litter trap etc.

23.1.3 Responsible Agencies:

Agencies involved	Role
Municipal Engineering Section/ Irrigation Department	Preparation of Detailed Plan and Implementation
Chengannur Municipality	Monitoring the Project
Land Revenue Department & Survey Department	Detailed Survey And Proper Delineation of the Canal
State Govt., World Bank	Funding Source

23.1.4 Need for the Project:

The existing canal network have missing links due to encroachment and presence of bottle necks, which hinders the free flow of storm water / flood water from reaching the natural water course causing flooding to the surrounding area.

Vettuthodu originates from Perinkulam padam area crossing the MC road near KSRTC bus stand and flows inside of the bus stand in a congested way and continues with some drainage intersections and finally met with Kandam thodu. It passes through the town center, the roadside drains combine with Vettuthodu in the municipal area causing pollution and clogging of drains and blocking the passage. Along the stretch of vettuthod, at certain points bottle neck junctions arise, ie. near KSRTC bus stand, which was covered using concrete slabs.

Restoration of the stream is required mainly inside the KSRTC Bus Stand and MC road. Construction of box culverts, side walls in these stretches, construction of covering slab in private property in Survey no 131 and construction of drain in the premises of Perinkulam padam is required. In some portions side wall restoration with fencing and informatory boards has to be provided.



Figure 23:5: Clogged portion of Vettuthodu through KSRTC bus stand & nearby property in Sy no 131

Illimala thodu has an average width of 10.00m at various stretches. Construction of side walls at damaged portions, construction of check dams for stretches passing through agriculture areas and provision of Litter traps and its periodical maintenance may solve the flooding of surrounding areas to a great extent.

This project will help to reduce the effect of flooding in the immediate vicinity of these streams so that the possibility of flood events in future can be avoided.

23.1.5 Suggested Implementation Mechanism:

This project may be implemented by the Chengannur Municipality or any agency suggested by Municipality.The project should start with a detailed land survey to delineate the canal stretch and boundary of the project area. A detailed project report has to be prepared for the succesfull implementation of the project.

23.1.6 Other Associated Issues to be addressed:

Major portions of Vettuthodu is encroached by private or public parties and its alignment has changed for various purposes. At present this canal is a place for waste dumping, exfoliation of wastewater and even for some construction activities. A precise and stringent encroachment eviction plan shall be adopted for the effective implementation of this project in the premises of vettuthodu.

23.1.7 Approximate Project Cost and Funding:

Approximate cost for the project is 14.10 Cr. The possibility of getting financial assistance from various agencies, State or Central government schemes shall be explored.

Sl. No.	Component	Value	Cost*
1	Detailed land survey to delineate the canal stretch and boundary	4700 m	40 Lakh
2	Mapping the civil engineering features(Cross section profile, longitudinal profile, flow accumulation studies)	4700 m	50 Lakh
3	Cleaning, Desilting & Deepening	4700 m	370 Lakh
4	Restoration of missing links		50 lakh
5	Construction of side protection wall (damaged portions)	2000m	5.00 Cr
6	Construction of culverts, bridges, litter trap etc.		3.00 Cr
7	Beautification cost at potential area and fencing work		1.00 Cr
	Total Cost of the project		**14.10 Cr**

**Note: All dimensions and cost calculations are only approximate figures.*

23.1.8 Project Period & Priority:

The approximate estimated project period is 2 years and first priority is assigned for this project.

23.2 Developing Water Basins for Flood Water Retention and Management

Chengannur town have Paddy fields or marshy areas which are scattered within the town. Studies shows that interventions should be made to conserve these lowlying areas so as to maximise the ecosystem functions. These areas can be conserved and managed as wetlands for ground water recharge, biodiversity conservation and also for retention of flood water. Existing paddy fields or marshy areas in the Municipality is identified as basins/retention areas (Figure 23:6). The retained water can be used for irrigation as well as yielding the ground water level. This project is an example for developing a basin for flood water retention.

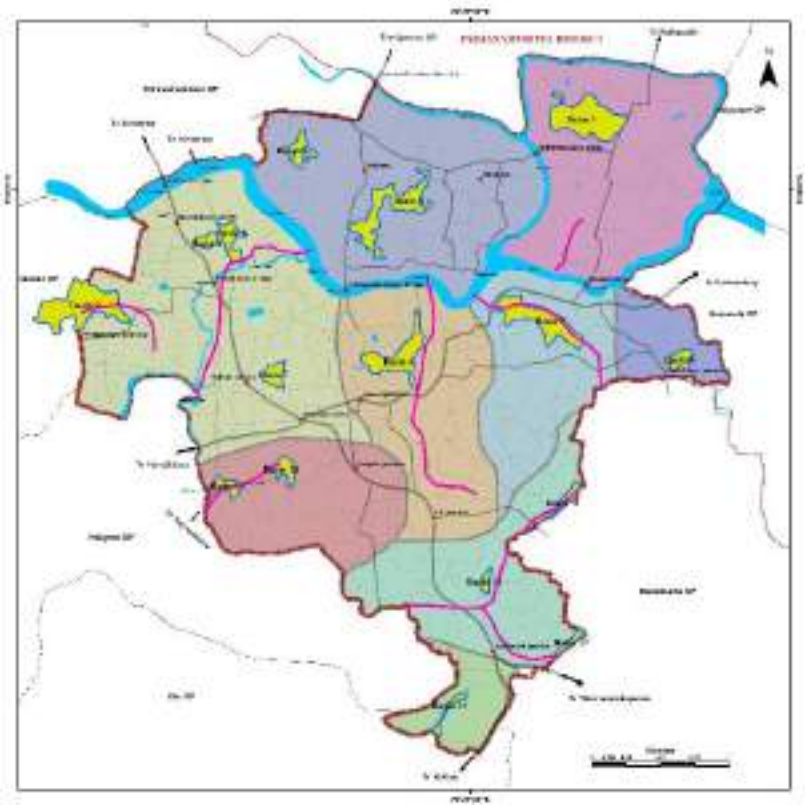

Figure 23:6: Basins for Flood Water Retention

23.2.1 Location & Ownership Details:

The existing paddy fields of Chengannur village in resurvey numbers 111, 112, 116, 117, 118, 119, 122 in ward 8 (Edanad West) is selected as one location. The existing marshy areas

located in resurvey numbers 301, 302, 303 of Chengannur village near Municipal Stadium in ward 24 (Town) is also selected as another location. These two locations are shown in Figure 23:7. These are demarcated as Ecological Conservation Zone in the Proposed Land Use map. The land is under private/public ownership.



Figure 23:7: Map showing the Locations for developing water basins for flood water retention

23.2.2 Project Brief

Aim: The project aims to develop the low lying areas by incorporating sponge interventions in design so as to reduce the flooding of adjacent areas.

Objectives:

- Increase the water storage capacity of the area by digging to a depth of 1m.
- Improve the farming activities in these areas.
- Create artificial recharging structures like percolation pits, gully plug, sub-surface dykes etc.

Components of Project: A conceptual image of the envisioned project is shown in Figure 23:8.

- Retention area.
- Farm ponds.
- Miyawaki forest
- Multi level parking
- Joggers walk way



Figure 23:8: Proposed projects at Perinkulam padam and Thamarachal

23.2.3 Responsible Agencies

Agencies involved	Role
Municipal Engineering Section/ Irrigation Department/ Agriculture Dept.	Preparation of Detailed Plan and Implementation
Chengannur Municipality	Monitoring the Project
Land Revenue Department & Survey Department	Detailed Survey And Proper Delineation of the Canal
State Govt., World Bank	Funding Source

23.2.4 Need For The Project

This project is inevitable to to conserve the existing Paddy fields or marshy areas within the town. Increasing the depth of these sites will improve the water storage capacity thereby prevents the flooding of adjacent land or reduce the flooding in those watersheds. Water can then be reused for groundwater recharge, irrigation or any other purpose, optionally requiring further treatment. The excess water from the basins may be overflowed to the near by water bodies if excess water is collected.

23.2.5 Suggested Implementation Mechanism

This project may be implemented by the Chengannur Municipality or any agency suggested by Municipality.The project should start with a detailed land survey to delineate the boundary of the project area. A detailed project report has to be prepared for the succesfull implementation of the project

23.2.6 Approximate Project Cost And Funding

Approximate cost for the project is 15.10 Cr. The possibility of getting financial assistance from various agencies, State or Central government schemes shall be explored.

Sl No	Component	Value*
1	Retention area deepening to 1.00 mtr Area 32376 sqm@250/sqm	8.00 Cr
2	Farm pond and related activities	50 .00 L
3	Miyawaki forest 2000sqm @Rs 3500/sqm	70.00 L

4	Multi level parking 100 nos	5.70 Cr
5	Joggers walk way 300 mtr	20.00 L
	Total civil construction	**15.10 Cr**

**Note: All dimensions and cost calculations are only approximate figures.*

23.2.7 Project Period & Priority

The approximate estimated project period is 5 years and second priority is assigned for this project.

23.3 Development of pilgrim amenity centre and and upgrading facilities in identified potential relief camps

As a halting centre (Edathavalam) for Sabarimala pilgrims, Chengannur Municipality attracts a large number of floating population from various places inside and outside of Kerala State. It necessitates the development of various infrastructures to support the pilgrim activities. By considering this, a pilgrim Amenity Center is proposed to accommodate the future needs. Also, the aspects of flood relief and disaster management can be incorporated in this project to develop potential relief camps. Both these uses are seasonal in nature. So a multipurpose building with adequate facilities to manage these different uses needs to be developed together with proper waste management techniques.

23.3.1 Location & Ownership Details

The proposed site for pilgrim Amenity centre is located towards the North of KSRTC bus station and nearer to Kunnathu Mahadeva Temple as shown in Figure 23:9. The plot has an area of about 0.5 acres in re survey numbers 272/1, 282, 263/19 of Chengannur village. This location is demarcated as public and semi-public use zone in the proposed land use map. The land is under the ownership of Devaswom Board.

