KOOTHATTUKULAM TOWN

MASTERPLAN
2036



OCTOBER 2020

KOOTHATTUKULAM
MUNICIPALITY

LOCAL SELF GOVERNMENT
PLANNING WING

MASTER PLAN FOR KOOTHATTUKULAM TOWN 2036

REPORT

Municipal Council of Koothattukulam & Local Self Govt. Planning Wing

FOREWORD

Koothattukulam is a town and Municipality situated in Muvattupuzha Taluk, towards the south east corner of Ernakulam District in Kerala. It lies at the junction of three Districts: Ernakulam, Kottayam and Idukki and covers an area of 2318.71 hectares. Koothattukulam is a newly formed Municipality of the Ernakulam District, the town has got Municipal status in November 2015. Koothattukulam Town is located along the M.C Road. The potential deriving out of the presence of M.C Road and other regional roads makes the Municipality an important commercial centre of the region.

The fast pace in growth of the Town and resulting issues make it necessary to adopt planned intervention for the growth of the town and to face the challenges associated with the remarkable growth of the Town. The thought in that direction has been materialized now as the "Master Plan for Koothattukulam Town". The Plan is drafted with the general purpose of guiding and accomplishing a coordinated, adjusted, and harmonious development of the town and its environs. I am happy to place it before the people of Koothattukulam, as it is through them and its hoped that the Town has to take shape as envisaged in the Plan.

All the members of the present council have actively participated in the discussions for finalising the Plan. Special acknowledgement to the Standing Committee Chairpersons for their guidance and involvement in the work. Members of the Special Committee and working group also put in considerable efforts in materializing this Plan. I also appreciate the Department of Town and Country Planning, Government of Kerala for their efforts in materialization of the Master Plan for Koothattukulam Town.

I am certain that the developments in the municipal area will reap maximum benefits through the Plan. This Plan prepared jointly by Koothattukulam Municipality and Kerala Town and Country Planning Department in the name " Koothattukulam Town Master Plan- 2036" can definitely help to transform Koothattukulam into a more liveable space for the generations to come.

Ernakulam
27/10/2020

Roy Abraham
Chairman, Koothattukulam Municipality

PREFACE

Natural transformation of villages into towns is always associated with many issues like backlog in supply of drinking water, traffic congestion, accumulation of solid wastes, housing shortage and absence of other public amenities. Also increased level of construction activities without considering the overall development need of the town may cause adverse environmental impacts in the town. As towns are playing vital role in the economic development and employment generation of the nation, development activities involving construction increase in towns. Hence there is a need for balancing development activities and natural environment, so that the productivity and liveability of towns can be made sustainable. This can be achieved only by guiding the development in an orderly manner through a long term Master Plan considering the available resources and future requirements and potential of the town. Master Plan is an important tool for urban development as such it guides, controls and manages urban growth in a planned manner.

The Kerala Town and Country Planning Act 2016, which came into effect following the 73rd and 74th amendments to the Constitution, empowers every Municipality to prepare a Master Plan. With a view to prepare Master Plans for all urban centres in the State, the scheme for preparation of Master Plans and Detailed Town Planning Scheme have been introduced in the year 2008. Koothattukulam Municipality in Ernakulam District is a recently formed Municipality for which a Draft Master Plan is prepared under the IIIrd Phase of the scheme.

The draft Master Plan for Koothattukulam Town is prepared after conducting exhaustive discussions with Council members as well as Special Committee members. Many workshops and discussion sessions were conducted with the members of Special Committee and Working Groups and draft Master Plan was prepared with their extensive support. Thus a good level of people's participation was ensured in this Plan.

The preparation of Draft Master Plan involved extensive data collection and analysis, identification of development issues setting up of goals and objectives, formulation of development concept and carving out policies and strategies followed by detailed sectoral proposals. All members of the Municipal Council extended their support in the task of preparation of the draft plan. In this report the whole hearted involvement of the former

Chairpersons Sri. Prince Paul John, Sri. Biju John, Sri. P. C. Jose and the present Chairman Sri. Roy Abraham are reckoned with gratitude. The members of the Special Committee also extended their whole support for completing the Draft Plan in time. The sustained and collective efforts of the Special Committee, working groups and the Planning Team culminated in the documentation of this Master Plan. I take this opportunity to appreciate the leadership provided by the Municipal Council and the Special Committee. As the planning exercise encompassed various sectors, it required the support and positive interaction with many public and private agencies/ departments. I acknowledge their collective contribution and co-operation. The hard work, spirit and the sincerity of the Planning team in the Regional Town Planning Office headed by Sri K. M. Gopakumar, Senior Town Planner in bringing this Draft Plan within the scheduled time is highly appreciated.

I am sure that the Master Plan of Koothattukulam Town will provide the frame work for orderly developments in the Koothattukulam Municipal area so that the Town becomes more productive, sustainable and liveable.

Thiruvananthapuram **Chief Town Planner**

ACKNOWLEDGEMENTS

Considering the role and importance of rational and orderly growth of urban centres, the Government of Kerala intends to streamline the development process in urban settlements, to ensure that these settlements continue to achieve their objectives of improved efficiency and productivity. In this respect, the Government has introduced a Scheme for preparation of Master Plans for municipalities in the state, and preparation of Master Plan for Koothattukulam Town was included in the third phase of the scheme.

The preparation of Master Plan for Koothattukulam Town was kicked off as a joint effort of Koothattukulam Municipality and Regional Town Planning Office, Ernakulam. Special attention was given for ensuring the participation of various stake holders such as elected representatives, line departments, residents of the locality and NGOs. With the co-operation of these stake holders, the process of preparation of Draft Master Plan involving systematic data collection, wide range of analyses, evolving development vision and formulating detailed proposals is completed.

The municipal council of Koothattukulam has resolved to prepare a new Master Plan for the Town by resolution No: 2 dated. 15-12-2017 and special committee was also constituted on 15/12/2017. Various activities were co-ordinated by special committee constituted specifically for the purpose, under the guidance and supervision of Koothattukulam municipal council.

Given the stupendous nature of the Master Planning task and the intricacy of details involved, right leadership and direction is very significant for the effective and successful preparation of the plan. Without the leadership and support of Municipal Council, it is impossible to fulfill the task of preparation of Master Plan. I acknowledge with gratitude the guidance and involvement of Sri. Prince Paul John, Sri. Biju John, Sri. P. C. Jose, former Chairmen of Koothattukulam Municipality, and Sri. Roy Abraham, present Chairman of the Municipality. As the planning exercise encompassed various sectors, it required the support and positive interaction with various public and private agencies/ departments. It would be unfair if their collective contribution and co-operation are not acknowledged. The contribution by the Municipal Council,

the Special Committee and the Working groups were highly significant in materialising this plan and especially in arranging discussions with other stake holders.

Smt. Girija, Chief Town Planner (Planning) and Sri. Gigi George, Chief Town Planner was a great source of constant motivation and inspiration in accomplishing this task. I am highly indebted to Smt. Ushakumari P.R., Senior Town Planner and Sri. Jayakumar J., Senior Town Planner for their guidance, encouragement, constant supervision & also for their support in completing this plan. The consistent support and consultation rendered by Smt. Sindhu K.M, Town Planner and other staff of the office of Chief Town Planner, Planning are also sincerely acknowledged. Smt. M.M. Sheeba, Town Planner is duly acknowledged for her contributions and involvement for materializing this Plan in its present form.

I appreciate the Planning team headed by Smt. Famidha Yoosaf, Deputy Town Planner, Kum. Gladis William, Deputy Town Planner, Smt. Souda A., Assistant Town Planner, Sri. Rinosh Cherian Thomas, Planner Associate, Sri Akhil R., Planning Assistant, Smt. Deepa Divakaran, Surveyor in the time bound preparation of the Plan. The service of the former Town Planner, Sri. Rajeev K.R, former Deputy Town Planner, Smt. Jayasree V.K are also remembered with gratitude for their contributions and involvement during their incumbency in this office.

I also appreciate all other staff of the Regional Town Planning Office for extending their sincere and dedicated assistance in the task. All the staffs have participated in various stages of preparation of Master Plan and I sincerely acknowledge their whole hearted participation.

Ernakulam
27/10/2020

K.M. Gopakumar
Senior Town Planner

Process of preparation of the Master Plan

The preparation of master plan for Koothattukulam is started based on the G.O (Rt.) No. 2955/2015/LSGD dated. 29.09.2015. Taking into account the spirit of 74th constitutional amendment, the GO stipulates a participatory approach for the preparation of the plan. The plan preparation is envisaged as a joint venture of the Municipality and the Town and Country Planning Department. The Master Plan is prepared based on the provisions of the Kerala Town and Country Planning Act 2016, Urban and Regional Development Plans Formulation and Implementation (URDPFI) Guidelines and other applicable guidelines and standards.

As stipulated in the G.O, the council of the Koothattukulam Municipality constituted a Special Committee (SC) which is headed by the Municipal Chairman, whereas the Regional Town Planning Office, Ernakulam constituted a planning team consisting of a Deputy Town Planner, Assistant Town Planner, Planner Associate, Planning Assistant and a Surveyor. These two teams worked together for the preparation of the plan. The plan preparation in the Municipality started with a seminar conducted on 12th August 2016 in order to sensitise the council members as well as the general public about the necessity of a master plan for the municipality and to ensure their participation in all the process of preparation of the plan. The data collection, constituting land use survey, socio economic survey and secondary data collection was performed by survey trainees selected by the Municipality/ Special Committee and trained by the planning team.





Discussions with the council



Presentation before the council on 17/04/2018

The study of traffic and transportation for Town is carried out by National Transportation Planning and Research Centre (NATPAC) Thiruvananthapuram. The details of existing traffic and transportations characteristics and proposals based on the detailed study by NATPAC were incorporated in the Master Plan.

Sectoral proposals were discussed and presented before the council on 11/08/2017, 18/08/2017, 05/10/2017, 30/01/2018 and 17/02/2018. The draft plan so prepared was presented before the council on 17/04/2018, and modifications were made as per the suggestions from the council.



Presentation before the Council and other selected representatives of the Town area on 27/02/2020

As per the directions of the Council and Chairman, the corrected Master Plan was again presented before the selected members and representatives of the Town area on 27/02/2020. The presentation team was led by Sri. J. Jayakumar, Senior Town Planner. The representatives of the town included Council members, representatives of vyaparai vyavasai samithi, various resident welfares association members in Town area, retired govt. officials from various departments residing in the Town area, officials from various govt. departments, NGO members, etc. Sri. Kennady John, Assistant Town Planner of the department (Idukki District) and a native of

Koothattukulam town, also attended as per the direction of Chairman as a representative of the council to help the members of council and the representatives in technical matters pertaining to the plan. The valuable suggestions and recommendations evolved during the discussion after the presentation were tabulated and given as a council decision. Those recommendations and suggestions were scrutinized and modifications were further incorporated in the draft plan prepared as per the council decision on 17/06/2020.



Presentation before the Council and other selected representatives of the Town area on 27/02/2020

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1 INTRODUCTION

Koothattukulam is a Municipal Town in Moovattupuzha Taluk, Koothattukulam village of Ernakulam District. Koothattukulam is the major township in the south east region of Ernakulam District. In the year 2015, Government of Kerala upgraded Koothattukulam Panchayath to Koothattukulam Municipality without any change in geographical setting.

1.1 NEED FOR THE PLAN

Being a newly formed Municipality, a Master Plan is mandatory to guide the development of the Town. Proximity to urban centers around and historical importance provides a scope of development for the Town. The preparation of Master Plan for Koothattukulam is started based on the G.O (Rt) No. 2955/2015/LSGD dtd. 29.09.2015.

As per the District Urbanization report, Koothattukulam is classified as fourth order settlement which is classified under service area of Piravom Municipality. Like many other Towns, Koothattukulam Town also faces problems like traffic congestion, lack of parking space, absence of a sewerage system, lack of proper solid waste management system etc. As a Municipal town and as a growing urban area, the town needs a plan to address the problems and to coordinate the activities generated by the new developments. Hence it is imperative to prepare a Master Plan to guide and accelerate the development of Town.

1.2 METHODOLOGY

The methodology adopted for preparation of the Master Plan is as per the guidelines issued vide G.O.(Rt.)No.2766/2009/LSGD dated 24.10.2009. As envisaged in the guidelines, the Master Plan has been prepared jointly by the Municipality and the Local Self Government Planning Wing.

The Plan preparation process consists of data collection, analysis (local level and spatial analysis), envisioning process and detailing. The Plan preparation is detailed in figure 1.1.

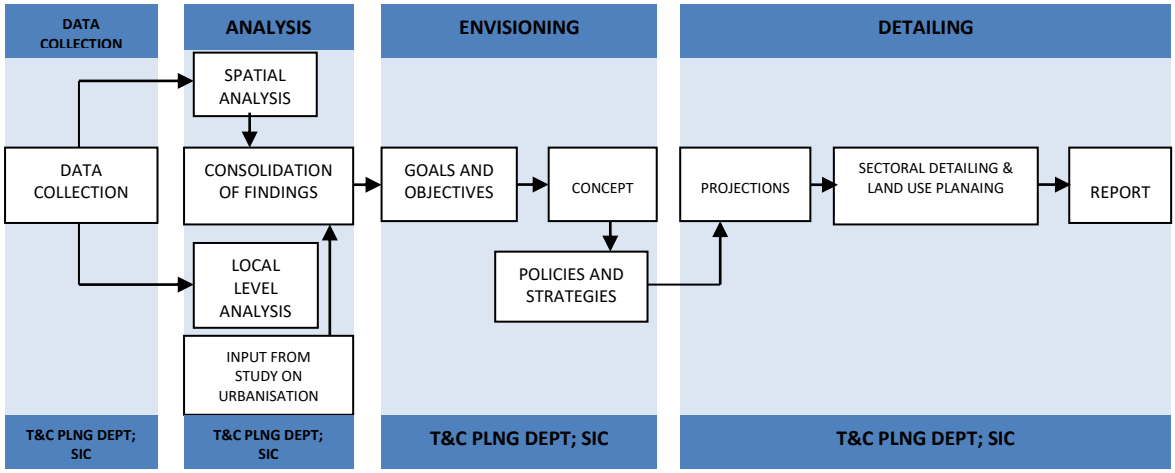


Figure 1-1 : Plan preparation and agencies involved

1.3 EARLIER PLANNING EFFORTS AND STUDIES

There is no considerable planning effort made for Koothattukulam other than the Development report published in 1996 which mentions the existing status of the Panchayath at that time.

The District Urbanisation Report (DUR) for Ernakulam District, 2011 prepared by the Department of Town and Country Planning presents the analysis and findings of the study on urbanisation in the district to provide an insight in to the urbanization trend in the district. The DUR defines the future spatial structure of a district, which is formulated by integrating hierarchy and activity pattern of urban and rural settlements and the connectivity between them. The spatial structure of a district will act as a frame for the orderly development of urban centres and their rural hinterland subsequently leading to a planned urbanisation.

1.4 PROFILE OF TOWN

1.4.1 Location

Koothattukulam is located between 9°50’10’’-9°52’59’’ N latitude and 76°32’40”-76°37’05”E longitude. Koothattukulam is located in the boundary region of Kottayam, Idukki and Ernakulam Districts. The Town lies 17km to the south of Moovattupuzha, and 37 kilometers north of Kottayam. Koothattukulam Town is bounded by Palakkuzha and Thirumaradi Gramapanchayaths in north side, Palakuzha and Veliyannur Gramapanchayath (Kottayam District) in east side, Veliyannur and Elanji in south, Elanji and Thirumaradi panchayaths in

the west. Some of the nearest Towns are Uzhavoor (10km), Ramapuram (11km),Kuravilangad (16km),Piravom (17km),Muvattupuzha (17Km), Thodupuzha (20Km), Ettumanoor (27km), Kothamangalam (30Km), Perumbavoor (37km).

Main Central road, better known as MC road, one of the main north- south connectivity of Kerala State passes through Koothattukulam Town and can be considered as the backbone of the road network system in the Town. A stretch of 4.7 km of MC road passes through Koothattukulam Town and it connects the Town with Moovattupuzha on the north and Kottayam on the south. State Highway 40 (Alappuzha - Madurai) traversing in east- west direction is another state highway passing through Koothattukulam Town. This road connects Koothattukulam with important Towns such as Thalayolaparambu, Vaikom and Alappuzha on the western side and Thodupuzha in the eastern side. Also, Koothattukulam is well connected to the important urban centres of the state – Thiruvananthapurm (180 Km), Kollam (130Km), Pathanamthitta (83Km), Alappuzha (65Km), Kottayam (40Km), Idukki (92Km), Cherthala (50Km), Kochi (45Km), Aluva (50Km) and Thrissur (97Km).

Road transport is the only mode of transport available in the Town. Nearest Railway station to the Town is Piravom Road railway station located at Velloor, which is 22km away from Town, and has stop for all passenger trains and most express trains. Nearest major railway stations are at Ernakulam and Kottayam.

1.4.2 Area and Population

As per 2011 census, Koothattukulam Town has an area of 23.18 sq.km with a population of 17,253 which is the lowest population among the other urban local bodies in the District. Population density of the Town is 744 persons per sq.km. Koothattukulam Municipality was established by upgrading Koothattukulam panchayat, with 25 wards. The average population per ward is 690. The male population is 8,384 and that of female is 8,869 with a sex ratio of 1058. Males constitute 48.50% of the total population indicating a slight lower than percentage of female population.

1.4.3 Climate

Koothattukulam has tropical climate with significant rainfall in most of the months of the year with an average annual temperature of 27.40 °C. The average rainfall is 3553 mm and

about 90% of the rain is received during south-west and north- east monsoon. Most of the precipitation falls in July, averaging 742 mm. The driest month is January with a precipitation of only 21 mm. The precipitation varies 721 mm between the driest month and the wettest month. With an average of 29.30 °C, April is the warmest month. July is the coldest month, with temperature averaging 26.20 °C.

1.4.4 Physiography

Ernakulam District is divided into three well-defined parts, viz. highland, midland and the lowland consisting of hills and forests, plains and the seaboard respectively. Koothattukulam is located in South-East of Ernakulam District which comes under the midland region.

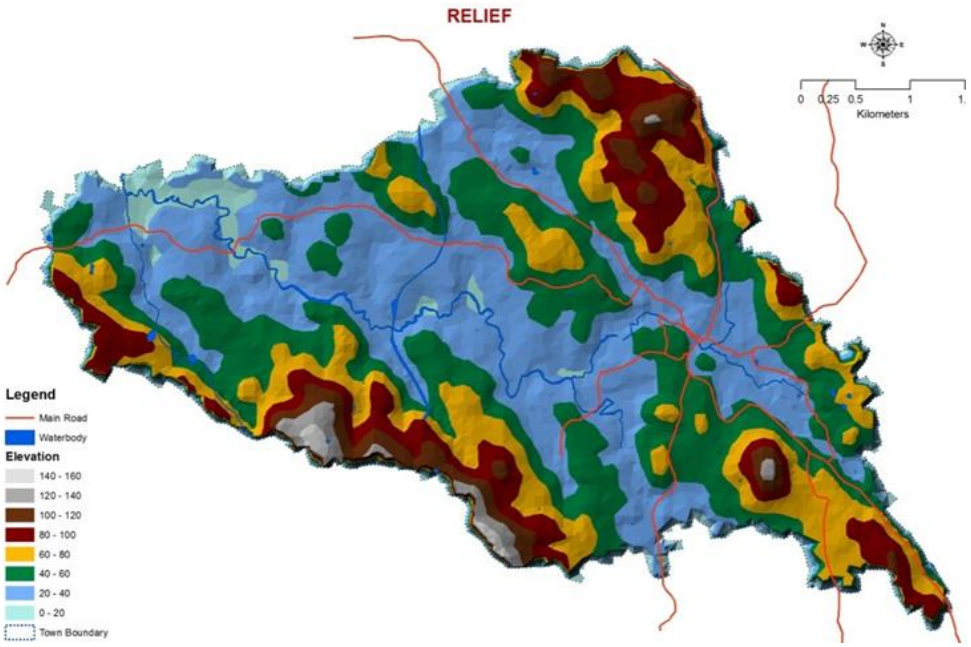


Figure 1-2: Map showing Relief of Koothattukulam Town

Koothattukulam is one of the local bodies in the boundary at south east side of Ernakulam District. The area is formed by many hills of height above 100m from the mean sea level and two valleys in-between. Arjuna Hill (Arjunanmala) is the largest hill (130m above mean sea level) and divides the region into two valleys. The two valleys in the central portion have its gradient from east to west. Valley on the southern side is comparatively bigger one and it extends up to Uzhavoor in Kottayam District. Uzhavoor stream is originating from this area and flows through Veliyanoor panchayat of Kottayam District and reaches Koothattukulam. Out of the 13 agricultural zones of Kerala, Koothattukulam possesses the central mid zone geographical features.

Koothattukulam Town has highest relief of 150m and lowest relief of 15m. The southern boundary region forming the water divide portion is a small ridge system with hills of more than 140m height. The southeast part has a saddle formation with its spur extending towards northwest. The lower tip of this region connecting the hillock at its northwest side is one of the best suitable sites for the construction of water security checks. The northern portion is also dominated by high lands with a relief up to 120m. The eastern side has a broad valley with streams running through it. This region has the lowest relief of 15m to 20m.

Koothattukulam Town has a general slope from SE to NW direction. The lowest slope is 6.05^0 and the highest is 86.78^0. Only 2% of the area has gentle slope and is located in the valley regions. Steep slope covers about 31.41% of the total area and is located all direction except the eastern side. In the north the orientation of slope is from north to south and in the southern side it is in south to north direction.

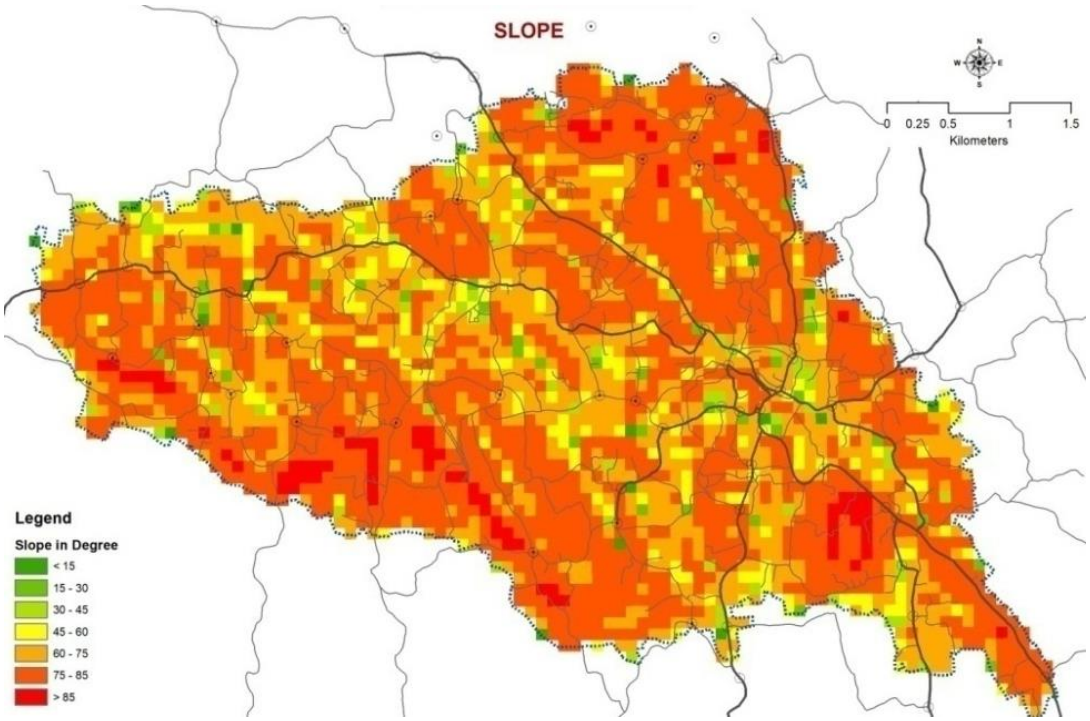


Figure 1-3 : Map showing Slope of Koothattukulam Town

The relief and slope of Koothattukulam indicates that it is a land locked Municipality with rugged topography.

1.5 HISTORY

1.5.1 History of governance

Koothattukulam was part of erstwhile Vadakkumkoor Kingdom until it was captured by Travancore kingdom. Vadakkumkoor kingdom had a weapon training centre in Onakoor and so this place came to known as “Payattukalam” which is the present day Paittakulam. Till 1952, the administrative setup of Koothattukulam was in the form of 'Village Union' and was changed into Panchayath. The Panchayat had been a Municipality for a brief period of about two and half years (1990 October 27 to 1993 March 31) and it was reverted to a special grade Gramapanchayath in 1993. The Koothattukulam Gramapanchayat was upgraded in to Municipality in 2015 by Government of Kerala.

1.5.2 History of development

Originally Koothattukulam is believed to have been ruled by four Brahmin families of Athimannu, Kottanadu, Kattimuttam and Pariyaram. Now, Koothattukulam consists of four distinct territories (locally known as 'karas') of Koothattukulam, Vadakara, Paittakulam and Kizhakombu and has a population of about 17,253. There are interesting folklores connected with the current names of territories. The cultural history of Koothattukulam dates back to the era of Buddhism and Jainism. It is reflected in its very name, which suggests that this must have been a land of ‘kooth’ and ‘aattam’. From time immemorial, Koothattukulam has been a shining example of religious tolerance and comity. Christian churches steeped in the cultural traditions of the Buddhist - Jainist era are a characteristic feature of the area. Though Christians form the majority of the population, there are a number of places of worship belonging to both Christians and Hindus. The Mahadeva temple at Koothattukulam, the OnamkunnuKavu, the Shiva temple at Arjunan Mala, the Devi temple at Kizhakombu, the St. John The Baptist Catholic Church and the St. John’s Syrian Jacobite Church at Vadakara etc. are just a few of the places of worship dating back several centuries.

Koothattukulam Region once thrived with agricultural activities and was one of the Agri-Business Centre in Travancore. More than 90% of the work force was engaged in agriculture activities during the past. Agriculture, farming and trading were the major source of economy and the residential neighbourhoods were sparsely developed. Later on

commercial facilities to cater the demand of neighbourhoods were also developed. The Public market of Koothattukulam, known as Sree Ramavarmapuram Market dates back to hundreds of years was a major centre for cattle trade, trading of rice and cashcrops and also was the centre/checkpoints authorized for taxation and inspection. Opening up of MC Road, connecting roads towards the nearby Towns and development of internal roads triggered more commercial and residential development in the region.

1.5.3 Bio diversity

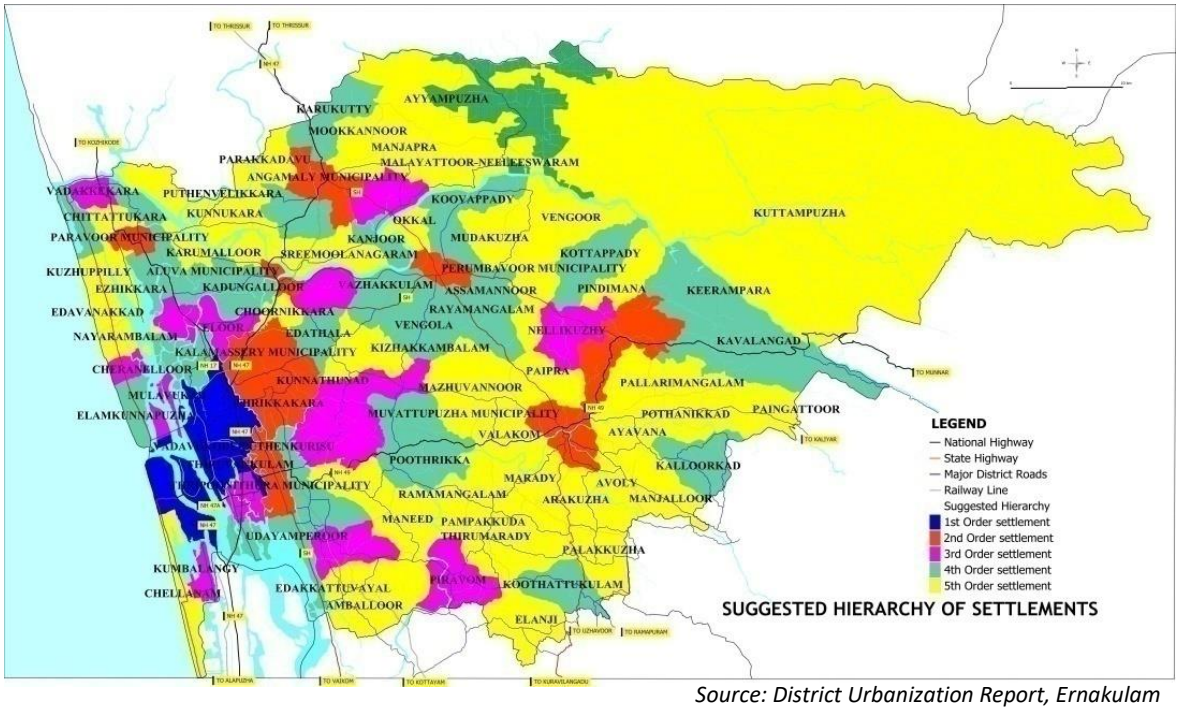
Koothattukulam has a hilly terrain in the eastern part and low lying areas in the central part. Depending on the location, different varieties of food crops and cash crops are cultivated. Rubber cultivation plays dominant role in the economic development of the region and rubber trees are extensively cultivated. There is no notified forest area in the Town but it has sacred groves or kavu which is home to wide range of flora and fauna.