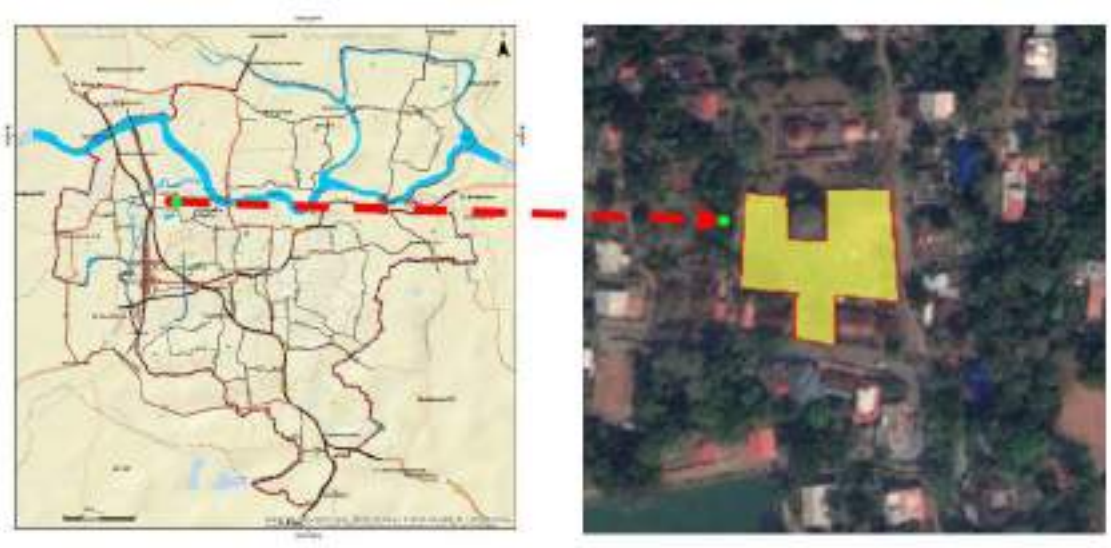

Figure 23:9: Location of proposed pilgrim centre

23.3.2 Project Brief

Aim: This project aims to support the pilgrimage by providing facilities for the pilgrims coming to this region as an Edathavalam, which can be alternatively used for relief purposes when required.

Objectives of the Study Are:

- To provide essential pilgrim facilities across the region to reduce their dependence / overloading at the final destination.
- To develop infrastructure facilities for the pilgrims to act as an intermediate camp.
- Development of potential relief camps outside flood prone area

Project Components:

- Construction of rooms/dormitory
- Restaurant/ Community Kitchen facility
- Provision of Parking facility
- Storage facility for food and essentials
- Locker facilities
- Drinking Water outlets
- Provision for first aid
- Toilet Blocks
- Insitu waste management facility
- Improvement in communication through telephone booths, mobile services and internet connectivity, Wi-Fi hotspots

23.3.3 Responsible Agencies

Agencies involved	Role
Municipal Engineering Section/PWD/ Devaswam Board	Preparation of Detailed Plan and Implementation
Chengannur Municipality	Monitoring the Project
State Govt., World Bank	Funding Source

23.3.4 Need For The Project

As per studies, on an average about 1,50,000 pilgrims visiting Sabarimala passes through Chengannur town as it is the nearest railway station to reach Sabarimala. At present, the town lacks necessary infrastructures required for the pilgrims. Providing the basic facilities in an affordable and hygienic environment may attract more pilgrims to this area, and their extended stay could boost the local economy. Also, in view of 2018 floods, there is a need to identify and develop potential relief camps in safe zone. Both these aspects are seasonal in

nature and these can be interlinked to have a better service to pilgrims as well as the local people so as to boost the local economy as well.

23.3.5 Suggested Implementation Mechanism

This project may be implemented by the Chengannur Municipality or any agency suggested by Municipality. As the land is possessed by Dvaswom Board they can actively involve in preparation, execution and maintenance of the project. Since the project is multi-functional all components of building requirements should be incorporated.

23.3.6 Approximate Project Cost And Funding

Approximate cost for the project is 8.6 Cr. The possibility of getting financial assistance from various agencies, State or Central government schemes shall be explored.

Sl No	Component	Value*
1	Total Built-up area including all components of building requirements	4000 m2
2	Assumed rate of construction	21500/m2
	Total cost of construction	**8.6 Cr**

**Note: All dimensions and cost calculations are only approximate figures.*

23.3.7 Project Periods & Priority

The approximate estimated project period is 2 years and first priority is assigned for this project.

23.4 Redevelopment of Market

Modernization and renovation of existing market is included as one of the strategy for development of trade and commerce sector in the town. Providing space for marketing locally produced value-added products and agriculture produces in the existing market area by conducting weekly markets using the available space in the present market with better management strategies can contribute to the trade and commerce sector.

23.4.1 Location & Ownership Details

The Market area is located near to North East side of Bethel Junction in Chengannur Town which is accessible from Mavelikkara-Chengannur road. The plot lies in resurvey number 298 of Chengannur village having an area of around 1.3 acres.The exact location of the market is shown in Figure 23:10. This location is demarcated as Commercial use zone in the proposed land use map. The land is under the ownership of the Municipality.

23.4.2 Project Brief:

Aim: To develop the existing market area situated in the town centre to a modern market with adequate infrastructure facilities.

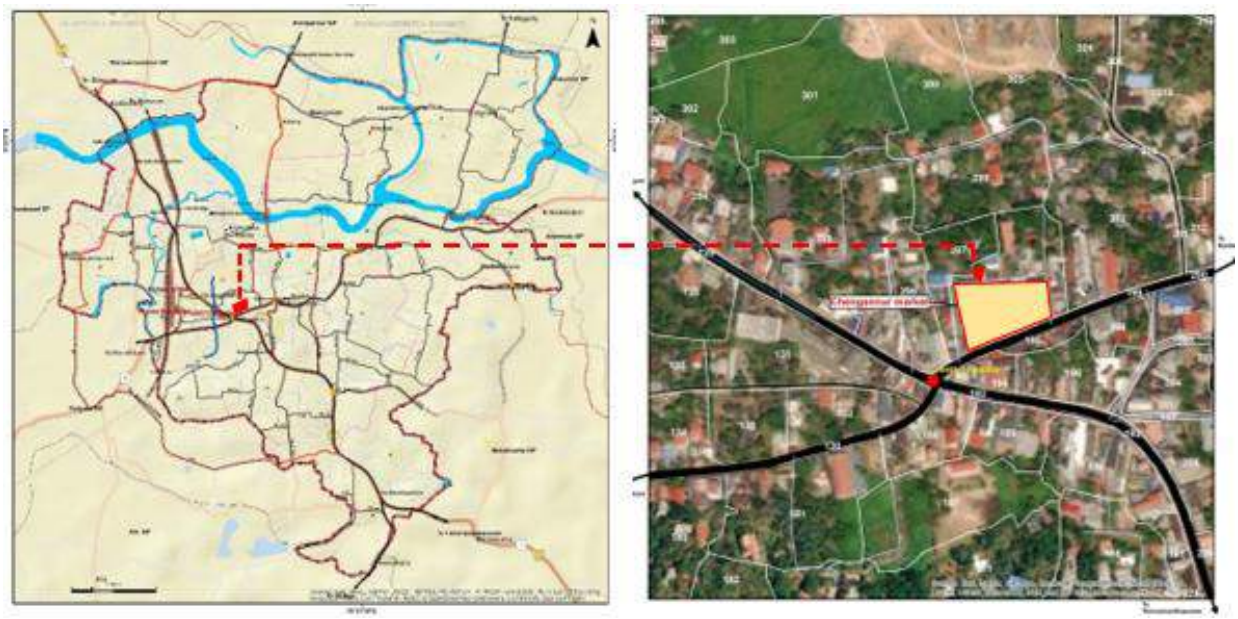

Figure 23:10: Map Showing the location of Proposed market

Objectives: The proposed intervention aims to achieve the following:

- Redevelop the Market into an integrated modern market complex with wholesale and retail shopping facilities so as to serve the local residents and its service population.
- Ensure improved parking and traffic management, and provide proper waste management facilities.
- Promote small shops and marginal businesses which are essential to the functioning of the market.
- To create a state-of-the-art civic infrastructure facility through PPP mode in the available space of the market area.

Components of Project:

- Construction of wholesale & retail Stalls & Building Complex
- Storage Area
- Toilet Complex
- Drinking Water Kiosks
- Solid & Liquid Waste Treatment facilities
- Parking Area
- Loading/ Unloading space

23.4.3 Responsible Agencies:

Agencies involved	Role
Municipal Engineering Section/PWD/ Devaswam Board	Preparation of Detailed Plan and Implementation
Chengannur Municipality	Monitoring the Project
State Govt., World Bank	Funding Source

23.4.4 Need for the Project:

Existing market is very congested and disorganized without proper waste disposal facilities, parking area and loading / unloading facilities. A proper well organised market can act as a common market for the region. The market is very much interlinked with commercial sector, transportation sector, waste management sector and other infrastructure sectors and also the social aspects. The main benefits of the project are commercial development to catalyse the economic development and also to cater the commercial requirements of its service area. The main beneficiaries of the projects are mainly the local people itself and, those who involved in trade and commercial activities. And if the project is not implemented, the current issues worsen the healthy development of the town as well as the region. The existing dilapidated and unused structures needs improvement and a well-organized and managed space available in the present market area can contribute to strengthen the economic status of town.

23.4.5 Suggested Implementation Mechanism:

This project may be implemented by the Chengannur Municipality or any agency suggested by Municipality.

23.4.6 Other Associated Issues to be addressed:

A temporary rehabilitation has to be developed for the relocation of the existing shops and stalls during construction.

23.4.7 Approximate Project Cost and Funding:

Approximate cost for the project is 5.24Cr. The possibility of getting financial assistance from various agencies, State or Central government schemes shall be explored.

SL No	Component	Value*
1	Plot area of the market area (Approximate)	5,300 m2
2	Total Built-up area (Approximate)	1500 m2
3	Miscellaneous construction(Water Kiosks and Waste management Facilities)	100 m2
4	Assumed rate of construction	28000/ m2
	Total Civil construction cost (Approximate)	4.545 Cr
6	Interim Rehabilitation cost during construction	0.2 Cr
7	Demolishing and management of existing building	0.5 Cr
	Total cost for the project	**5.245 Cr**

**Note: All dimensions and cost calculations are only approximate figures.*

23.4.8 Project Period & Priority:

The approximate estimated project period is 2 years and Third priority is assigned for this project.