1.6 REGIONAL SETTING

Regional setting of the town can be illustrated from the District Urbanization Report (DUR) published on January 2011 which spells out the hierarchy of the town in the District, its functional character and its connection with other settlements, its locational advantage, character of its influence area etc. Koothattukulam is one among the 13 municipalities in Ernakulam District. The regional setting of a Town describes hierarchy of settlement in the regional scenario, the activity which the Town has to perform and its connectivity with different settlements.

1.6.1 Koothattukulam in Regional Context

State Highway 1, widely known as Main Central Road (MC Road) traversing from Thiruvananthapuram to Angamaly passes through Koothattukulam and is the most important road in Koothattukulam. Koothattukulam is one of the urban settlements in the region along with Piravom which is of higher order comparatively, catering the population of nearby rural local bodies in Ernakulam as well as Kottayam District.

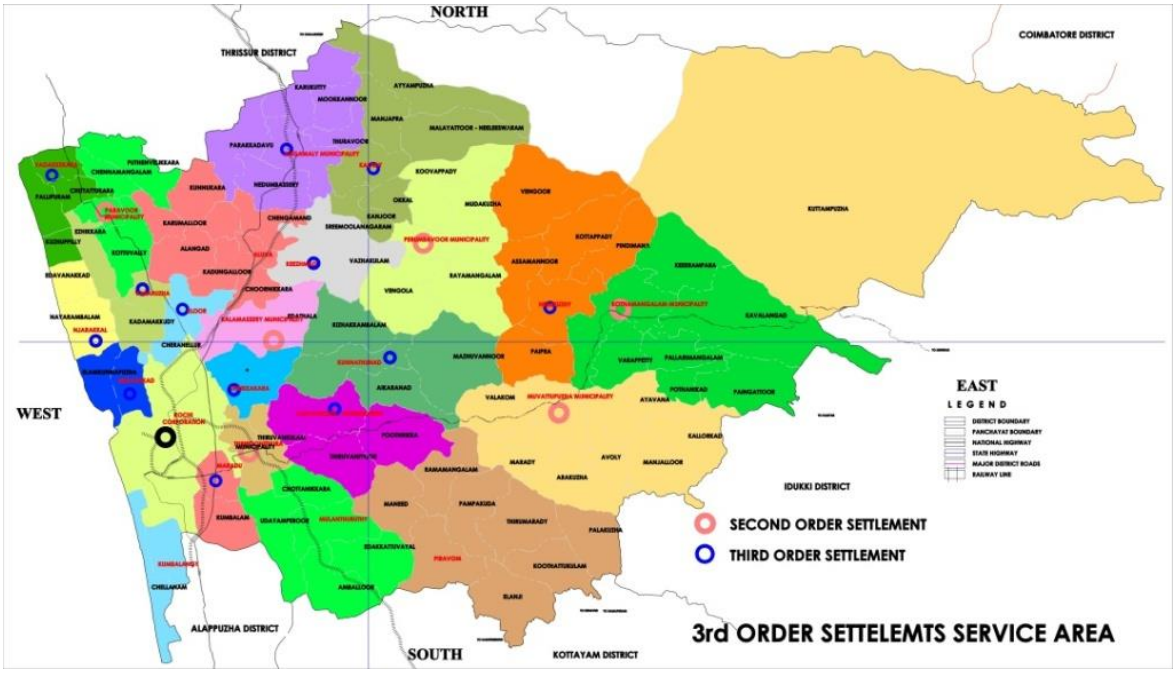


Source: District Urbanization Report, Ernakulam

Figure 1-4: Hierarchy of settlement in District

As per the District Urbanization Report, Koothattukulam Town has been classified as fourth order settlement which is under the service area of Piravom Municipality, a proposed third order settlement in the District. Kochi Corporation, the first order settlement in Ernakulam District is followed by 9 second order settlements which include all other municipalities in District except Maradu, Eloor, Piravom and Koothattukulam. Koothattukulam is proposed as a fourth order settlement. Even though Koothattukulam is fourth order it has a scope of development along with Piravom, as nearby local bodies are all fifth order and depends on these urban centres. The settlement hierarchy order are proposed based on the criteria Centrality, Existing hierarchy, Connectivity, Administrative status and also based on the population density.

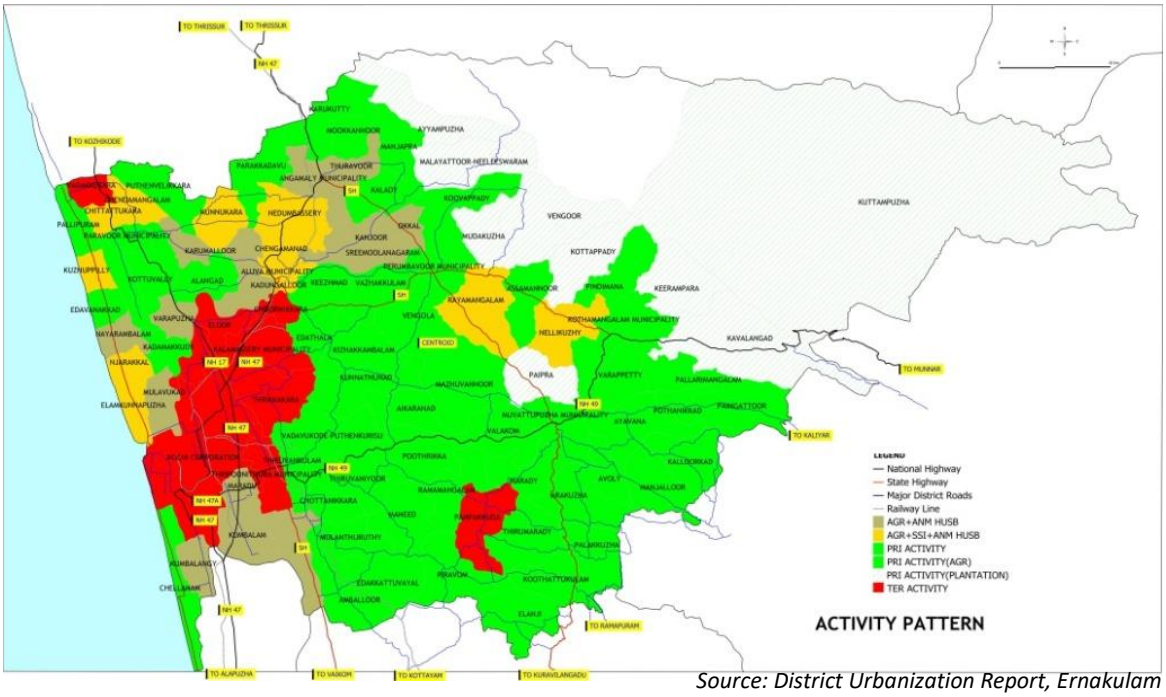
The hierarchy of settlements of Ernakulam District as revealed from regional setting study is shown in Figure 1.4. Koothattukulam which is newly formed Municipality, along with grama panchayaths of Pampakuda, Ramamangalam, Maneed, Edakkatuvayal, Elanji and Thirumarady comes under the service area of Piravom muncipality in Ernakulam District. The nearby settlements are of fifth Order, therefore Piravom and Koothattukulam has to cater the demands of these areas.



Source: District Urbanization Report, Ernakulam

Figure 1-5 : Service area for Settlements in District

The Activity pattern of Ernakulam District is shown in Figure 1.6. In this study Tertiary activity, Primary activity (Plantation), Primary activity (Agriculture), combination of Agriculture and Animal husbandry, Primary activity (Agriculture and Animal husbandry) are the activities identified for various settlements of the District.

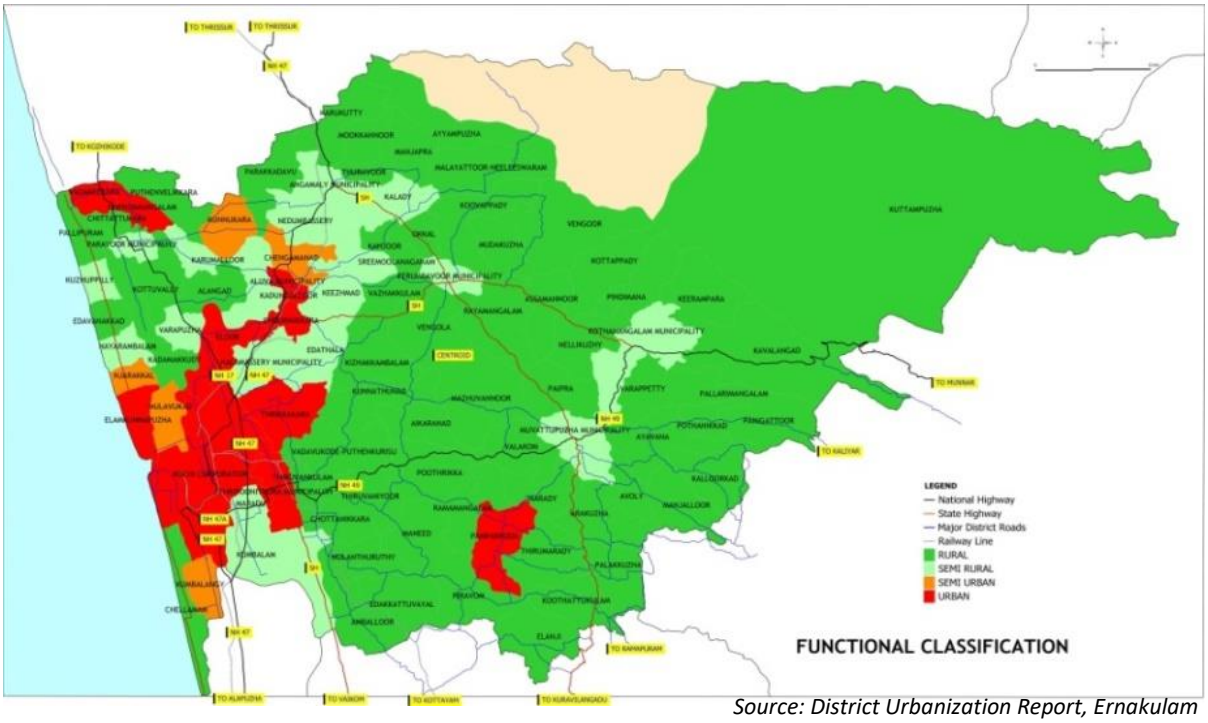


Source: District Urbanization Report, Ernakulam

Figure 1-6 : Activity pattern of settlements in District

Based on land use concentration and functional character, the activity pattern of Koothattukulam Town and nearby local bodies are found to be primary activity which is mainly agriculture (Dry cultivation). Agricultural workers and cultivators are the predominant workers in these areas. There is a concentration of agricultural or plantation land use in such areas and also the plot sizes and major land uses indicate the nature of activity as primary.

The functional character of a settlement is the major activity within the settlement, be it agriculture (rural) or secondary sector and tertiary sector activities (urban activities) or an activity in between rural and urban, i.e. semi rural or semi urban. Based on District Urbanisation Report, the functional character of the Koothattukulam Town is rural based on land use and average plot size within the settlement. The functional character of local bodies in the District is shown in figure 1.7.



Source: District Urbanization Report, Ernakulam

Figure 1-7 : Functional character of Local bodies

1.6.2 Major Nodes

In the District Urbanisation analysis, Koothattukulam is an important node in the region. Central junction in Koothattukulam is classified as 3rd order node and Mangalathuthazham junction is classified as a fourth order node in the District. The hierarchy of node is indicated by the extent of activity taking place in the node. The extent of activity is measured by a

proxy indicator denoted by the hierarchy of roads meeting at that place. The third order nodes have to fulfil the functions of a community centre mentioned in the Town and Country Planning Organization (TCPO), Govt. of India guidelines for commercial facilities. As per TCPO guidelines community centre has to cater a population of 40000. But due to dispersed settlement in the District, the service population of the third order nodes is taken as approximately 80,000.

Central junction in Koothattukulam is proposed as a second order node in DUR. The second order nodes have to fulfill the functions of a city centre mentioned in the Town and Country Planning Organization (TCPO), Govt. of India guidelines for commercial facilities. Due to dispersed settlement in the District, the service population of the 2nd order nodes is taken as 4.5 lakhs. Mangalathuthazham junction is proposed as third order node in the District.

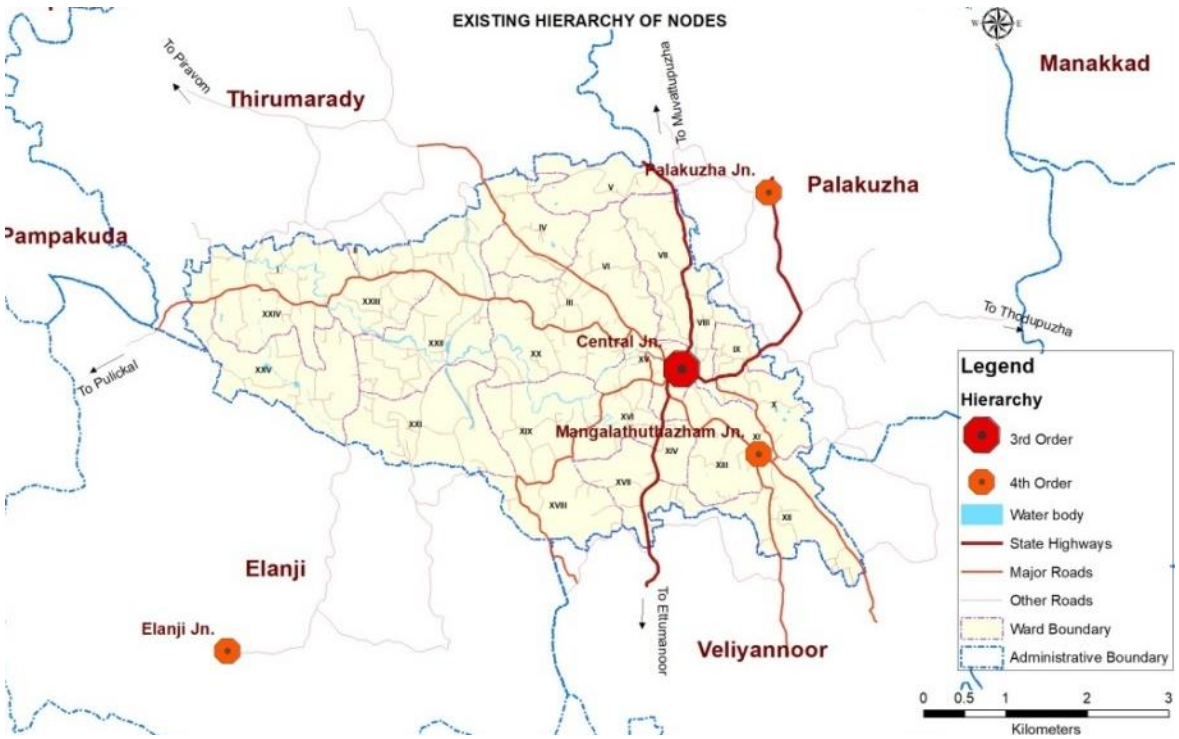


Figure 1-8 : Existing Hierarchy of Nodes

1.6.3 Connectivity

Road transport is the only mode of transportation available in the Town. The road network of Koothattukulam consists of State Highways, Major District Roads (MDR), Others District Roads (ODR) and Local body roads. State Highway 1, widely known as Main Central Road (MC Road) traversing from Thiruvananthapuram to Angamaly passes through Koothattukulam and is the most important road in Koothattukulam. New State Highway-40

from Alappuzha to Madurai also passes through Koothattukulam Town. State Highway-42 from Kumarakom to Cumbummettu passes through outskirts of Koothattukulam Town area. Apart from the state Highways mentioned above, several MDRs and ODRs also serve the transport needs of the people.

Railway infrastructure is absent in Koothattukulam and the nearest railway station is Piravom road (22km), but only 12 express trains and 18 passenger/MEMU services halt at this station. Lack of sufficient public transport connectivity between Koothattukulam and Piravom Road station is another intricacy for the people of Koothattukulam. Other nearby railway stations are Kuruppanthara (23km), Kaduthuruthy (24km), Vaikom Road(25km), Ettumanoor (28km) and Kanjiramattom (28km)- but have stops for few number of trains only. Passengers bound to southern parts of the state will be using Kottayam Railway Station located at a distance of 37km and passengers bound to northern parts of the state will be using Ernakulam (49km) or Aluva station (50km).

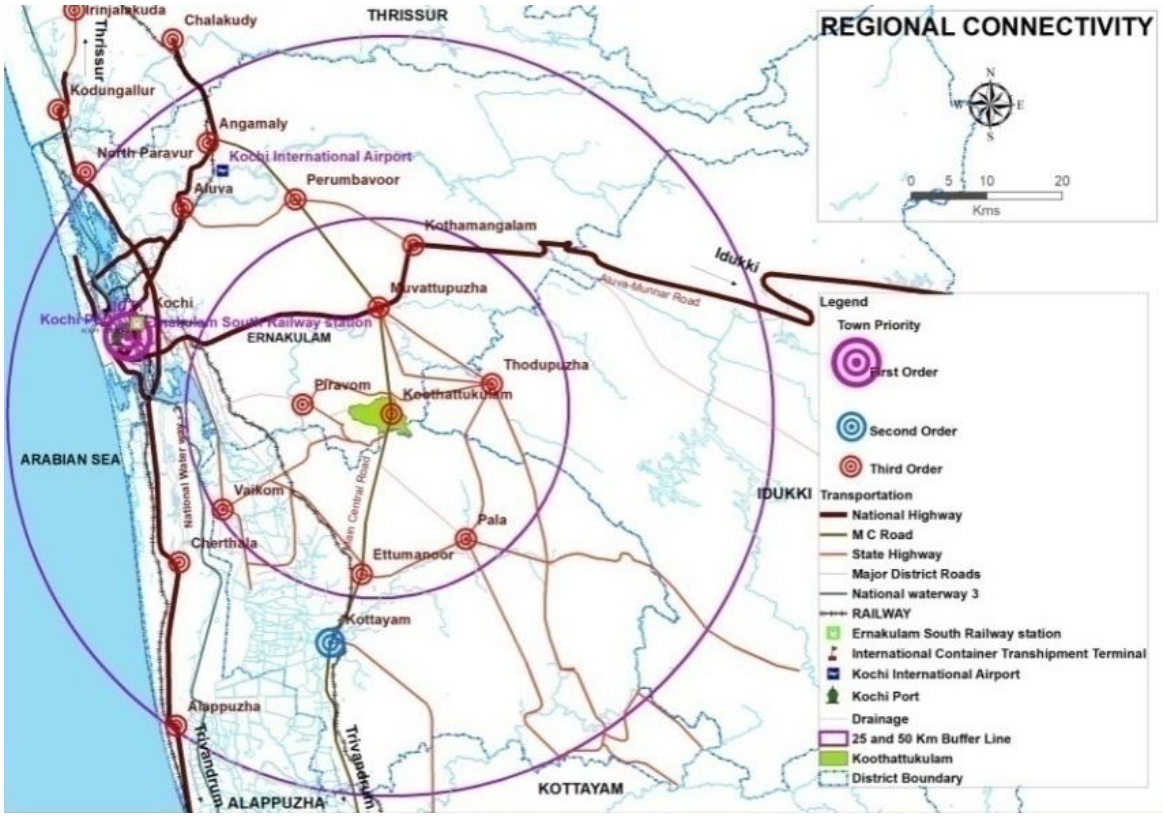


Figure 1-9 : Connectivity of Koothattukulam with other urban centers

1.7 DELINEATION OF PLANNING AREA

The regional level analysis based on district urbanisation report of the district has been considered for the delineation of planning area for the preparation of master plan. The role of the town under consideration in the overall development of the region and its influence area are the major deciding factors. The planning area has been delineated by analysing the characters like urban profile, functional character and land use concentrations of the town and grama panchayats lying adjacent to Koothattukulam town viz. Palakuzha, Thirumarady, Pampakuda, Elanji of Ernakulam District and Veliyanoor Gramapanchayat of Kottayam district. The adjacent grama panchayats are showing functional character as rural. However, considering that physical aspect and contiguity of development, the planning area is taken as Koothattukulam municipal area itself.

1.8 INFLUENCE AREA

The Public market of Koothattukulam, known as Sree Ramavarmapuram Market dates back to hundreds of years was a major centre for cattle trade, trading of rice and cashcrops and also was the centre/checkpoints authorized for taxation and inspection. Still cattle market is functioning as the main market catering the nearby local bodies in the region. Along with Piravom, Koothattukulam acts as the service area for the nearby local bodies of Thirumarady, Elanji, Palakuzha of Ernakulam district and Veliyanoor of Kottayam district.



Figure 1-10 : Service area connectivity with influence area

1.9 INFERENCE

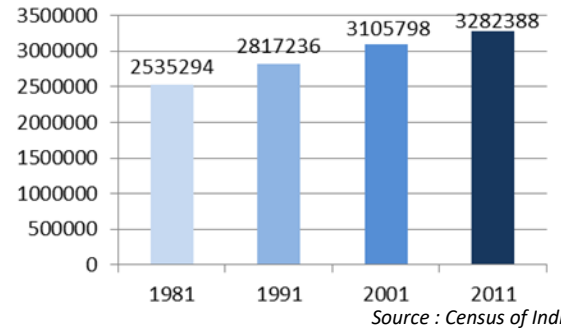
Koothattukulam Town has an area of 23.18 sq.km with 25 wards having a total population of 17,253 as per Census of India 2011.The physiographic characteristic of the Town shows no high land or forest land and it comes under the midland category. In the regional context of the District, Koothattukulam is a fourth order settlement and Central junction in

Koothattukulam is classified as 3rd order node and Mangalathuthazham junction is classified as a fourth order node in the District as per District urbanization Report, Ernakulam. In the District level analysis Primary agriculture (Agriculture) is identified as the activity of the Town. The economy of the region is agriculture oriented and primary sector activity is the character of the region. Nearby local bodies in the region are less developed and classified as fifth order settlements, hence Koothattukulam acts as the main service centre to cater its service area in the region. Thus as an emerging urban local body, Koothattukulam acts as a provider and facilitator for its nearby rural local bodies.

2 DEMOGRAPHY

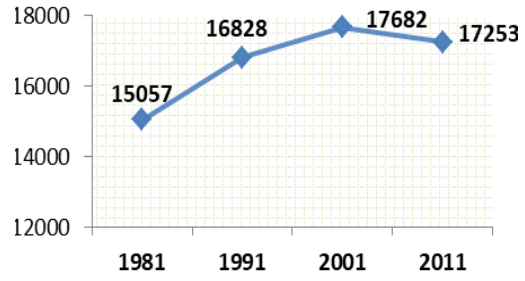
2.1 POPULATION SIZE

As per 2011 census, the total population of Ernakulam District is 3,282,388. District is placed in the 3rd position as far as population size is concerned in the state level. The decadal variation in the size of population of the District over the last five decades is shown in figure 2.1.



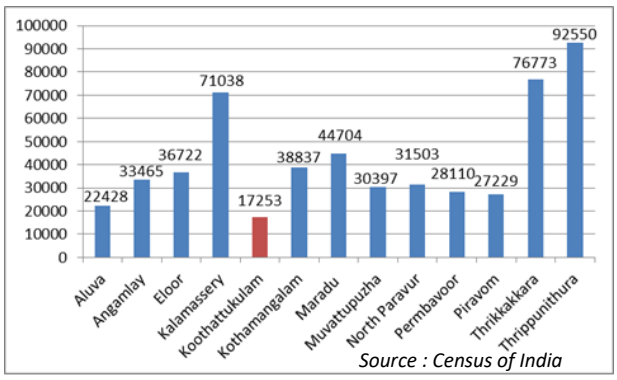
Source : Census of India

Figure 2-1 : Decadal wise population growth of Ernakulam District



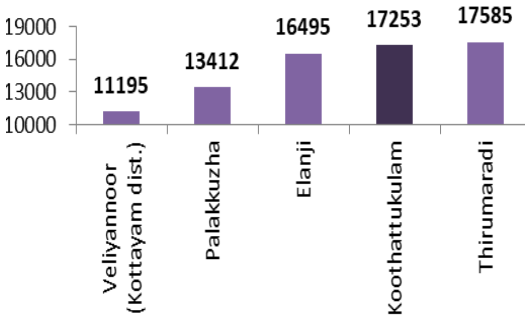
Source : Census of India

Figure 2-2 : Decadal wise population growth of Koothattukulam



Source : Census of India

Figure 2-3 : Comparison of population of Koothattukulam with other Towns in Ernakulam District



Source : Census of India

Figure 2-4 : Comparison of population with surrounding LSG's

The population of Koothattukulam Town as per 2011 census is 17253. This is only 0.53% of the total District population of Ernakulam. The decadal population growth of Koothattukulam Town is shown in figure 2.2. While analyzing the past trends it is found that the decadal population within the Town is gradually increasing up to 2001 census and decreasing from 2001 to 2011. This pattern is not matching with the population figures of the District. Koothattukulam has the lowest population while comparing with other Towns in the District.

2.2 POPULATION DISTRIBUTION

Ward wise population distribution of Koothattukulam Town as per 2011 census is shown in figure 2.5. Wards located in the south eastern sides of the Town near MC road shows high population followed by wards located along Piravom- Edayar road.

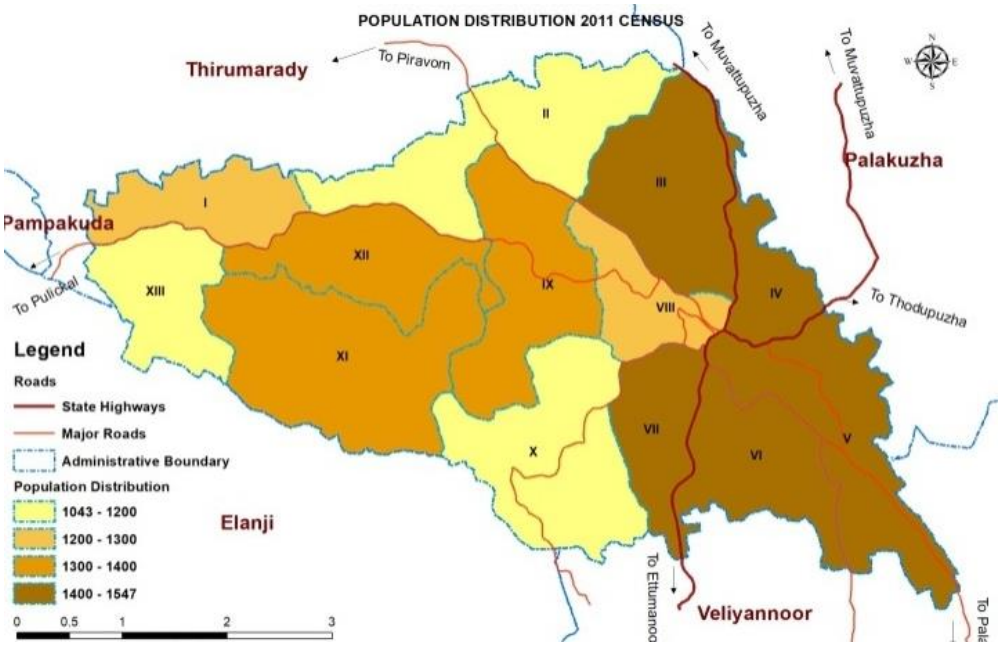


Figure 2-5 : Ward wise distribution of population

Source : Census of India

2.3 DECADAL GROWTH RATE OF POPULATION

Decadal growth rate of population in the Municipal area is shown in figure 2.6.The population growth rate shows a declining trend in the Municipal area. During the period from 2001-2011, Koothattukulam Town witnessed negative growth rate of 2.43. Population growth rate of Koothattukulam is low when compared to Ernakulam District. The decadal growth rate of population of Ernakulam District is 5.69%. Population growth rate of Koothattukulam has shown a trend in continuous decrease since 1981 to 2011. During 1981-1991, population growth rate was 11.76% which reduced to 5.07% during 1991-2001 from which further decreased to -2.43% during 2001-2011.

Table 2-1 : Growth Rate of Koothattukulam town and Ernakulam District

Description	1981-1991	1991-2001	2001-2011
Koothattukulam	11.76	5.07	-2.43
Ernakulam dist.	11.12	10.24	5.69

Source : Census of India

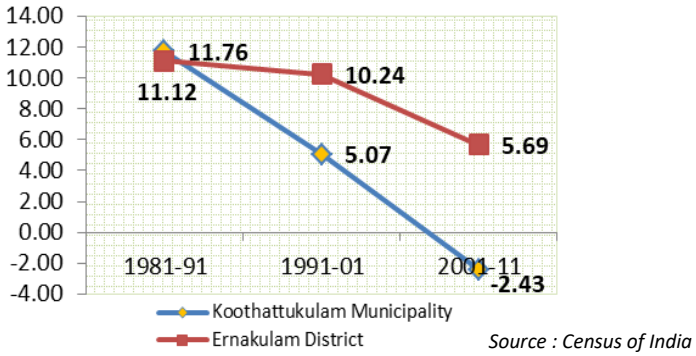


Figure 2-6 : Decadal growth rate of population in Koothattukulam

The comparison of growth rate of population with other municipal Towns in Ernakulam District shows a continuous level of decrease. Population growth rate of Koothattukulam during 1981-1991 was 11.76%, with 5th highest population growth rate among 14 Towns in District. During 1991-2001, population growth rate decreased from the previous decade to 5.07%, where Koothattukulam had moved down to 11th position in growth rate. An inverse decrease in the population growth rate had occurred during 2001-2011, which similarly reflected in decrease in the population from 17682 to 17253, making Koothattukulam the municipal Town with second lowest population growth rate in the District.