23.5 Development of Multi Level Parking area & Truck terminal

For most urban centres, space is a limited resource whose shortage comes with a string of other problems. One of the most annoying ones, especially for vehicle owners, is the lack of parking spaces. A lack of parking contributes significantly to traffic jams. Studies shows that there is a dearth of parking spaces for private vehicles in the Municipality causing curb parking affecting the carrying capacity of the roads. To accommodate the parking needs of the town, a multilevel parking area is proposed. A truck terminal is also proposed nearer to this area for the purposes of transferring goods.

23.5.1 Location & Ownership Details

The proposed project is located in resurvey number 291 of Chengannur village as shown in Figure 23:11. This location is demarcated as special use zone 3: parking area in the proposed land use map. The land is under public or private ownership.

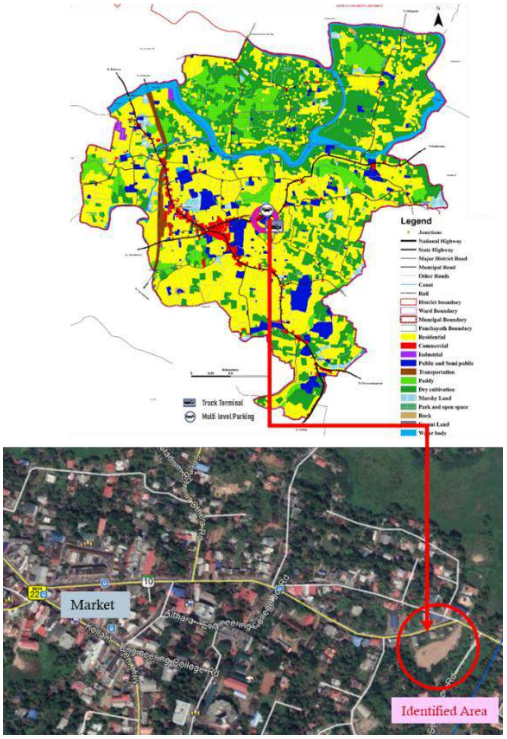

Figure 23:11: Map showing the location of proposed Multi level parking area and truck terminal

23.5.2 Project Brief:

Aim: To develop multi level parking facilities and loading and unloading space for goods within the town.

Components of Project:

- Transport Operators Office
- Yard
- Dormitory
- Water Kiosk
- Sanitary Facility
- Restaurant and Retail shop
- Weigh Bridge
- Service Station
- Fuel Pump
- ATM

Agencies Involved:

Agencies involved	Role
Chengannur Municipality	Implementation
PWD	Technical advice & Management

23.5.3 Need for the Project:

Most of the commercial activities are centered along the main road which results in major traffic issues. Main reason for traffic problem is the unauthorised parking of vehicles and trucks along the side of roads. Parking on pavements, at the side of the road and sometimes even outside homes, further reduces available space. Multi-storey car parks can eradicate the problems caused by a lack of parking space. Since the population and number of vehicles on the road will only continue to increase, there is a need to use space as efficiently as possible. Multi-level parking facilities are the next revolutions, bearing numerous benefits to the cities, vehicle owners, and the general public. Vehicles parked outside are left unprotected and are therefore prone to vandalism and theft. Driving around in search of parking spaces also increases the risk of drivers wandering to insecure areas where they can encounter problems.

23.5.4 Suggested Implementation Mechanism:

This project may be implemented by the Chengannur Municipality or any agency suggested by Municipality.

23.5.5 Approximate Project Cost and Funding:

Approximate cost for the project is 30 Lakhs. The possibility of getting financial assistance from various agencies, State or Central government schemes shall be explored.

SL No	Component	Cost*
1	Transport Operators Office	2L
2	Multi layer parking	10L

3	Yard	2 L
4	Dormitory	3 L
5	Water Kiosk	6 L
6	Sanitary Facility	2 L
7	Restaurant and Retail shop	3 L
8	Weigh Bridge, Service Station, Fuel Pump	2L
	Total Cost of the project	**30 L**

**Note: All dimensions and cost calculations are only approximate figures.*

23.5.6 Project Period & Priority:

The approximate estimated project period is 5 years and Third priority is assigned for this project.

23.6 Constructing Over Pass/Under Pass at Identified Locations (Foot Over Bridge at Velavoor Junction)

As Chengannur Town is a center of floating population to Sabarimala especially during Sabarimala festive season (Mandalakalam), pedestrian facilities of the town have to be improved. Velavoor junction is the main junction of Chengannur Municipality, where heavy pedestrian movement occurs from Railway Station to Velavoor junction and then onwards to Chengannur Mahadeva temple through Guru Chengannur road during peak hours.

23.6.1 Location & Ownership Details:

A foot over bridge is proposed at Velavoor (railway junction) Junction which is along Northern side of Bethel Junction at a distance of 500 meters away in Latitude 9°19'15.00"N longitude 76°36'36.56"E. The map showing the location of this project is shown in Figure 23:12. The land is under the ownership of Chengannur Municipality.

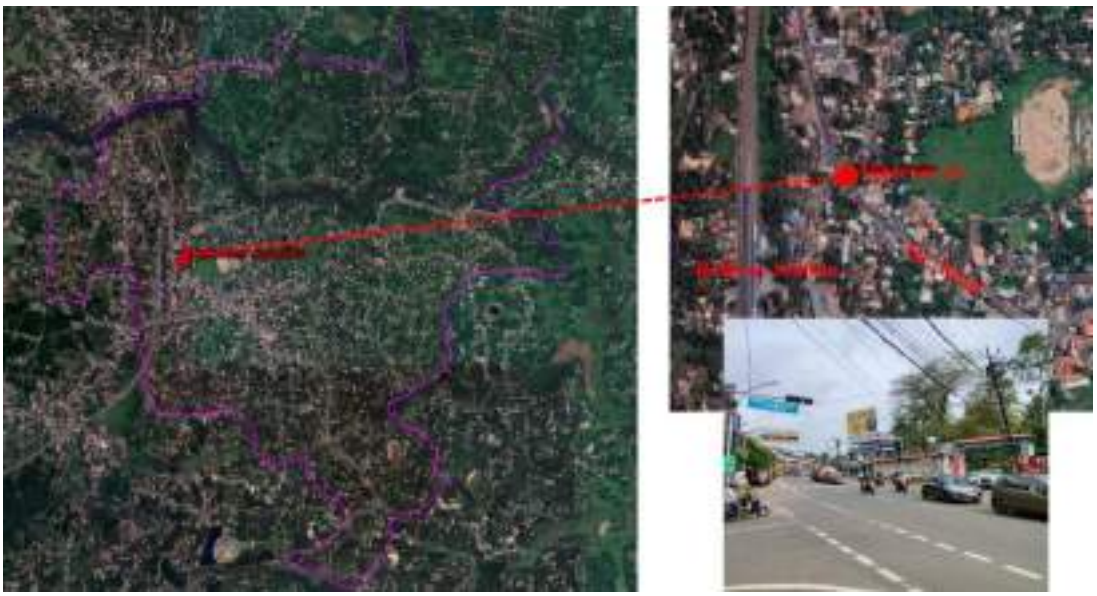

Figure 23:12: Map showing location of the proposed Foot Over Bridge and existing view at Velavoor Junction

23.6.2 Project Brief:

This project proposes a foot over bridge across MC road at Vellavoor Junction, where the average width of the road is 12.00 meters and has a widening proposal of 21.00 meter in the proposed land use plan.

23.6.3 Need for the Project:

Velavoor junction is one of the main junction along MC Road, where pedestrianisation is very difficult due to the narrow width of the road. Nearness to the railway station makes this junction very active during normal time as well as in the pilgrimage season at Sabarimala. Velavoor junction have a peak hour traffic of 2,743 PCU. Hence it is necessary to construct a foot over bridge at this junction.

23.6.4 Other Associated Issues to be addressed:

A detailed background study need to conducted before the implementation of project so as to analyse the feasibility of this project.

23.6.5 Approximate Project Cost and Funding:

Approximate cost for the project is 2.5Cr. The possibility of getting financial assistance from various agencies, State or Central government schemes shall be explored.

SL No	Component	Cost*
1.	Construction cost	2.50 Cr
	Total cost (Approximate)	2.50 Cr

**Note: All dimensions and cost calculations are only approximate figures.*

23.6.6 Project Period& Priority:

The approximate estimated project period is 3 years and Second priority is assigned for this project.

23.7 Setting up of a Liquid Waste Treatment Plant

23.7.1 Location & Ownership Details:

A liquid waste treatment plant is proposed at the location as shown in Figure 23:13 which is demarcated as special use zone in the proposed land use map. The land is under public or private ownership.

23.7.2 Project Brief:

This project envisages the development of liquid waste management facilities for Chengannur town. The proposed intervention aims to achieve the following:

- Assessment, analysis and Quantification of the present liquid waste management system, facilities and issues in the town area.

- Land acquisition, Implementation, Operation & Maintenance.

Agencies Involved:

Agencies involved	Role
Suchitwa mission / State Govt./ World Bank	Funding and technical support
Chengannur Municipality	Preparation of detailed Plan and implementation Plan, Monitoring the project
Municipality	Operation and Maintenance

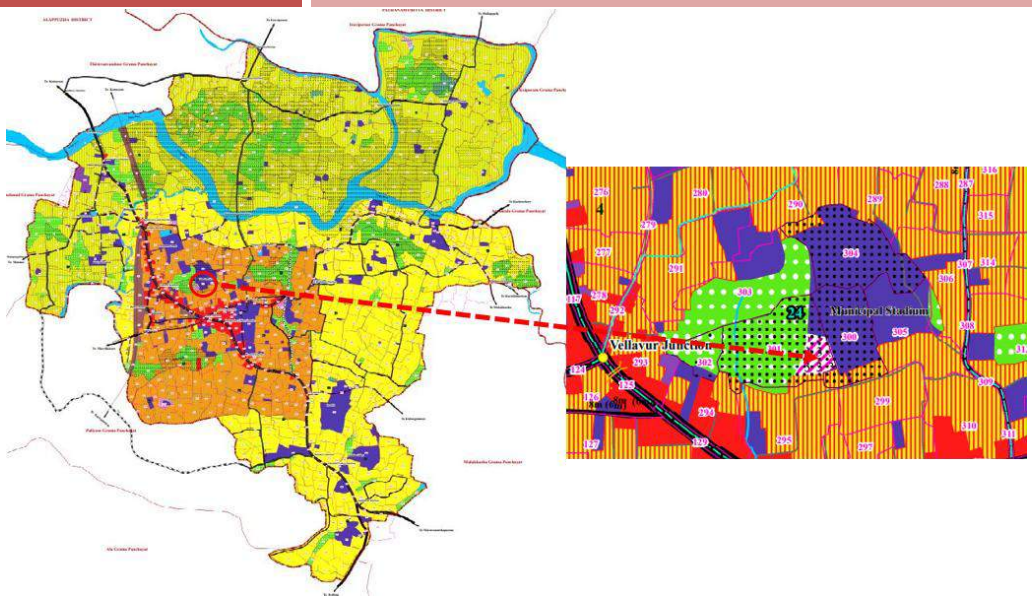

Figure 23:13: Map showing the location of proposed Liquid Waste Treatment Plant

23.7.3 Need for the Project:

The town does not have a public sewerage system at present. Septic tanks are used for disposal of sewage as a general practice. However, many households still adopt soak pits, E.S.P type/two pit latrines etc. it is noticed that there are a few houses even without sanitary latrines particularly in housing colonies. The waste water from the markets, hotels, commercial establishments and other public buildings are disposed directly into the road side drains. During rainy seasons, these drains overflow, spilling such sullage and sewage onto the roads and the open yards of nearby houses. A major share of this untreated waste water ends up in the canals causing foul smell and water pollution. Such polluted and stagnating water bodies form breeding beds for mosquitoes. Implementation of this project considerably reduce the waste management issues of both grey as well as black water.

23.7.4 Suggested Implementation Mechanism:

This project may be implemented by the Chengannur Municipality or any agency suggested by Municipality.

23.7.5 Approximate Project Cost and Funding:

Approximate cost for the project is 4 Cr, including the land acquisition cost. The possibility of getting financial assistance from various agencies, State or Central government schemes shall be explored.

SL No	Component	Cost*
1	Assessment, analysis and Quantification of the present liquid waste management system, facilities and issues in the Town area.	30.0 L
2	Identification and acquisition of land (50Cents) for STP, outside flood prone region	2.5 Cr
3	Implementation	1.0 Cr
4	Operation and maintenance of MSTP and STP (Recurring)	20.0 L
	Total cost for the project	**4 Cr**

**Note: All dimensions and cost calculations are only approximate figures.*

23.7.6 Project Period& Priority:

The approximate estimated project period is 2 years and Second priority is assigned for this project.

23.8 Drain mapping and networking of drains

Environmentally fragile areas including paddy fields, ponds, canals, rivers and natural drains etc. are to be preserved/protected/restored to ensure clean, green and hygenic living environment to develop the town into an eco friendly, disaster resilient and aesthetically pleasing town. A detailed drainage mapping of the existing natural network of drains is required for such a preservation/protection/restoration. Natural streams once existed in the towns are missing now due to encroachment. Revival of these streams are necessary to drain out and catch the rainwater so as to reduce the effect of flooding. A detailed drain mapping should be conducted for identifying all drain networks, so that gaps in the existing system can be identified for further protection and restoration works. Figure 23:14 shows the streams and waterbodies within the Municipality.

23.8.1 Location & Ownership Details:

This proposal is a research output based project. There fore, the detailed location of the project cannot be specified. The area falls inside the municipal limits considering the special limitation of Master Plan. The project land is owned by Chengannur Municipality.

23.8.2 Project Brief:

Aim: To conduct a detailed drain mapping and networking of drains in Chengannur Municipal area emphasising on natural canals aimed at both existing and deteriorated canal network by considering the topography of the region.

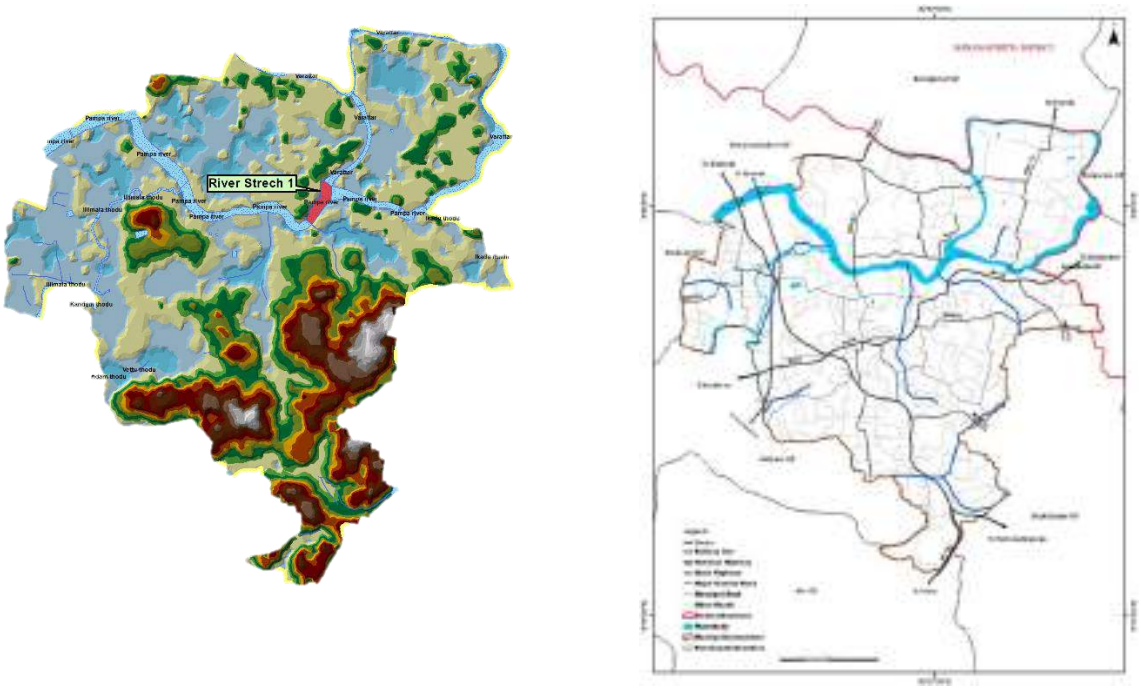

Figure 23:14 Map showing Streams and waterbodies
(Source: Derived from Nammal Nammukayi report & Landuse survey 2019 by LSGD Planning - Alappuzha)

Objectives: The proposed intervention aims to achieve the following:

- A preliminary identification of drains, generate a map showing the existing natural drains and the probable location of drains which are exhausted by encroachment or land conversion, by the help of suitable software and reconnaissance survey.
- Prioritization of identified drains by considering various parameters such as flood intensity, neighbouring population density, and other factors which leads to the vulnerability of drain.
- Delineation of natural drains based on propriety by concerned departments such as land revenue department, resurvey department, and technical or subject expertise.
- Detailed drain mapping and plotting of drain network with the help of Arc GIS or with the help of relevant software.

Components of Project

- GIS Mapping and Preliminary site study and survey
- Prioritization analysis of drains
- Detailed onsite survey of natural drains
- Finding and sorting of the relevant survey and sub survey maps from government department
- Entrusting the survey work to the appropriate institution/ subject expertise

- Giving trainings and guidance for the surveyors.
- Coordination and managing of survey work.
- Plotting of detailed drainage network

23.8.3 Responsible Agencies:

Agencies involved	Role
LSGD Planning	GIS Mapping and Preliminary site study and survey
Land Revenue department & Survey Department, Municipality	Coordination and monitoring of detailed onsite survey of natural drains
PWD, Irrigation	Technical Support
Technical Institution (College students)	Conducting Survey
Municipality, State Govt., World Bank	Funding source

23.8.4 Need for the Project:

Chengannur Municipality consists of lot of natural drains and waterbodies, in which many are chocked and encroached which lead to the deterioration of entire drainage system that roots seasonal inundation in the town. Revival of these streams are necessary to drain the rainwater so as to avoid flooding in the town. Absence of a drainage network map of the town causes problems in execution of canal/drainage rejuvenation projects. Hence a detailed drain mapping should be conducted for identifying all drain networks in the town area, so that the entire existing drainage as well as the gaps in the existing system can be identified which can help to drain out water from all water logged areas in a faster way.

This drain mapping project may be interlinked with physical and social infrastructure, environment and disaster management sector. The main benefit of the project is that the prepared natural drainage network map can be used as a data base for various canal rejuvenation projects. Further it will help to bring out numerous flood mitigation measures. The direct beneficiaries are the line departments concerned, who are related to the implementation of interlinked projects and indirectly this will benefit to the local inhabitants.

23.8.5 Suggested Implementation Mechanism:

This project may be implemented by the Chengannur Municipality or any agency suggested by Municipality. The project can start with a Preliminary site study/survey and preparation of a detailed project report. The possibility of getting assistance from various technical institutions /Subject experts may be explored for the entire work.

23.8.6 Other Associated Issues to be addressed:

There may be chancse of encroachment which needs eviction if any from private as well as public users. At present, the natural drains are used for waste dumping, outlet drain for wastewater and even for some construction activities. So there is a chance of protest against the detailed survey of existing system and network mapping from the public. But this can be addressed from the experience of the recent flood happened in the Town. Necessary awareness campaigns may be organised to establish the need of this project.

23.8.7 Approximate Project Cost and Funding:

Approximate cost for the project is 1.8 Cr, including the land acquisition cost. The possibility of getting financial assistance from various agencies, State or Central government schemes shall be explored.

SL No	Component	Cost*
1	GIS Mapping and Preliminary site study and survey and	20 L
2	Prioritization analysis of drains	10 L
3	Detailed onsite survey of natural drains	10 L
4	Plotting of detailed drainage network	1.4 Cr
	Total Cost (Approximate)	**1.8 Cr**

**Note: All dimensions and cost calculations are only approximate figures.*

23.8.8 Project Period& Priority:

The approximate estimated project period is 2 years and First priority is assigned for this project.