Table 2-2 : Comparison of Population growth rate of Koothattukulam Town with other towns in the district

	Population				growth rate		
	1981	**1991**	**2001**	**2011**	1981-91	1991-01	2001-11
Aluva	25278	24774	24110	22428	-1.99	-2.68	-6.98
Angamaly	28307	30391	33409	33465	7.36	9.93	0.17
Eloor	31701	34455	35573	36722	8.69	3.24	3.23
Kalamassery	43767	54342	63116	71038	24.16	16.15	12.55
Koothattukulam	15057	16828	17682	17253	11.76	5.07	-2.43
Kothamangalam	33122	35535	37173	38837	7.29	4.61	4.48
Maradu	28749	34995	41012	44704	21.73	17.19	9.00
Muvattupuzha	25313	27595	29246	30397	9.02	5.98	3.94
North Paravur	26288	27906	30059	31503	6.15	7.72	4.80
Permbavoor	23064	24667	26547	28110	6.95	7.62	5.89
Piravom	24048	25203	27263	27229	4.80	8.17	-0.12
Thrikkakkara	38318	51166	65984	76773	33.53	28.96	16.35
Thrippunithura	43646	51078	59884	92550	17.03	17.24	54.55
Kochi corporation	513249	564589	595575	633553	10.00	5.49	6.38

Source : Census of India

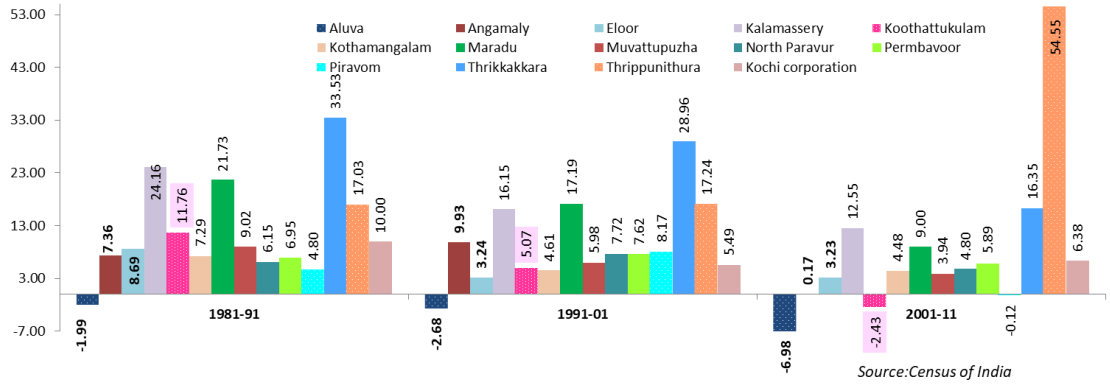


Figure 2-7 : Comparison of decadel growth rate of population with other Towns in the District

Aluva Municipality constitute the lowest population growth rate with a continuous decrease from 1981-1991 to 2001-2011. Tripunithura Municipality has the highest existing population growth rate of 54.55% as Thiruvankulam was also added to Tripunithura Municipality.

The comparison of decadel growth rate of Koothattukulam Town with other Towns in the District is shown in figure 2.7. Also figure 2.8 shows the growth rate of Koothattukulam town with surrounding Muncipalities and Kochi Corporation. Koothattukulam falls in a region of low population growth rate in the District. Comparison of population of Koothattukulam Town with nearby LSGs is shown in figure 2.4. Koothattukulam Town has the fourth highest population when compared to surrounding LSG's. Veliyannoor has the least population. Population of nearby LSGs in Ernakulam District is also showing a decreasing trend.

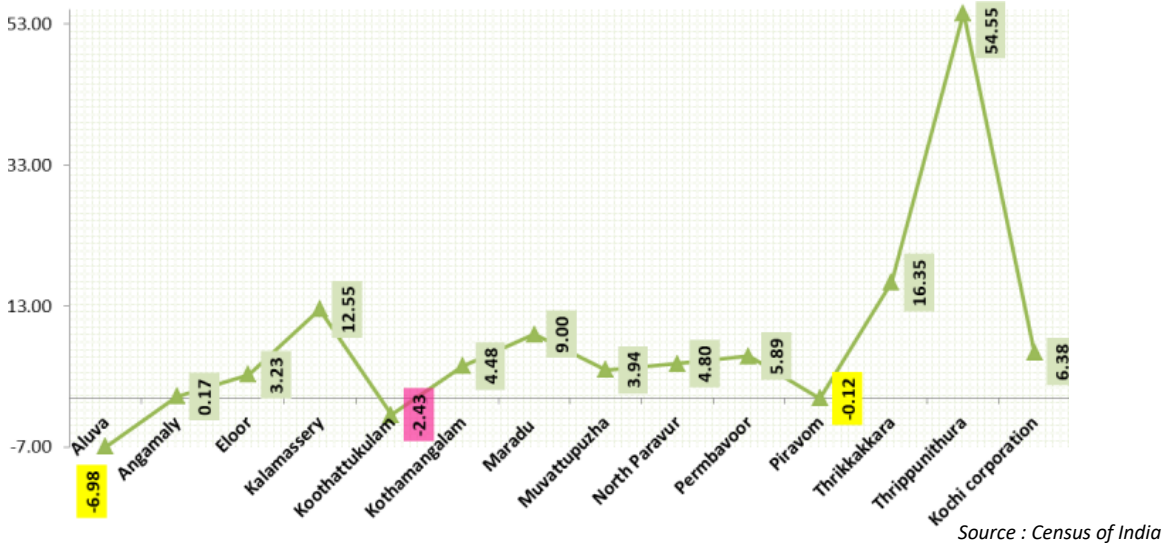


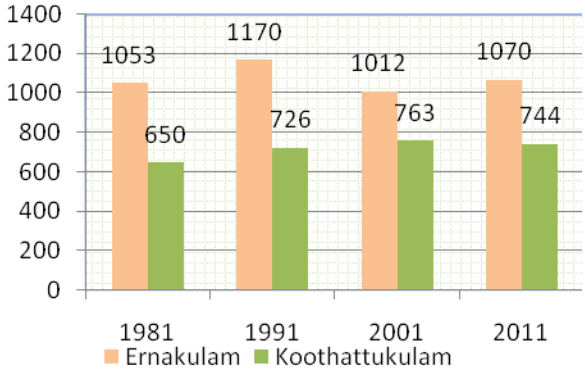
Figure 2-8 : Comparison of population growth rate with surrounding LSG's

Elanji GP is having slightly higher negative growth rate than Koothattukulam. Population growth rate is high in Veliyanoor GP. As per the socio-economic survey data analysis there is negligible immigrants to the Town. Nearly 1.5% of the total families surveyed have at least one out-migrant in the family.

The reason for negative growth rate is presumed as the reduction in the job opportunities in plantation sectors, mainly in rubber plantation. Another reason is the absence of economic activities attracting the workforce. These two factors lead to outmigration and negative growth rate of population.

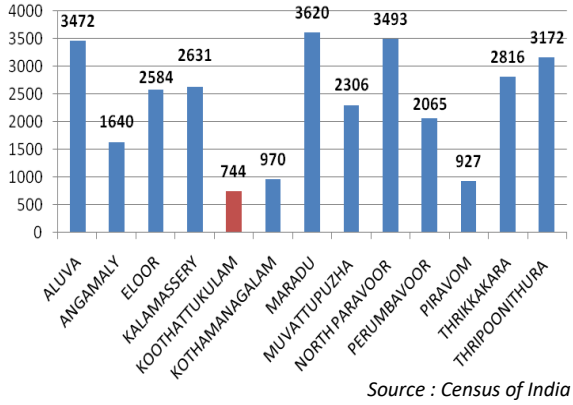
2.4 DENSITY OF POPULATION

As per 2011 census, the density of Koothattukulam is 744 persons per sqkm. The comparison of population density with Ernakulam District is shown in figure 2.9. The population density of Koothattukulam is lower than the District average.



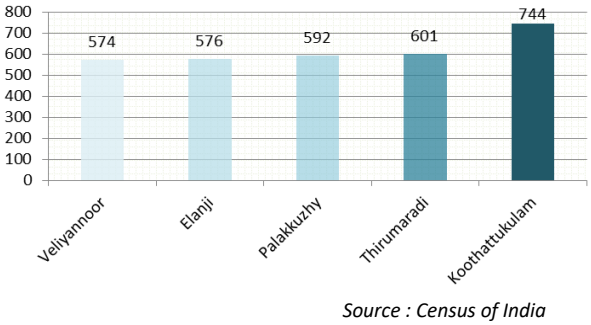
Source : Census of India

Figure 2-9 : Comparison of population density with the District



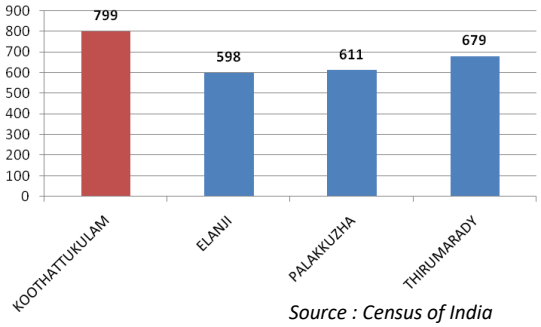
Source : Census of India

Figure 2-10 : Comparison of population density of Koothattukulam with other Towns in the District



Source : Census of India

Figure 2-11: Comparison of population density of Koothattukulam with nearby LSGs (2011 Census)



Source : Census of India

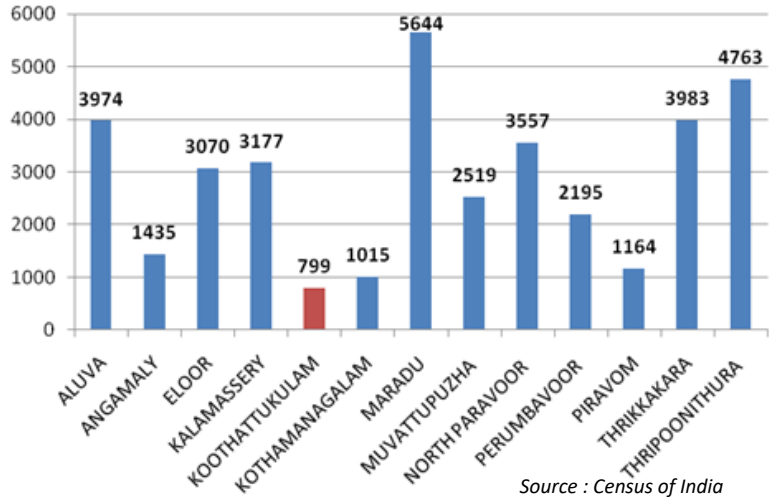
Figure 2-12: Comparison of net population density of Koothattukulam with nearby LSGs (2011 Census)

Population density of Koothattukulam was 650 persons/sq.km in 1981 which increased to 726 persons/sq.km in 1991 and it continued till 2001 with a density of 763 persons/sq.km. In 2011 population density of Koothattukulam decreased to 744 persons/sq.km.

Table 2-3 : Comparison of Density of Koothattukalam with nearby LSGs

	Total Population	Area (in Sq.km)	Density
Aluva	22428	6.46	3472
Angamaly	33465	20.40	1640
Eloor	36722	14.2	2214
Kalamassery	71038	27	2631
Koothattukulam	17253	23.18	744
Kothamangalam	38837	40.04	970
Maradu	44704	12.35	3620
Muvattupuzha	30397	13.18	2306
North Paravur	31503	9.02	3493
Perumbavoor	28110	13.61	2065
Piravam	27229	29.36	927
Thrikkakkara	77319	27.46	2816
Thripunithura	92550	29.18	3172
Kochi Corporation	633553	107.13	5914

Source : Census of India



Source : Census of India

Figure 2-13 : Comparison of net population density of Koothattukulam with other Towns in the District

The comparison of population density with other Towns in the District is shown in table 2.3 and figure 2.10. When compared with other Towns, Koothattukulam has the least population density. Koothattukulam Town has lowest population density, with 7th position in area and 14th position in population size. The comparison of density of population of Koothattukulam Town with surrounding LSGs is shown in figure2.11. The population density of Koothattukulam is high comparing to adjacent LSGs.

The net density of population in Koothattukulam is 799 persons per sq.km. The comparison of net population density with nearby LSG's in the District is shown in fig 2.12 and that with other Towns in the District is shown in fig 2.13. The net population density of the Town is the highest among its surrounding panchayaths and least among the other Towns in District. The ward wise distribution of population density is shown in figure 2.14. The highest concentration is seen in wards along the sides of MC road, and it is followed by the wards near the other major road corridors in the Town like Piravom-Edayar road and Koothattukulam- Ramapuram road.

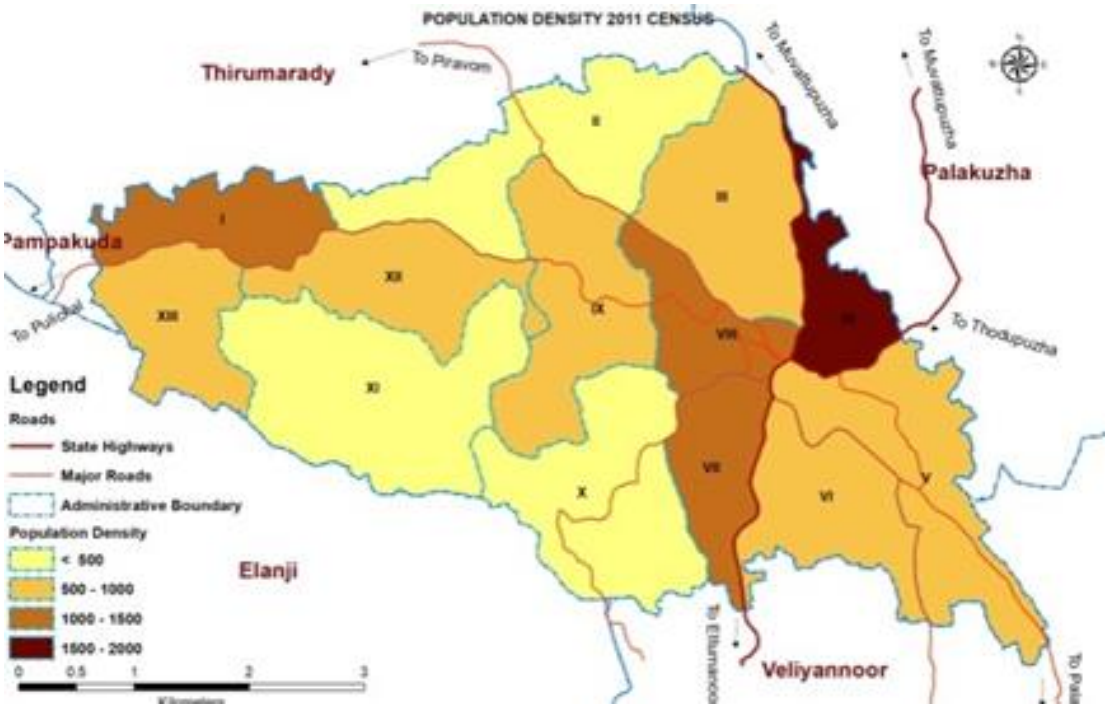


Figure 2-14: Ward wise population Density (2011 Census) *Source : Census of India*

2.5 LITERACY

According to 2011 census, literacy rate of Koothattukulam Town is 96.38% (figure 2.15) which is slightly higher than that of the District figure of 95.88% and the state (94%). Out of the total population of 17253 persons, 15366 are literates.