23.9 Channel widening, deepening and side protection of Pampa River up to Thottappally spillway

During south west monsoon, flooding is most common in Pampa river. The flood waters from pampa river might be diverted to Arabian sea at the extreme Southern end, where a spill way was built in 1951 in Thottappally.The Global warming and adverse climatic conditions will lead to calamities in future. The water logging is the major issue after flooding. Increased frequency of flood resulted in settling of sand and silt in the channel and therefore widening, deepening and side protection of pampa river up to thottappally spillway could be done to reduce the risks during flooding.

23.9.1 Location & Ownership Details:

The entire stretch of the Pampa River passing through the Municipal limits comes under this project considering the special limitation of the Master Plan. The project land is owned by Chengannur Municipality.

23.9.2Project Brief:

Aim: This project aims to lower the flood water level in Pampa river by adoptingRoom for the river principles. It also aims to construct a barrier to control the entry of water to the catchment area of the river during flood.

Objectives:

- To increase the carrying capacity of the Thottappally spillway by widening and deepening of the channel leading to it.
- To construct side protection, wall or outer bund to the entire length of Pampa river on its both sides.

Components of Project:

- Estimation of width and depth of river.
- Find out the depth up to which deepening to be done.
- Removal of natural and artificial obstructions such as trunks of trees or illegal artificial constructions along the river side
- Removal of accumulated gravel, sand and silt from river bed.
- Construction of side protection works.
- Bund construction using geotextiles.

Agencies Involved:

Agencies involved	Role
Chengannur Municipality	Implementation & Monitoring
PWD Roads	Technical advice & Management

23.9.3 Need for the Project:

Pampa River is the main river flowing through this municipality. The entire river stretch is filled with sand and silts resulted in reduction in depth of the channel. In order to increase the capacity of the river deepening and widening must be done.

The rivers prone to flood are often carefully managed. Construction of bunds is the useful defence to prevent the bursting of their banks. Geotextiles are permeable blanket and effective in protecting river bank from erosion as well as it acts as a filter to prevent migrating soil along the slope.

23.9.4 Suggested Implementation Mechanism:

This project may be implemented by the Chengannur Municipality or any agency suggested by Municipality. The project should start with a detailed study such as determining proposed depth and width of Pampa River and its channels. The work of trash, debris, and invasive plants removal in the basins can be done under the National Rural Employment Guarantee program.

23.9.5 Other Associated Issues to be addressed:

Removal of encroachment is one of the major issue that may be faced during the implementation of this project. Proper disposal of dredged materials is also to be found out. Due to widening, downstream area of river may easily have flooded and it should also have considered. Finding out the depth and width of the channel is also not an easy task to done.

23.9.6 Approximate Project Cost and Funding:

Approximate cost for the project is 63 L. The possibility of getting financial assistance from various agencies, State or Central government schemes shall be explored.

Sl. No.	Component	Cost
1	Dredging of channel	15 L
2	Deposition of materials dredged	8 L
3	Outer bund setting using geotextiles	30 L
4	Estimation of depth and width of channels	10 L
	Total Cost (Approximate)	63 L

**Note: All dimensions and cost calculations are only approximate figures.*

23.9.7 Project Period & Priority:

The approximate estimated project period is 5 years and First priority is assigned for this project.

23.10 Maintenance and reconstruction of culverts in flood prone areas

Culverts ranges from narrow pipes to larger construction, made of concrete, stone or PVC. The size of culverts is one of the important factor in determining the blockage and small culverts are more prone to be flooded. Improper maintenance of culverts leads to blockage during severe storms.

23.10.1 Location & Ownership Details:

The culverts located in flood prone areas as per the PLU Map of Chengannur Muncipality, which is owned by Chengannur Municipality.

23.10.2 Project Brief:

Aim: This project aims to identifying the outdated or inadequately designed culverts in flood prone areas of Chengannur Muncipality and updating design standards to account for increased water flow. Adequately designed and positioned culverts will reduce the flooding potential of adjacent property and thus preventing the backflow.

Objectives:

- Identifying the vulnerable culverts in flood prone areas of Chengannur Muncipality.
- Maintenance and Reconstruction of Culverts.

Components of Project:

- For increasing design capacity: Increase ditch capacity, Replace the culvert with box or arch culvert, if needed replace culvert with bridges or add pipe culverts.
- For reducing the embankment erosion: Shape culvert entrance, construct a cutoff wall, install appropriate Culvert end sections, install lining in the ditch, install check dams, Construct an energy dissipater.

- For improving the alignment: Realign culvert, install approach berms, install flow diverters, install additional culverts, realign stream channel.
- For reducing obstructions: Install an entrance debris barrier, install a sediment catch basin upstream, Install a relief culvert
- For replacing or relocating the culverts with water crossing: Relocate the culvert, add a low water crossing, add a high water over flow crossing

Agencies Involved:

Agencies involved	Role
Chengannur Municipality	Implementation & Monitoring
PWD Bridges, Irrigation Department	Technical advice & Management

23.10.3 Need for the Project:

The blockage of water from the Pamba river through the canal leads to increased level of water during heavy rain, which resulted in extensive devastation to people's lives, livelihood, habitation, land, livestock, water and sanitation systems during flood. Culverts play a major role of defence in hazard mitigation. Their purpose is to reduce the chances of flooding. However, they only fulfil their task only when they are correctly placed and maintained. Culverts improve public safety during storm events by allowing water to pass freely, reducing damage to roads and property as well as emergency response costs. Right sizing of culverts also shrinks the maintenance cost of town.

23.10.4 Suggested Implementation Mechanism:

This project may be implemented by the Chengannur Municipality or any agency suggested by the Municipality. The project should start with a detailed study on existing Culverts in the flood prone areas and estimating its capacity to carry flood discharge.

23.10.5 Other Associated Issues to be addressed:

Identification of vulnerable culverts and also removal of encroachment around the existing culverts.

23.10.6 Approximate Project Cost and Funding:

Approximate cost for the project is 92 L. The possibility of getting financial assistance from various agencies, State or Central government schemes shall be explored.

Sl. No.	Component	Cost
1	Detailed survey on location of existing culverts	2 L
2	Maintenance and desilting of existing culverts	30 L
3	Construction of new culverts or Replacing the existing culverts with bridges	60 L
	Total Cost (Approximate)	92 L

**Note: All dimensions and cost calculations are only approximate figures.*

23.10.7 Project Period & Priority:

The approximate estimated project period is 5 years and First priority is assigned for this project.

23.11 Phasing of Projects

Phasing of the identified projects has been done based on priority needs, inter and intra – service linkages, size and duration of the requirements, the time-span required for implementation of the project and availability of funds. The horizon year of the Master Plan is phased into 4 and the expected period of completion of the project is shown in Table 23-1.

Table 23-1: Phasing of Various Projects

Sl. No.	Project	Phasing			
		5 year	10 year	15 year	20 year
1	Restoration of Streams & Channels	✓			
2	Developing Water Basins For Flood Water Retention And Management		✓		
3	Development Of Pilgrim Amenity Centre And And Upgrading Facilities In Identified Potential Relief Camps	✓			
4	Redevelopment of Market			✓	
5	Development Of Multi Level Parking Area & Truck Terminal			✓	
6	Constructing Over Pass/Under Pass at Identified Locations (Foot Over Bridge at Velavoor Junction)		✓		
7	Setting up of a Liquid Waste Treatment Plant		✓		
8	Drain Mapping and Networking of Drains	✓			
9	Channel widening, deepening and side protection of Pampa River up to Thottappally spillway	✓			
10	Maintenance and Reconstruction of culverts in Flood Prone Areas	✓			

24 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.

Land use zoning with consideration to flood vulnerability for a sustainable future development has been done for the Municipal area and is described in previous chapters. For proper enforcement of zoning, zoning regulations are to be made. All future developments within the planning area shall be in conformity with the provisions of the 'Master Plan for Chengannur Town 2041'.

The development regulation for the 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 conformable uses applicable to the Municipal area outside the Flood prone areas. These Zoning regulations specified in Part B will be further restricted with additional regulations in Part C made applicable to various flood prone areas as delineated in the proposed land use map. Part D includes the Annexe I & II.

All the four parts of the Development Regulations shall be considered in total while processing an application for construction activities in the Municipal area.

24.1 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 Chengannur 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 scheme prepared and made in force within the framework of this Master Plan.
2. For the implementation and enforcement of the proposals envisaged in the Master Plan, areas have been zoned under various categories such as *Residential Use Zone*, *Residential Mix Use Zone*, *Agriculture Cum Residential Use Zone*, *Commercial Use Zone*, *Industrial Use Zone*, *Public & Semi Public Use Zone*, *Park and Open Spaces Use Zone*, *Traffic and Transportation Use Zone*, *Ecological Conservation Zone*, *Water Bodies* and *Special Use Zones* for securing the most efficient and effective use of land in public interest. Details regarding the nature of uses 'Permitted' and uses 'Restricted' in each zone are presented in the Table 24-1. 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 flood risk, proposed land use and the developments in various flood prone areas are further modified by Flood prone area overlay regulations in Table 24-2. Notwithstanding anything contained in the zoning regulations of the Master Plan, the additional regulations in Part C – Regulation for Flood Prone area 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, Chengannur Municipality (herein after refer to as the 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 studied based on their performance characteristics and spatial locational factors. Such cases which come under this category are classified as '*Uses Restricted*'.
    a. ***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),
    b. ***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. All uses which does not come under '*Uses Permitted*' or '*Uses Restricted*' will be considered as '*Uses Prohibited*'. '*Uses Prohibited*' are various objectionable uses in each zone which shall not be permitted under normal circumstances.
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 in uses permitted or uses restricted – 1 in that particular use zone, can be considered by the secretary, with the concurrence of the Town Planner and that of similar nature to any in uses restricted – 2 in that particular use zone, can be considered by the secretary, with the concurrence of the Chief Town Planner.
7. 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. All such existing uses in every zone shall 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.
8. 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 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 concerned.
9. Existing areas and structures of archaeological importance, agricultural uses and religious uses may be permitted to continue in all the zones and shall not constitute non–conforming uses.

10. 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.
11. 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*, *Park and Open Spaces Use Zone*, *Ecological Conservation Zone* and *SpecialUse Zones* this provisions shall not be applicable.
12. 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*' and any other applicable statutes as amended from time to time shall prevail over the respective provisions of this Master Plan.
13. Silence Zone, as prescribed by the Noise Pollution (Regulation and Control) Rules, 2000 under the Environment (Protection) Act, 1986 and its subsequent amendments, shall be applicable to the area under this plan.
14. Operational constructions as defined in the '*Kerala Town and Country Planning Act, 2016*' shall be treated as permitted use in the Master Plan area.
15. Regulation of constructions and land developments on the sides of new roads/roads proposed for widening as per the Master Plan shall be governed by the distance from the centerline of the road, unless otherwise specified in the Plan or in 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.
16. 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.
17. 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, if such designated paddy or wetland area falls in any of the flood prone area shown in the Master Plan, it shall be conserved as water retention areas and no construction and/ or land development shall be permitted in it from the date of commencement of these regulations.
18. Other than in the Flood prone area, any piece of land which is marked as '*Ecological Conservation Zone*' but not designated as paddy lands or wetlands under the '*The Kerala Conservation of Paddy land and Wetland Act, 2008*' can be deemed as part of the immediate surrounding zone and constructions shall thereafter be allowed with the concurrence of the 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.

19. Existing ponds shall be preserved considering its infiltration characteristics and impact on ground water recharging, other environmental and aesthetic values.
20. No construction/ land development shall obstruct/ reduce drainage capacity in the area.
21. No person shall construct any building within 2m from any plot boundary abutting natural/manmade drains having minimum width of 2m to 5m and 5m from drains and canals having width more than 5m. In case of existing authorized buildings in these protected areas, only repair/reconstruction of the existing building limiting to the existing built–up area is permissible and the construction outside the protected areas shall be guided as per the zoning regulations in the specific zone.
22. Future expansion of existing 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*, *Residential Mix Use Zone*, *Commercial Use Zone*, *Industrial Use Zone*, *Public & Semi Public Use Zone and Agriculture Cum Residential Use Zone* subject to restrictions imposed under other acts and rules; *if* such uses are not included in the permitted uses or restricted uses as per the zoning regulations applicable. However, such projects shall conform to provisions under *Special use Zones*, widening of roads or new road alignments envisaged in the Master Plan.
23. Only the existing areas under Public and Semi Public uses and Industrial uses are intended to be included under *Public & Semi Public Use 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.
24. 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 Chengannur Municipality regarding any proposal for acquiring that particular land for any public use at the time of application for building construction or land development.
25. 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. Maintenance of existing authorized uses/ buildings may be permitted. However, Reconstruction of existing authorized uses/ buildings/ addition of new blocks shall be permitted only with adequate flood resilient measures with the concurrence of the Town Planner, in a case to case basis. If required advice from DDMA may be sought.
26. 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 ground as well as revenue records and decision taken by the Secretary in this regard shall be final.

27. The land specially demarcated for certain projects as *Special Use Zones* may be procured as per the provisions of *The Kerala Town and Country Planning Act 2016*, by Chengannur 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.
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. Disaster Mitigation projects shall be permitted in all zones.
30. 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*, *Residential Mix Use Zone*, *Commercial Use Zone*, *Industrial Use Zone*, *Public & Semi Public Use Zone and Agriculture Cum Residential Use Zone*; if such uses are not included in the permitted uses or restricted uses as per the zoning regulations applicable. However, such projects shall conform to provisions under *Special* Use *Zones*, widening of roads or new road alignments envisaged in the Master Plan.
31. Any public utility areas and building under government approved schemes, irrigation/ water supply schemes and new road proposals or any detailed road alignments approved by line departments for implementation in the planning area shall have due regard to the flood proneness and shall incorporate necessary flood resilient measures.
32. For the purpose of these regulations, built–up area means the total area covered by the building at all floor levels.
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.
34. General Guidelines for Large Scale Projects
    a) Any part of the project falling within the flood prone areas shall be permitted with adequate flood resilient measures and shall be devoid of any land filling.
    b) 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 *Water Bodies and Ecological Conservation 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.

       Also, 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 cost. The project shall be completed within a period of 5 years or as suggested by the committee.

34.1 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

c) 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.

d) The meeting shall be presided over by the Chairperson or in his absence by a member to be authorized by him.

e) The quorum of the meeting shall be majority of the total number of members of the committee for the project.

f) The developer shall also produce before the committee, all required clearance from the State and Central Government agencies concerned.

35. Taking into consideration of the fact that Master Plan for Chengannur town was the first ever Risk Informed Master Plan prepared on pilot basis in the State and adequate sensitization programmes were not conducted on its regulations due to the restrictions imposed on the outbreak of Covid in the State, constructions carried out prior to 2022 based on a building permit then issued, or constructions with floor area less than 66 sq.m, in all cases for which records are available with the Municipality prior to the date of resolution of Municipal Council approving the Master Plan for Chengannur for republication (ie., prior to 25.10.2024) may be regularised/permit issued, subject to satisfying the following conditions and the provisions of other applicable statutes.

1) For re-issuing the building permit or getting completion certificate/occupancy certificate in the case of buildings which does not comply with the provisions of road widening proposals stipulated in the Master Plan published in 2021, the applicant shall enter into an agreement with the Secretary, Chengannur Municipality in stamp paper of adequate value and duly registered, to the effect that the said construction shall not adversely affect any road widening proposals at the time of implementation; and any construction carried out shall be demolished at the owner's cost and risk and

the land owner shall not submit any form of application/petition, before any Government/court/any agencies concerned regarding the claim for such compensation in this regard. The land additionally required for road widening in these areas will also be relinquished free of cost by the land owners.

2) The buildings with floor area less than 66 sq.m including buildings under Government approved housing schemes identified and reported by Municipality, for which application were already submitted for permit, are relaxed from the restrictions imposed based on risk areas of the Master Plan for Chengannur published in 2021.

3) For the identified buildings reported by the Municipality, which have not complied with the basement height criteria alone as per the regulations for Flood Prone Area in the Master Plan republished, relaxation on the height of plinth from surrounding ground level, shall be granted by the Secretary Chengannur Municipality.

24.2 Part B–Specific Guidelines

Table 24-1: Zoning Regulation for various land use zones in Chengannur Town

Sl. No.	Uses Permitted	Uses Restricted–1	Uses Restricted–2
1	2	3	4
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, Dharmasala, Guest house, Hostels and Boarding houses.	Fuel Filling Stations.	
	Shops, Professional Offices, Commercial Offices/Establishments, Banking & other Financial Institutions, Restaurants, Canteen, Hotels, IT/Software units with built–up area limited to 300 m^2.	Cremation Ground/Crematorium, Burial Ground/Common Vault.	
	Cottage Industries including coir, Service Industries of non–nuisance Nature (See Annex–I), having built–up area up to 300 m^2.		
	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 (Outpatient), Diagnostic Centers etc. having a built–up area limited to 300m^2.		
	Ashram, Madrasa, Places of Worship.		
	Pain and Palliative care centers.		
	Community facilities such as Community Halls, Movie Halls, Auditorium, Wedding Halls, Convention Centers, Recreational Clubs, Social Welfare Centers, Gymnasium/ Yoga Centers, Swimming Pool, Libraries, Reading rooms etc. having built–up area limited to 300m^2.		
	Godowns/ Warehouses/ Stacking yards for Storage of non–hazardous materials.		
	Automobile workshops for two/ three wheelers with built–up area limited to 200 m^2.		
	Utility Installations and Civic Amenities essentially serving the needs of residential community such as Post Office, Tot lots, Parks, Playgrounds, Open grounds.		

	Government (Local /State/ Central) or Public Sector Offices, Civil Defense and Home guard. Public utility areas and public utility buildings.		
	Plant Nurseries, Pump House, Smoke houses or similar uses for agriculture value addition attached to a residential building. Poultry farms, Dairy and Kennel, Storage of agricultural produces and seeds.		
	Wells and Irrigation Ponds incidental to community needs.		
	Critical Infrastructure–Police Station, Telephone Exchange, Fire Station and Water treatment plants below 5 MLD.		
1.2	**Provided that the access road has an existing width of 5m minimum.**		
	Shops, Professional Offices, Commercial Offices/Establishments, Banking & other Financial Institutions, Restaurants, Canteen, Hotels, IT/Software units with built–up area limited to 500 m^2.		
	Diagnostic Centers, Clinics (Outpatient)–built–up area limited to 500 m^2.		
	Community facilities such as Community Halls, Movie Halls, Auditorium, Wedding Halls, Convention Centers, Recreational Clubs, Social Welfare Centers, Gymnasium/ Yoga Centers, Swimming Pool, Libraries, Reading rooms etc. having built–up area limited to 500m^2.		
	Automobile Workshops / Automobile Service Stations for light motor vehicles with built–up area limited to 500 m^2.		
	Cottage Industries including Coir, Service Industries of non–nuisance Nature (See Annex–I), having built–up area up to 500 m^2.		
1.3	**Provided that the access road has an existing or proposed width of 8m minimum.**		
	All shops including Shopping complexes, Shopping malls, Hyper markets, Restaurants, Hotels, Canteen, Markets, Professional Offices, Commercial Offices and Establishments, Banking & Financial Institutions, IT Software units.	LPG distribution centers (excluding bottling plants and bulk storage) limiting the built–up area limited to 500 m^2.	
	Community facilities such as Community Halls, Movie Halls, Auditorium, Wedding Halls, Convention Centers, Recreational Clubs, Social Welfare Centers, Gymnasium/ Yoga Centers, Swimming Pool, Libraries, Reading rooms etc. having built–up area limited to 3000m^2.	Sawmills with timber yards, slaughterhouse .	
	Secondary/ Higher Secondary Schools, Technical High Schools.		
	Markets, Automobile Workshops / Automobile Service Stations for light motor vehicles – built up area limited to 1000 m^2.		
	Cottage Industries including Coir, Service Industries of non–nuisance Nature (See Annex–I), having built–up area up to 3000 m^2.		
	Critical Infrastructure– Hospitals with 5 beds, Water Treatment Plants.		
1.4	**Provided that the access road has an existing or proposed width of 10m minimum.**		
	Educational institutions of higher order such as Colleges/ Universities/ General education institutions/ Specialized/ Professional education institutions/ Research and development institutions.	LPG distribution centers (excluding bottling plants and bulk storage)	Multiplex