The female literacy rate of Koothattukulam Town is 96.38% which is higher than the corresponding District figure of 94.46%. Males have a higher literacy rate of 97.59% .The male literacy rate is slightly higher than the District average of 97.36%. Out of the total literates, 7723 are males and 8820 are females. It is to be noted that the numbers of female literates is higher than that of male literates. The literacy rate of Koothattukulam

Municipality has increased from 80.09% in 1981 to 96.38% in 2011 and is shown in figure 2.15. This increasing trend of literacy rate is a welcome sign for future development. An analysis of literacy data brings to light the fact that the literacy rate of Koothattukulam is higher than the literacy rates of the District and the state.

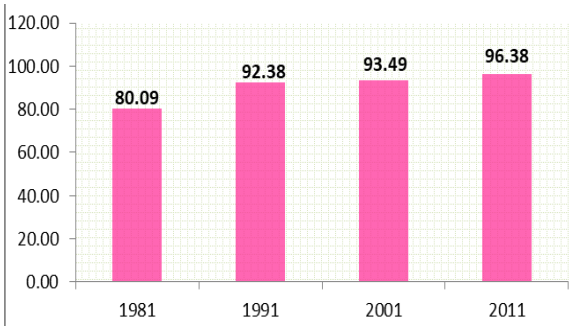


Figure 2-15 : Decadal Variation of literacy rate of Koothattukulam Town

Source : Census of India

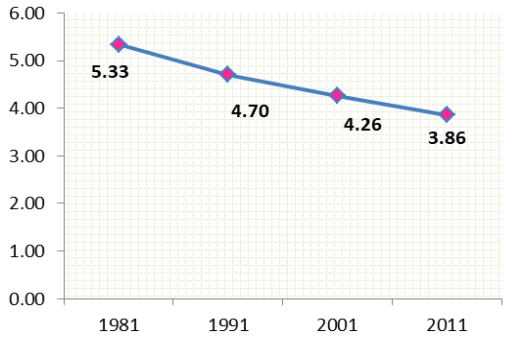


Figure 2-16 : Variation of Household size

Source : Census of India

2.6 HOUSEHOLD SIZE

The average household size in 1981, 1991, 2001 and 2011 is 5.33, 4.70, 4.26 and 3.86 respectively. This is shown in figure 2.16. The household size is decreasing in the Municipality. Household size of Koothattukulam is small when compared to the state and District figures which are 4.3 & 4 respectively.

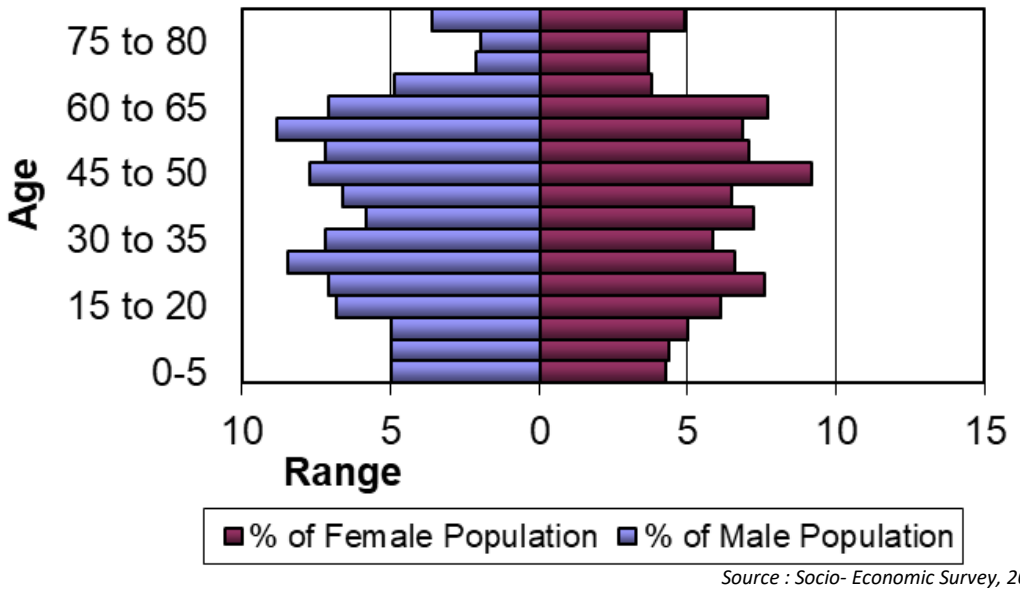
2.7 AGE – SEX PYRAMID

The age sex pyramid obtained from socio economic survey is shown in figure 2.17. The maximum percentage of male population is seen in age group 55-60 years and female in range 45-50. The child population along with youth and middle aged population will consist of a major portion of total population. The maximum difference in percentage of male and female population is seen in age range of 55-60 years where the percentage of male population is more than that of female.

The percentage of male population is more than that of female in the age group of 0-5 and 5-10 years. Percentage of the female population (50.59%) is slightly higher than the percentage of male population (49.41%). Percentage of working population constitutes 69.12%. Percentage of old age group constitutes 14.14% of the population (female: 8.52% and male 5.62%). The sex ratio is low compared to the District.

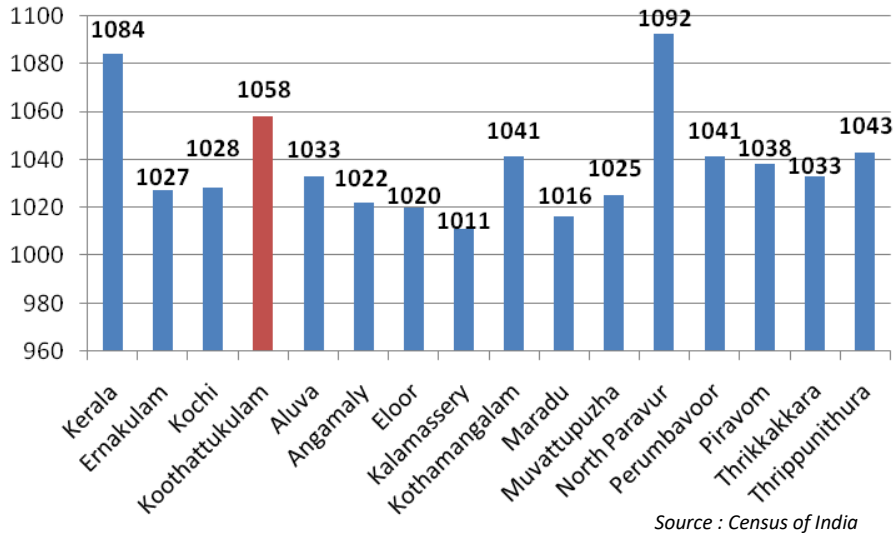
Table 2-4 : Age- Sex Pyramid of Koothattukulam town

	% of Male Population	% of Female Population
0-5	4.99	4.26
5 to 10	4.99	4.38
10 to 15	4.99	4.99
15 to 20	6.86	6.09
20 to 25	7.11	7.55
25 to 30	8.48	6.58
30 to 35	7.23	5.85
35 to 40	5.86	7.19
40 to 45	6.61	6.46
45 to 50	7.73	9.14
50 to 55	7.23	7.06
55 to 60	8.85	6.82
60 to 65	7.11	7.67
65 to 70	4.86	3.78
70 to 75	2.12	3.65
75 to 80	2	3.65
greater than 80	3.62	4.87



Source : Socio- Economic Survey, 2016

Figure 2-17: Age – Sex pyramid



Source : Census of India

Figure 2-18 : Comparison of sex ratio of Town with state, Ernakulam District, Kochi city and other Town in the District

The sex ratio of Koothattukulam is 1058 as per 2011 census. The comparison of sex ratio with state, Ernakulam District, Kochi city and other Town in the District is shown in figure 2.18. This shows that on comparison with them, the sex ratio in Town is lower than the state and higher than the District, Kochi city and all other Towns in the District except North Paravur.

2.8 INFERENCE

The population of Koothattukulam Town as per 2011 census is 17253. Koothattukulam has the lowest population while comparing with other Towns in the District. Population growth rate of Koothattukulam has shown a trend of continuous decrease from 1981 to 2011. Total population in the Town is declining for the last one decade with a negative population growth rate of 2.43%. Even though the growth rate is negative, the growth rate in Koothattukulam Town is slightly above that of Aluva Town. Most of the nearby LSGs of Koothattukulam Town also shows negative growth rate. Hence it may be assumed that the growth of population of the Koothattukulam follows a general pattern of declining growth rate. The reason for negative growth rate is presumed as the reduction in the job opportunities in agricultural sectors. Another reason is the absence of economic activities attracting the workforce. These two factors lead to outmigration and negative growth rate of population. The population density of Koothattukulam Town is 744 which is low compared to other Towns in the District. The literacy ratio of the Town is 96.38% which is comparatively high and literacy rate among women is found increasing here. This is an indication of women employment in the Town.

3 OCCUPATIONAL STRUCTURE

3.1 WORKERS

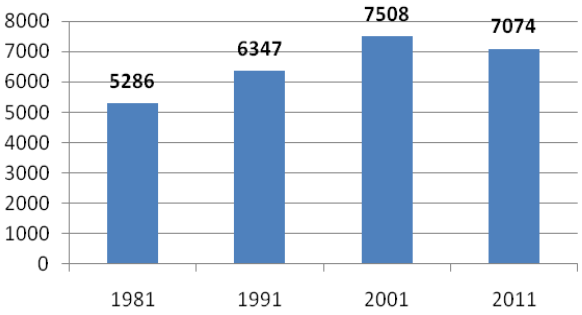
According to 2011 census the number of workers in Koothattukulam Town is 7074. The numbers of workers were 5286, 6347 and 7508 during 1981, 1991 and 2001 respectively. The number of workers is seen decreasing from 2001 to 2011 in the Town. During this period other workers has increased from 76% to 78% but the percentage of cultivators and agricultural labourers has seen decreased over the years. Therefore, it can be concluded that the decrease in the number of workers is due to declining trend in the primary sector. The variation of number of workers is shown in figure 3.1.

The number of female workers is 2231 which is 31.54% of total workers. The total number of male workers is 4843 which are 68.46% of total workers. The percentage of women workers is less than the District average of 29.35%.

Table 3-1 : Temporal variation in Work Force Participation Rate – Koothattukulam Town

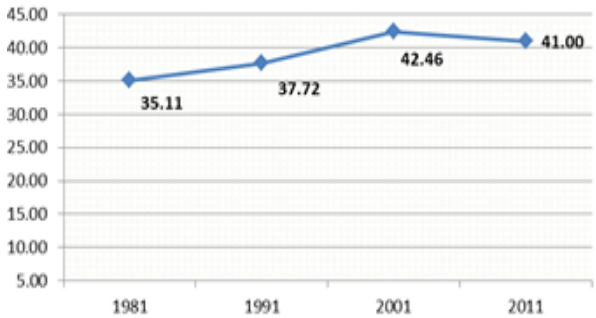
Year	1981	1991	2001	2011
Population	15057	16828	17682	17253
Total workers	5286	6347	7508	7074
Work participation rate	35.11	37.72	42.46	41.00

Source : Census of India



Source : Census of India

Figure 3-1: Variation in number of workers



Source : Census of India

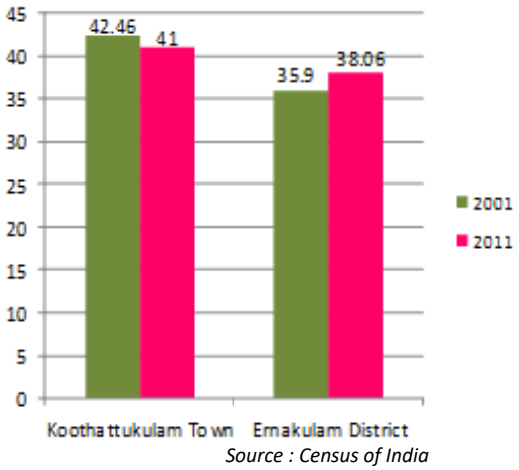
Figure 3-2 : The temporal variation of WPR (1981-2011)

3.2 WORK FORCE PARTICIPATION RATE

The work force participation rate is the percentage of the working age population in the labour force. As per 2011 census the work force participation rate of Koothattukulam Municipality is 41%. It means, out of total population of 17253 persons, 7074 people are workers. WPR of the Town is high when compared with the WPR of the District (38.06%). The temporal variation of WPR is shown in figure 3.2

The work force participation rate shows an increasing trend from 1981 to 2001 and WPR is seen decreasing from 2001 to 2011. This may be attributed due to the decrease in the primary sector.

The WPR of Koothattukulam Town is 41% which is higher than the average District figure of 38.06% and that of Kochi Corporation 38%. The WPR of Koothattukulam as per census 2001 was 42.46% (figure 3.2). The comparison of WPR with District in 2001 and 2011 census is shown in figure 3.3. From the figure it can be seen that even though there is a decrease in growth rate of Koothattukulam from 42.46 to 41, Koothattukulam has more work participation rate compared to the District.