	Community facilities such as Community Halls, Movie Halls, Auditorium, Wedding Halls, Convention Centers, Recreational Clubs, Social Welfare Centers, Gymnasium/ Yoga Centers, Swimming Pool, Libraries, Reading rooms, Museum, Exhibition Centers and Art gallery, Indoor Games Stadium, etc.	Gas godowns and uses of similar nature.	
	Automobile Workshops / Automobile Service Stations for Light and Heavy Motor Vehicles, Industrial Estates & Industrial Parks.		
	Cottage Industries including coir, Service Industries of non–nuisance Nature (See Annex–I)		
	Critical Infrastructure– Hospitals / Health institutions.		
2	**RESIDENTIAL MIX USE ZONE**		
2.1	The following areas in Residential Use Zone will also be deemed as a part of Residential Mix Use Zone. 1) Land to a depth of 100m on either side of MC Road . 2) Land to a depth of 75m on either side of Mavelikkara – Kozhancherry Road and Kollam – Theni Road.		
	All uses that are permitted in Residential Use Zone are permitted in this zone unless otherwise specified in the following:	Fuel filling stations	
	Shops, Professional Offices, Commercial Offices/Establishments, Banking & other Financial Institutions, Restaurants, Canteen, Hotels, IT/Software units with built–up area limited to 500 m^2.		
	Community facilities such as Community Halls, Movie Halls, Auditorium, Wedding Halls, Convention Centers, Recreational Clubs, Social Welfare Centers, Gymnasium/ Yoga Centers, Swimming Pool, Libraries, Reading rooms etc. having built–up area limited to 500 m^2.		
	Weigh Bridge, Automobile workshops for 2/3 wheelers, Cottage Industries including coir, Service Industries of non–nuisance nature (See Annex I) with built–up area up to 500 m^2.		
	Parking Plaza, Taxi/Jeep Stand/ Truck terminal/ Transport terminal, Public utility area and buildings.		
	Godowns/ Warehouses/ Stacking yards–Storage of non–hazardous materials built–up area limited to 300 m^2.		
2.2	**Provided that the access road has an existing width of 5m minimum**		
	All shops including Shopping complexes, Shopping malls, Hyper markets, Restaurants, Hotels, Canteen, Markets, Professional Offices, Commercial Offices and Establishments, Banking & Financial Institutions, IT Software units with built–up area limited to 1000 m^2.		
	Community facilities such as Community Halls, Movie Halls, Auditorium, Wedding Halls, Convention Centers, Recreational Clubs, Social Welfare Centers, Gymnasium/ Yoga Centers, Swimming Pool, Libraries, Reading rooms etc. having built–up area limited to 1000 m^2.		
	Weigh Bridge, Automobile Workshops / Automobile Service Stations for light motor vehicles, Service Industries of non–nuisance nature (See Annex I) with built–up area up to 1000 m^2.		
	Godowns/ Warehouses/ Stacking yards for Storage of non–hazardous materials with built–up area limited to 500 m^2.		
	Critical Infrastructure– Hospitals with 5 beds		
2.3	**Provided that the access road has an existing or proposed width of 8m minimum**		

	All shops including Shopping complexes, Shopping malls, Hyper markets, Restaurants, Hotels, Canteen, Markets, Professional Offices, Commercial Offices and Establishments, Banking & Financial Institutions, IT Software units.	Sawmills with Timber yards, Slaughterhouse.	
	Community facilities such as Community Halls, Movie Halls, Auditorium, Wedding Halls, Convention Centers, Recreational Clubs, Social Welfare Centers, Gymnasium/ Yoga Centers, Swimming Pool, Libraries, Reading rooms etc. having built–up area limited to 3000 m^2.	Museum, Exhibition Centers and Art gallery.	
	Weigh Bridge, Automobile Workshops / Automobile Service Stations for light motor vehicles, Cottage Industries including Coir, Service Industries of non–nuisance nature (See Annex I) with built–up area up to 3000 m^2.	LPG distribution Centers (excluding bottling plants and bulk storage).	
	Godowns/ Warehouses/ Stacking yards– Storage of non–hazardous materials built–up area limited to 1000 m^2.		
	Marble and Granite Storage Centers, Industrial Estates & Industrial Parks –built–up area limited to 2000 m^2.		
	Critical Infrastructure– Hospitals and health Centers		
2.4	**Provided that the access road has an existing or proposed width of 10m minimum**		
	Weigh Bridge, Automobile Workshops / Automobile Service Stations for Light and Heavy Motor Vehicles, Cottage Industries including Coir, Service Industries of non–nuisance nature (See Annex I), Marble and Granite Storage Centers, Industrial Estates & Industrial Parks.	Gas godowns and uses of similar nature.	Multiplex
	Community facilities such as Community Halls, Movie Halls, Auditorium, Wedding Halls, Convention Centers, Recreational Clubs, Social Welfare Centers, Gymnasium/ Yoga Centers, Swimming Pool, Libraries, Reading rooms, Museum, Exhibition Centers and Art gallery, Indoor Games Stadium, etc.		
	Godowns/ Warehouses/ Stacking yards– Storage of non–hazardous materials		
3	**COMMERCIAL USE ZONE**		
	All shops including Shopping complexes, Shopping malls, Hypermarkets, Restaurants, Hotels, Canteen, Markets.	Fuel filling stations.	Multiplex
	Professional offices, Commercial Offices & Establishments, Banking and Financial institutions, IT Software units.	Other public utility areas & Public utility buildings.	
	Movie Halls, Auditorium / Wedding Halls / Community halls/ Convention Centers, Social welfare centers, Library and Reading rooms.	Gas godowns and uses of similar nature.	
	Residential buildings, Residential flats/Apartments with or without lower floor(s) for commercial use, Night shelters, Orphanages, Old age homes, Dharmasala, Hostels and Boarding houses, Lodges, Guest houses, Night Shelters, Ashram.	Godowns/wareho use/storage of non–hazardous materials and Stacking yards limited to 500 m^2.	
	Day Care and Crèche, Nursery / Kinder Garten / Schools up to Higher Secondary level, Expansion of existing educational institutions, Tot lots, Parks & Playgrounds, Fair grounds, Open air theatres Gymnasium, Yoga Centers, Swimming Pools.		
	Museum, Exhibition Centers and Art gallery, Social Welfare centers, Indoor Games Stadium.		
	Cottage Industries, Automobile workshops, Automobile Service Stations, Cold storage, Service Industries of non–		

	nuisance Nature (See Annex I) with built–up area up to 200 m^2.		
	Weigh bridges, Printing press, IT Hardware / Electronic Industries, Marble and Granite Storage / Cutting centers.		
	Government (Local /State/ Central) or Public Sector Offices, Civil defence and Home guard.		
	Clinics, Diagnostic centres and Hospitals.		
	Taxi/ Jeep stand/ Truck Terminal.		
	Parking plaza, Transport terminals, Public utility areas and buildings.		
	Plant nursery, Storage of agricultural produces and seeds, Pump House, Wells and Irrigation Ponds.		
	Pain and Palliative care centres, Places of worship.		
3.1	**Provided that the access road has an existing or proposed width of 10m minimum**		
	Educational institutions of higher order such as Colleges/ Universities/ General education institutions/ Specialised/ Professional education institutions/ Research and development institutions.		
	Cottage Industries, Automobile workshops, Automobile Service Stations, Service Industries of non–nuisance Nature (See Annex I).		
	Critical Infrastructure– Hospitals.		
4	**INDUSTRIAL USE ZONE**		
4.1	All industries other than obnoxious and nuisance type industries, Ice factory, Cold storage, printing press, water treatment plants.	Public Utility Areas & Public Buildings.	
	Godowns/Warehouses/Storage of non–hazardous material, Stacking yards, Weighbridge, Marble and Granite Storage and Cutting Centers, Industrial Estates & Industrial Parks, Institute's incidental to industrial estates IT Software and hardware Units, Dry cleaning plants, Power plants, Sub stations.	Junk yards, Storage of Explosive and fireworks, Storage of hazardous materials.	
	Residential buildings incidental to the industrial use. Tot lots, Parks and Playgrounds attached to incidental residential use. Dairy and dairy Farms, dairy related industries, Poultry farms, Piggery farm and Smoke houses.	Sawmills with Timber Yard, Slaughter Houses/ Fish / Meat processing Centers.	
	Shops, Professional Offices, Commercial Offices, Banks & other Financial Institutions, Restaurants, Canteen, Hotels – built–up area limited to 200 m^2.	Obnoxious and nuisance type industries (see Annex II).	
	Additions and alterations to the existing buildings including construction of new blocks without altering the use.	Dumping yards and Sewage Treatment Plants	
	Government or Public sector offices, Transport terminals incidental to industrial use. Any other activity incidental to industrial use.	Fuel Filling Stations, Gas godowns and uses of similar nature.	
5	**PUBLIC & SEMI PUBLIC USE ZONE**		
5.1	Local/State/ Central Government/ Public sector offices and other related public buildings. Additions and alterations to the existing public and semi public buildings including construction of new blocks without altering the use.	Cremation Ground / Crematorium, Burial Ground, Common Vault.	
	Residential Quarters, other buildings incidental to public and semipublic use.	Fuel Filling Stations.	
	Educational institutions (including professional education/collegiate education /higher education institutions), Library and Reading rooms, Social welfare	Gas godowns and uses of similar nature.	