Source : Census of India

Figure 3-3 : Comparison of WPR with District

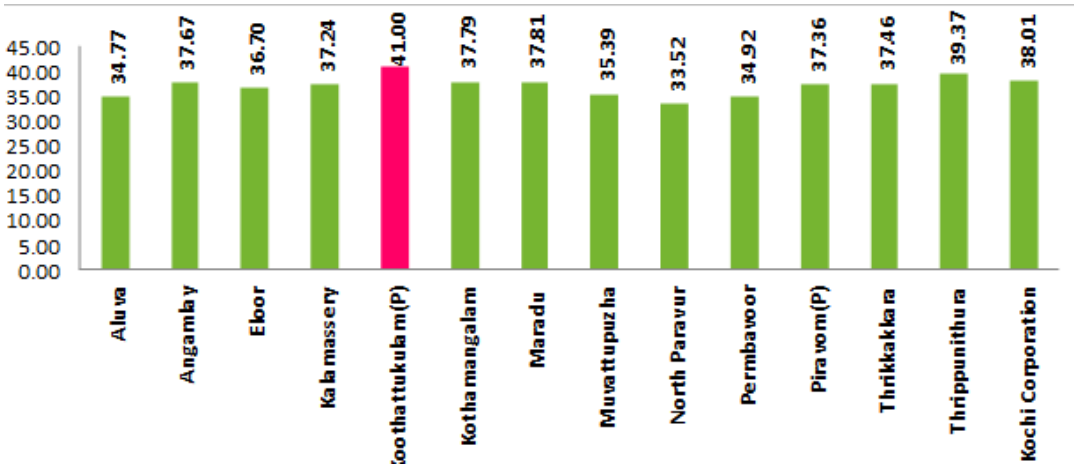
The comparison of WPR with other Municipalities in the District is shown in figure3.4. From the figure it is seen that WPR (2011) of Koothattukulam is the highest when compared with other Towns and the Corporation. Prominence of plantation workers in the Koothattukulam region is the main reason for higher value of WPR.

Table 3-2 : Comparison of Work participation rate of Koothattukulam with other urban centres in Ernakulam district

	Population	workers	WPR
Aluva	22428	7798	34.77
Angamlay	33465	12606	37.67
Eloor	36722	13477	36.70
Kalamassery	71038	26454	37.24
Koothattukulam	17253	7074	41.00
Kothamangalam	38837	14675	37.79
Maradu	44704	16903	37.81

Muvattupuzha	30397	10756	35.39
North Paravur	31503	10560	33.52
Permbavoor	28110	9816	34.92
Piravom	27229	10173	37.36
Thrikkakkara	76773	28967	37.73
Thrippunithura	92550	36437	39.37
Kochi corporation	633553	240791	38.01

Source : Census of India



Source: Census 2011

Figure 3-4 : Comparison of WPR with other Towns and Corporation

The comparison of WPR with nearby LSGs is shown in figure 3.5. Koothattukulam stands in second position when compared to the surrounding LSGs. Thirumaradi has the highest WPR. Work force participation rate of Thirumaradi shows a continuous increase over the years. WPR has increased from 36.08% to 40.97% from 1991 to 2001 and from 40.97% to 41.62% during 2001 to 2011. WPR of other neighbouring local bodies is seen decreasing during 2001 to 2011.

Table 3-3 : Comparison of Work participation rate of Koothattukulam with neighbouring grama panchayaths

	Population	workers	WPR
Palakkuzha	13412	4249	31.68
Veliyannoor	11195	4581	40.92
Elanji	16495	6372	38.63
Thirumaradi	17585	7318	41.62
Koothattukulam	17253	7074	41.00

Source : Census of India

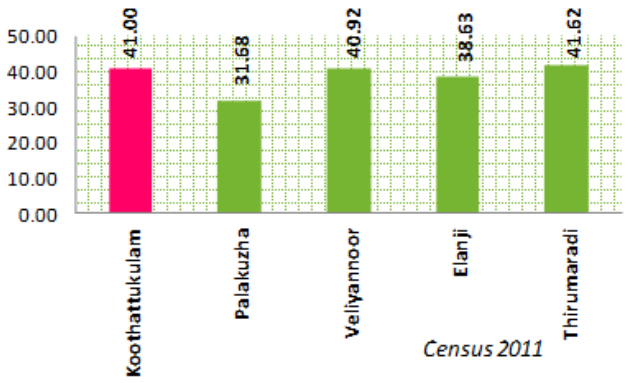


Figure 3-5 : Comparison of WPR with nearby LSGs

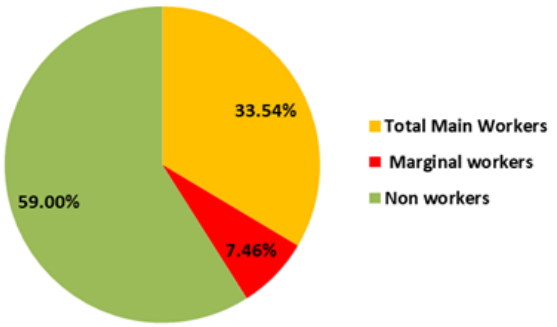
3.3 OCCUPATIONAL STRUCTURE

As per census the total workers constitute two categories, main workers and marginal workers. The total workers constitute 41% of the total population of Koothattukulam, of this 33.54% are main workers and 7.46% are marginal workers (figure 3.6). 59% of the population are not working. Compared to the district percentage values employment is more in Koothattukulam town.

Table 3-4 : Classification of workers of Aluva town and Ernakulam district – 2011

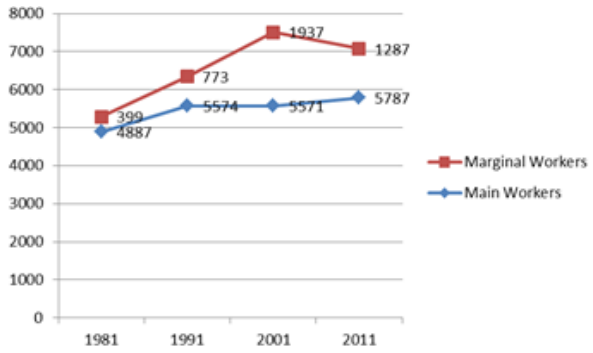
Classification of Workers	Koothattukulam Town		Ernakulam District	
	Total workers	% to population	No. of workers	% to population
Total Main Workers	5787	33.54	1061388	32.33
Marginal workers	1287	7.46	187955	5.73
Non workers	10179	59.00	2033045	61.94

Source : Census of India 2011



Source : Census of India

Figure 3-6 : Classification of workers



Source : Census of India

Figure 3-7 : Variation of main workers and marginal workers from 1981-2011

The absolute figures of main workers and marginal workers are 5787 and 1287 respectively. The figure shows that out of the total population 41% are the total workers. Main workers constitute 81.81% of total workers. Marginal workers in Koothattukulam Town constitute 18.19% of the total workers which is more than that of the District (15.04%). When comparing with other municipalities Perumbavoor and Piravom Municipalities have higher share of marginal workers. Marginal workers constitute 20.52% of the total workers in Perumbavoor and 22.01% of the total workers in Piravom Municipalities. The variation of main workers and marginal workers from 1981-2011 is shown in figure 3.7.

The number of female workers is 2231 which constitute 31.54% of total workers. The total number of male workers is 4843 which constitute 68.46% of total workers. The percentage of women workers is greater than the District average of 26.90%. Even though Koothattukulam Town witnessed negative growth rate male workers has increased from 68.30% to 68.46% while female workers has decreased from 31.70% to 31.54% during 2001-2011. Population growth rate is declining, if the current trend continues an increase of only 3142 population is expected by 2036. The main workers are further classified into 4 categories namely cultivators, agricultural labourers, house hold industries and other workers. The details are shown in table 3-5.

Table 3-5 : Classification of main workers

Type of Labourers	Number	Percentage
Cultivators	859	12.14
Agricultural labourers	594	8.40
HH industry workers	159	2.25
Other workers	5462	77.21

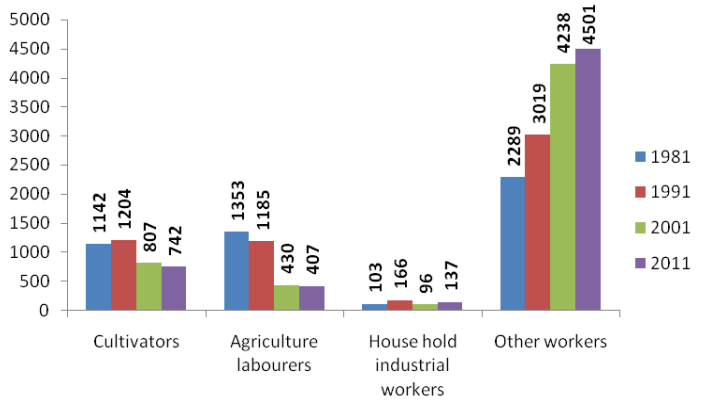
Source : Census of India

On examining the share of cultivators, agricultural labourers and household industrial workers in the workforce, it can be understood that the total cultivators constitute about 12% of the workers whereas District averages of the percentage of total cultivators is 4%. The percentage of agricultural labourers is 8.4% which is higher than the District average of 5.71%.It may be noted that large number of people in Koothattukulam is employed in plantation sector but they are not counted as agricultural workers since it is included as other workers in census. Household industrial workers in Koothattukulam constitute 2.25% of the workforce which is also greater than the District figure of 1.92%. This shows that the

economic base of Koothattukulam Town is least dependant on primary sector (with the exception of plantation workers) even though the Municipal area falls in the rural belt of the District. If plantation sector is also considered as primary sector, then it may be presumed that this sector has got significance in the development of the area.

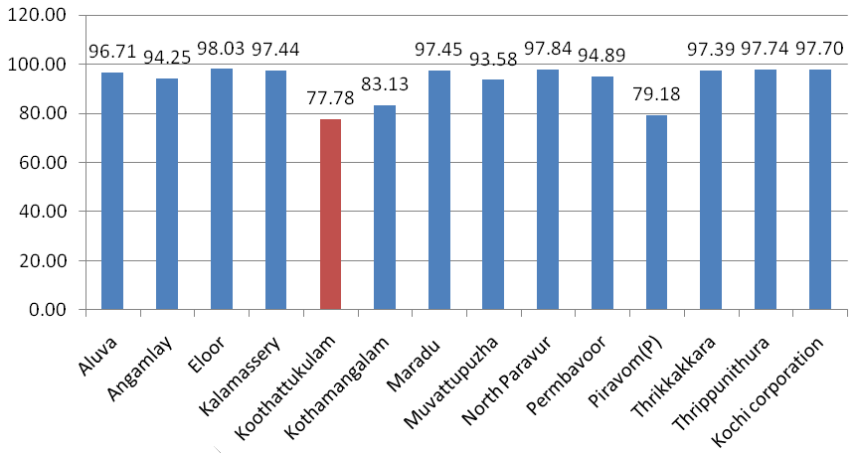
3.4 TEMPORAL VARIATION OF WORKERS

The number of workers in various categories from 1981 to 2011 in the Town is shown in figure3.8. The number of cultivators increased from 1981 to 1991 and then drastically decreased in 2001 and 2011census, whereas the number of other workers has increased constantly from 1981 to 2011. The number of agriculture labourers also shows a declining trend. The number of house hold industrial workers is almost consistent from 1991-2011. This is a clear indication of the weakening of the primary, mainly the agricultural sector, in the Town and shifting to other activities.



Source : Census of India

Figure 3-8: Temporal variation of different category of workers



Source : Census of India

Figure 3-9 : Comparison of percentage of other workers in the main workers with other ULB's in the District

A comparison of percentage of other workers in the main workers in Town with other urban local bodies in the District is shown in figure 3.9. This helps to understand the level of urban character of Town based on the number of workers. Even though other workers are dominating in the Town, it is observed that Koothattukulam has the lowest percentage of other workers in main workers among the other urban local bodies in District which implies that the Town has more of a semi-rural character.

3.5 SPATIAL DISTRIBUTION OF WORKERS

Figure 3.10 and 3.11, gives the ward wise concentration of cultivators and agricultural labourers. The maximum concentration of cultivators is at the geographical central region of the Town and then towards its southwest. Similarly the agriculture labourers are concentrated along the central region more towards the south along the north-south direction.