	centers, Museum, Swimming pools, Exhibition centers and Art gallery, Convention centers, Indoor/ outdoor games stadium. Clinics, Diagnostic centers and Hospitals, Pain and Palliative care centers.		
	Public Utility Areas and Buildings.		
	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.		
	Ashram, Madrassa and Places of worship.		
6	**AGRICULTURE CUM RESIDENTIAL USE ZONE**		
6.1	Residential buildings consisting of Single or Multifamily dwellings, Residential flats/ Apartments, Residential quarters, Night shelters, Orphanages, Old age homes, Dharmasala, Guesthouse, Hostels and Boarding houses.	Stacking yards, Saw mill with timber yards.	
	Shops, Professional Offices, Commercial Offices/ Establishments, Banking & other Financial Institutions, Restaurants, Canteen, Hotels, IT/Software units with built–up area limited to 200 m^2.	Fish, meat processing centers.	
	Cottage industries, Industrial Estates & Industrial Parks, Service and manufacturing Industries of non–nuisance Nature (See Annex I).	Fuel filling stations.	
	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.	Cremation Ground/Crematorium, Burial Ground/Common Vault.	
	Health institutions essentially serving the needs of residential community such as Dispensaries, Clinics (Outpatient), Diagnostic Centers etc. having a built–up area limited to 200m^2.		
	Pain and Palliative care centers. Ashram, Madrasa, Places of Worship.		
	Community facilities such as Community Halls, Recreational Clubs, Social Welfare Centers, Gymnasium/ Yoga Centers, Swimming Pool, Libraries, Reading rooms etc. having built–up area limited to 200m^2.		
	Automobile workshops for two/ three wheelers with built– up area limited to 200 m^2.		
	Utility Installations and Civic Amenities essentially serving the needs of residential community such as Post Office, Tot lots, Parks, Playgrounds, Open grounds, Civil defense and Home guard, Public utility areas and Public utility buildings.		
	Government (Local /State/ Central) or Public Sector Offices.		
	Godowns/ Warehouses/ Stacking yards for Storage of non–hazardous materials, Storage of agriculture produces and seeds.		
	Agriculture, Horticulture and Fodder cultivation, Pastures, Grazing ground and other types of cultivation including social forestry.		
	Dairy Farms, Fish farms, Piggery farm, Seed farms, Poultry farms, Plant nursery, Pump house, Smoke houses or similar uses for agriculture value addition attached to a residential building, Wells and Irrigation ponds.		
6.2	**Provided that the access road has an existing width of 5m minimum**		
	Shops, Professional Offices, Commercial Offices/ Establishments, Banking & other Financial Institutions,	Sewage Treatment Plants.	

	Restaurants, Canteen, Hotels, IT/Software units with built–up area limited to 500 m^2.		
	Community facilities such as Community Halls, Recreational Clubs, Social Welfare Centers, Gymnasium/ Yoga Centers, Swimming Pool, Libraries, Reading rooms etc. having built–up area limited to 500m^2.		
	Automobile Workshops / Automobile Service Stations for light motor vehicles with built–up area limited to 500 m^2.		
	Water treatment plants below 5 MLD.		
6.3	**Provided that the access road has an existing or proposed width of 8m minimum**		
	Shops, Professional Offices, Commercial Offices/ Establishments, Banking & other Financial Institutions, Restaurants, Canteen, Hotels, IT/Software units with built–up area limited to 1000 m^2.	LPG distribution centers (excluding bottling plants and bulk storage) built–up area limited to 500 m^2.	
	Health institutions essentially serving the needs of residential community such as Dispensaries, Clinics (Outpatient), Diagnostic Centers etc. having a built–up area limited to 500m^2.		
	Community facilities such as Community Halls, Recreational Clubs, Social Welfare Centres, Gymnasium/ Yoga Centers, Swimming Pool, Libraries, Reading rooms etc. having built up area limited to 1000m^2.		
	Automobile Workshops / Automobile Service Stations for light motor vehicles with built–up area limited to 1000 m^2.		
	Water treatment plants.		
	Weigh Bridge.		
6.4	**Provided that the access road has an existing or proposed width of 10 m minimum**		
	Shops, Professional Offices, Commercial Offices/ Establishments, Banking & other Financial Institutions, Restaurants, Canteen, Hotels, IT/Software units.	LPG distribution centers (excluding bottling plants and bulk storage)	
	Health institutions essentially serving the needs of residential community such as Dispensaries, Clinics (Outpatient), Diagnostic Centers etc.	Gas godowns and uses of similar nature.	
	Community facilities such as Community Halls, Recreational Clubs, Social Welfare Centers, Gymnasium/ Yoga Centers, Swimming Pool, Libraries, Reading rooms, Museum, Exhibition Centers and Art gallery, Indoor Games Stadium, etc.		
	Movie Halls, Auditorium, Wedding Halls, Community Halls, Convention Centers.		
	Automobile Workshops / Automobile Service Stations for Light and Heavy Motor Vehicles.		
	Critical Infrastructure– Hospitals and Health Centers.		
7	**PARK & 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.	
	Tot Lots, Park, Playgrounds, Turf, Comfort Stations, Swimming Pool, Open Air Stadium, Open Air Theatre, Zoological and Botanical gardens.		
8	**TRAFFIC & TRANSPORTATION USE ZONE**		

8.1	Transport terminals including constructions that form an integral part of the terminal.	Public Utility Areas and Buildings.	
	Any incidental uses to the transport terminals such as Retail Shops, Restaurants, Canteen etc.	Fuel Filling Stations.	
	Staff Quarters, Offices, Night Shelters, Guest Houses etc incidental to the Transport terminals, Parks, Parking Plazas, Comfort stations.		
9	ECOLOGICAL CONSERVATION ZONE		
9.1	Constructions/ land developments in conformity with '*The Kerala Conservation of Paddy Land and Wet Land Act,2008*' in force in lands designated as paddy land or wet land under the said Act.	Minor Public utility areas & buildings which will not affect the character of the area.	
	Paddy cultivation, Fish farms, Agriculture/ Horticulture/ Fodder cultivation / Seed Farms/ Wells and Irrigation Ponds without any building construction, Pump house.		
10	WATER BODIES		
10.1	All existing water bodies shall be conserved.		
	Restoration and rejuvenation of waterbodies.		
	Bridges, Side protection walls, Bathing ghats, floating jetty etc. may be permitted based on community level requirements.		
	Traditional fishing and allied activities undertaken by local communities.		
	Facilities related to canal / river tourism without affecting and altering the natural environment may also be permitted.		
11	SPECIAL USE ZONES		
	Special Use Zones include the areas specifically demarcated for certain projects. No other activity unless otherwise specified should be permitted in such areas.		
11.1	**Special Use Zone – 1: Eco Tourism Spot 1**		
	Any construction/ land development essential for the development/ improvement of open–air recreational facilities shall be permitted in this zone. The essential facilities and other incidental uses for promoting eco-tourism activities shall be permitted without altering the natural rock structure of the area.		
	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 a part of *Agriculture Cum Residential Use Zone*.		
11.2	**Special Use Zone–2: Eco Tourism Spot–2**		
	Activities essential for promoting pilgrim tourism facilities shall be permitted in this zone. Temporary infrastructure for supporting the recreational facilities shall be permitted. Other essential facilities and incidental uses for promoting tourism activities shall be permitted without altering the natural rock structure of the area.		
	Minor Public utility areas & buildings without affecting the character of the area.		
	Sustainable building methods are preferable for new developments.		
	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 a part of *Mixed Use Zone*.		
11.3	**Special Use Zone–3: Liquid Waste Treatment Plant**		
	Any construction/ land development essential for the development/ improvement of liquid waste treatment plant and its incidental uses are permitted.		
	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 a part of *Public and Semi Public Use Zone*.		
11.4	**Special Use Zone–4: Pilgrim Amenity Centre**		
	Any construction/ land development essential for the development/ improvement of Pilgrim Amenities shall be permitted. Night shelters, Open showers, Public toilets, Commercial uses incidental to the main use.		
	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 a part of *Public and Semi Public Use Zone*.		

11.5	**Special Use Zone–5: Parking area**
	Parking areas, Multi-level parking structures, Mechanised parking facilities, Truck Terminal. Information kiosk, Commercial areas, offices and other uses incidental to the main use.
	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 a part of *Mixed Use Zone*.

24.3 Part C–Regulations for Flood Prone Area

Flood prone area: These are areas which are exposed to floods as indicated in the 25–year return period flood maps published by KSDMA. This map is part of proposed land use map as an overlay.

Areas likely to be inundated to a depth up to 0.6m is excluded from flood prone area regulations. Areas likely to be inundated to a depth of more than 0.6m and up to 1.5m is named as Flood prone area I and the areas likely to be inundated to a depth of more than 1.5m is named as Flood prone area II.

For reducing flood risk, permissible developments in various land use zones (Part B Table 24-1) are further modified by regulations for flood prone area given in Table 24-2. These modified regulations are aimed at reducing damages and losses to people and assets in the flood prone areas mapped by KSDMA. These regulations have to be read in conjunction with the zoning regulations in Part B Table 24-1 and wherever a conflict occurs the modified regulations in the in Part C Table 24-2 shall prevail.

Table 24-2: Zoning regulation for the Flood prone Area

	Permitted Uses in Flood Prone Area
1.	All existing authorized uses will be permitted to continue including their maintenance and strengthening works.
2.	Expansion of existing buildings to the upper floors under permitted uses in Part B of the respective land use zone will be allowed.
3.	Constructions in respective zones as in the Proposed Land Use Plan.
4.	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.
5.	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.
6.	Height of compound wall shall not exceed 1.5 meter and no sharp–edged projections shall be fixed on the compound walls or gates.
7.	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.
8.	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.
9.	Electrical points shall be provided above 1.2 m from finished floor level
10.	Essential utility services with suitable flood proofing.
11.	Agriculture, Horticulture, Pisci culture, Fodder cultivation and other types of cultivation including social forestry.
12.	Ancillary structures to the above including Pump house, Well, Irrigation pond and Granary for temporary storage.
13.	Parks and other organised recreational open areas with essential ancillary structures.
14.	**Flood Prone Area I**
14.1	All new buildings or additions in the ground floor shall be built on a plinth height of 60cm from the surrounding ground level.
15.	**Flood Prone Area II**

15.1	All new buildings or additions in the ground floor shall be built on a plinth height of 1.20m from the surrounding ground level.
15.2	Basement floors are not allowed for any use other than parking.

24.4 PART D–ANNEX

See Annex I & II

ANNEX-I

TYPE OF NON-OBNOXIOUS AND NON-NUISANCE TYPE OF SERVICE OR LIGHT INDUSTRIES PERMISSIBLE IN RESIDENTIAL 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. Dye ing and ble aching 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
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

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.