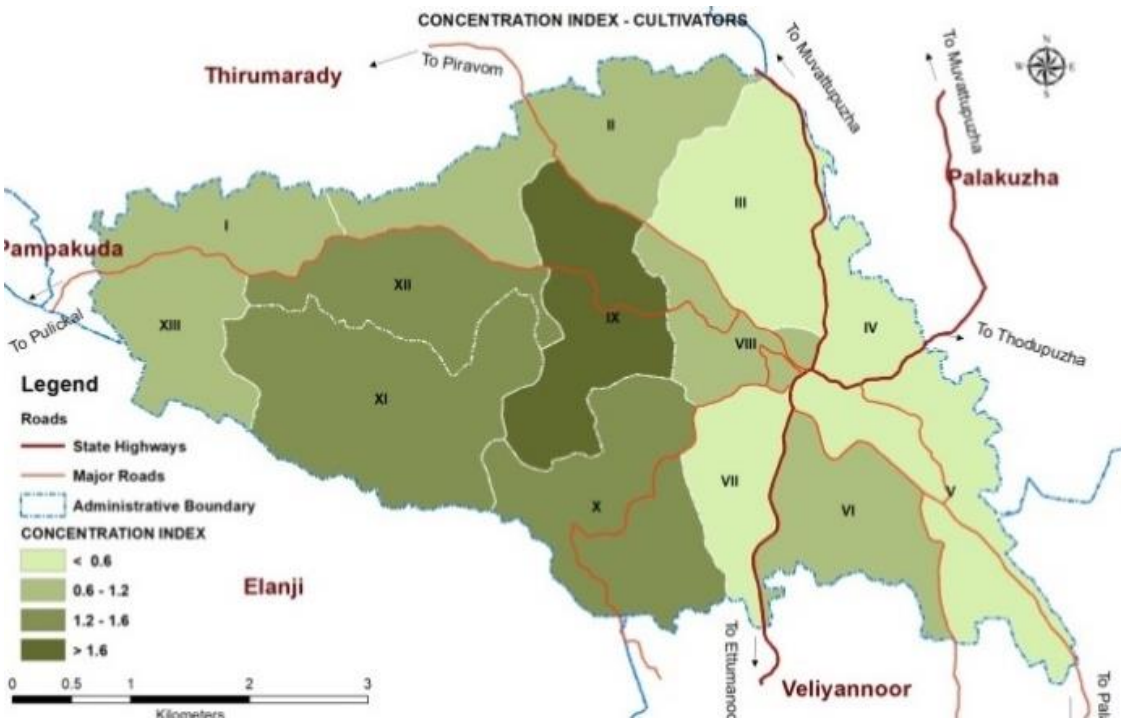


Figure 3-10 : Concentration index of Cultivators

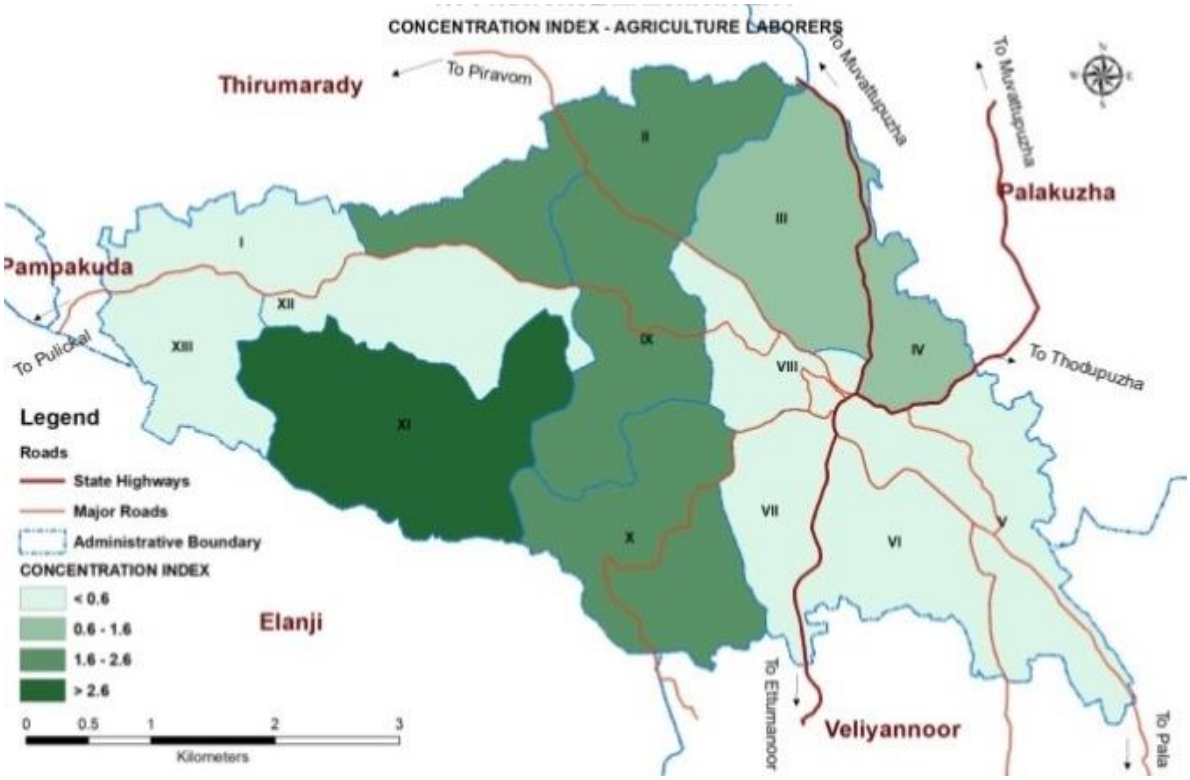


Figure 3-11 : Concentration Index of Agriculture labourers

From the maps it can be seen that both the category of workers are concentrated within the same or nearby wards. The agricultural land is distributed more or less in the same or nearby wards where there is a high concentration of cultivators and agricultural workers.

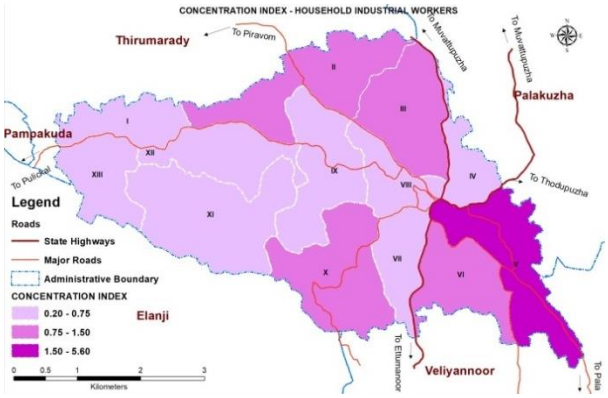


Figure 3-12 : Concentration index of Household industrial workers

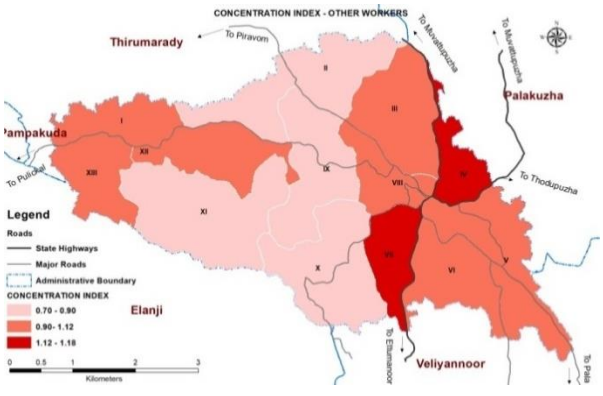


Figure 3-13 : Concentration Index of Other workers

Figure 3.12 and 3.13 shows the concentration index of household industrial workers and other workers. Household industrial workers are concentrated at the southeast end of the Town and also at thenorthern, southern and eastern wards of Municipality. Tertiary/ service

sectors are concentrated at the Town core area and its concentration is more in the eastern and western wards especially wards near the Town centre.

3.6 INFERENCE

From the analysis it is observed that the WPR in Koothattukulam is 41%, with a major share of other category of workers including the persons engaged in rubber plantations. Analysing the occupational structure, it is seen that share of main workers is high which will aid the overall development. The share of marginal workers is comparatively low. Analysis also shows a decline in the share of primary sector employees (cultivators and agricultural labourers), which together constitute only 20% of the total workers. The percentage of household industrial workers is less and follows a consistent form. When the shares of cultivators, agricultural labourers and house hold industrial workers are declining, the share of other workers are increasing at very high pace from 46% in 1981 to 77% in 2011. This major shift in employment pattern shows a lack of interest towards the primary agriculture sectors, due to the reduced output from those sectors.

4 LAND USE

4.1 GENERAL ANALYSIS OF LAND USE

The land use pattern by which the available land within the Town is put to use, decide the spatial structure and character of any Town. The existing land use in the area gives an indication of the existing sectors of development. Land and use thereon form a major determinant in spatial planning. The entire process of planning is focused finally at preservation or regulated change in land use of the constituent parcel of land in the area for which planning is conceived.

To understand the existing situation and to plan for the future, the exact share ofthe 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 urbanization, industrialization, and agriculturalization even though 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.

4.2 EXISTING LANDUSE PATTERN OF THE TOWN - 2016

As per the Land Use survey conducted by the department in 2016, it is seen that the major share of the geographical area of the existing land use pattern of the Town is covered with agricultural use. M.C. Road which passes in north south direction divides Koothattukulam Town in to two and majority of the development is seen on both sides of M .C. Road. Piravom-Ernakulam Road from western side, Ramapuram, Pala Road from eastern side and M.C.Road meet in Koothattukulam Town and most of commercial activities are seen around this junction and on both sides of these roads whereas agricultural activity is predominant in western side of the Town. The Land use breakup of Koothattukulam Town area is shown in table 4.1 and figure 4.1. From the figure it is observed that the majority of land (73.12 %) is used for dry agricultural purpose. The residential area is only 18.19 %. Area of water body is

1.01 %, urban land use including industrial, commercial, transportation, public and semi public together account only 7.47 %.

Table 4-1 : Land use of Koothattukulam Town

Land use			Area in ha	% of Total Area	% of Developable Area
Residential			421.65	18.19	18.38%
Commercial			31.77	1.37	1.38%
Industrial			12.87	0.56	0.56%
Public & Semi public			42.66	1.84	1.86%
Open Space			0.24	0.01	0.01%
Traffic & Transportation			85.67	3.7	3.73%
Agriculture	Dry agriculture	Plantation	1168.24	50.41	50.91%
		Mixed crops	397.03	17.13	17.30%
		Total	1565.27	67.54	68.22%
	Wet agriculture		129.36	5.58	5.64%
	Agriculture-Total		1694.99	73.12	73.87%
Barren Land			0.94	0.04	0.04%
Vacant Land			3.79	0.16	0.17%
Water body			23.42	1.01	
Total			**2318.01**	**100.00**	**100.00**

Source : Land use survey

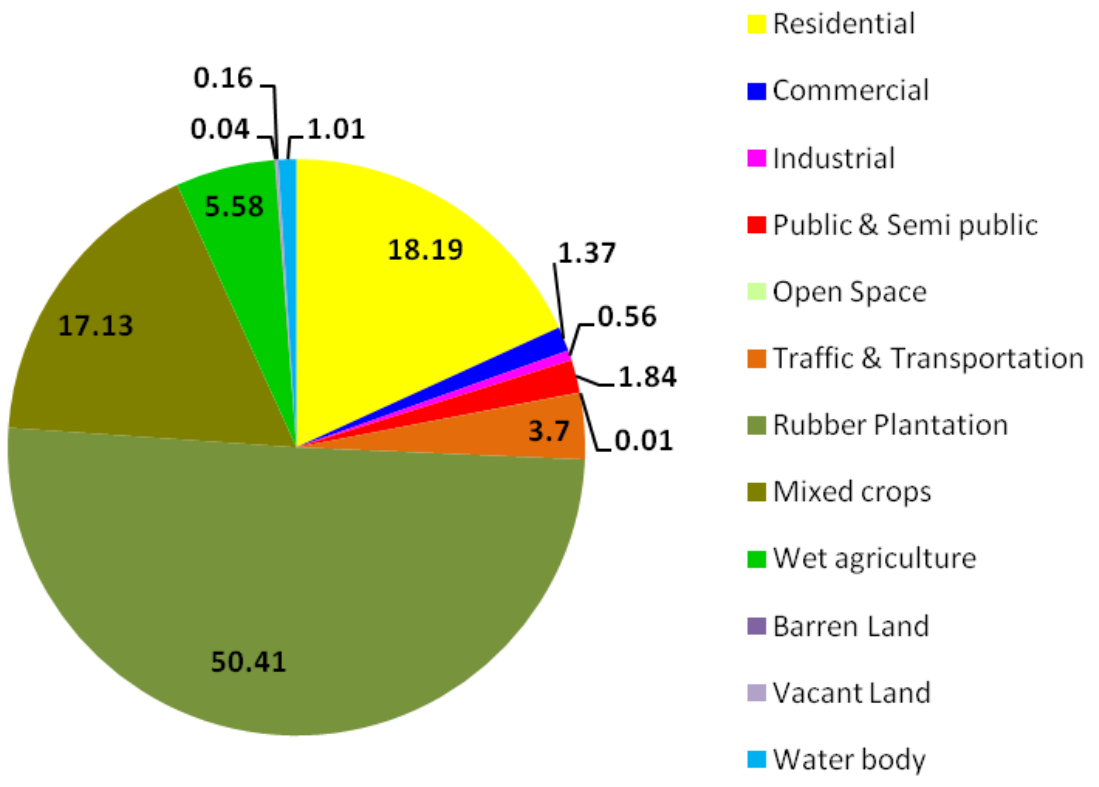


Figure 4-1 : Existing Land Use break up - 2016

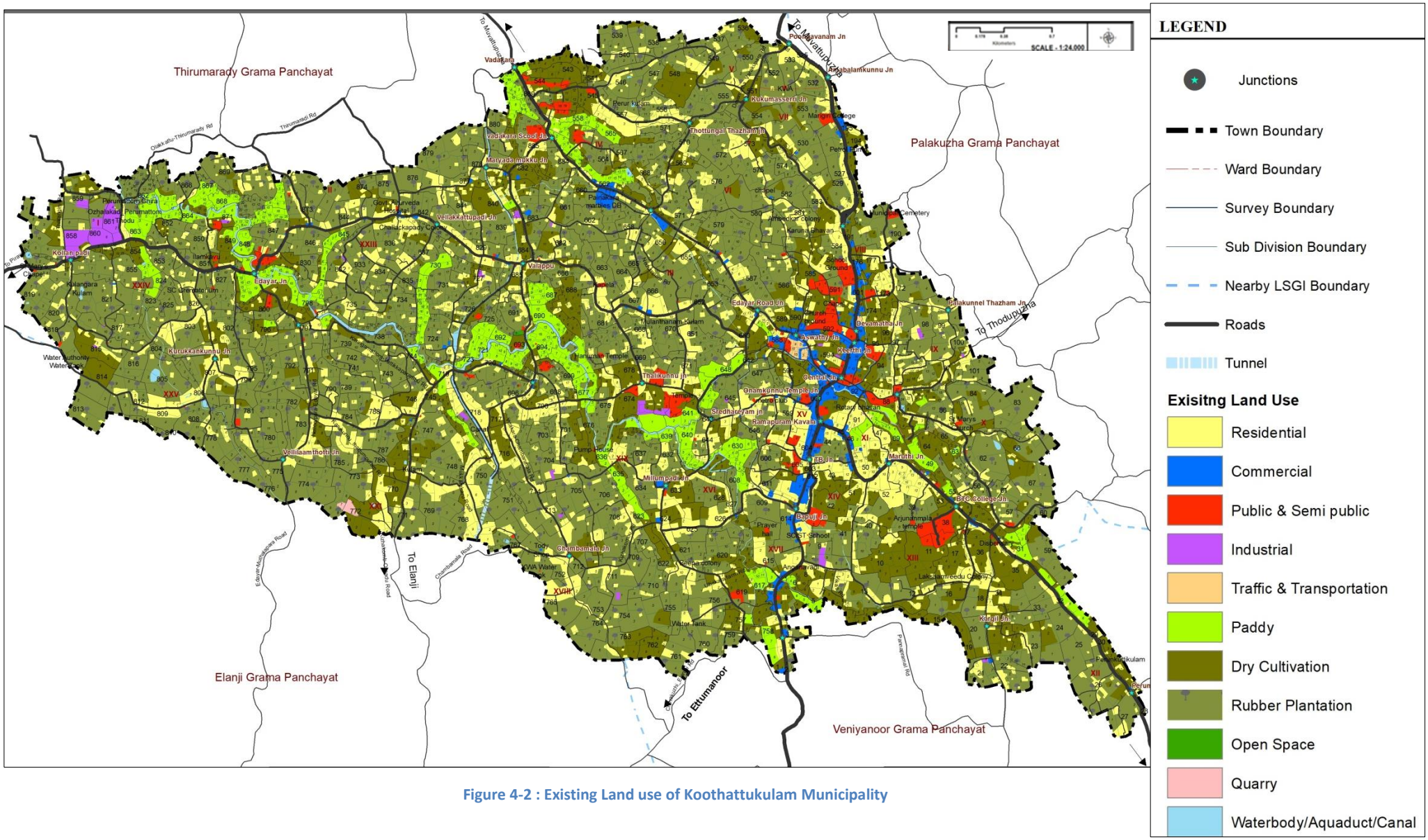


Figure 4-2 : Existing Land use of Koothattukulam Municipality

4.2.1 Residential Land use

Residential area stands in the second position in the land use with 421.65 hectares which is 18.19% of the total Town area. As per the land use survey 2016, residential area is distributed in almost all the wards and is mixed up with agriculture. Higher residential density is seen towards the Town centre. Considering the gross residential area, the density is seen as 40.91 persons per hectare. However 70% of the residential is seen as farm house type. Residential area is spread in the rest of the agricultural area. Thus it can be seen that sparsely disbursed nature of residence is seen in Koothattukulam.

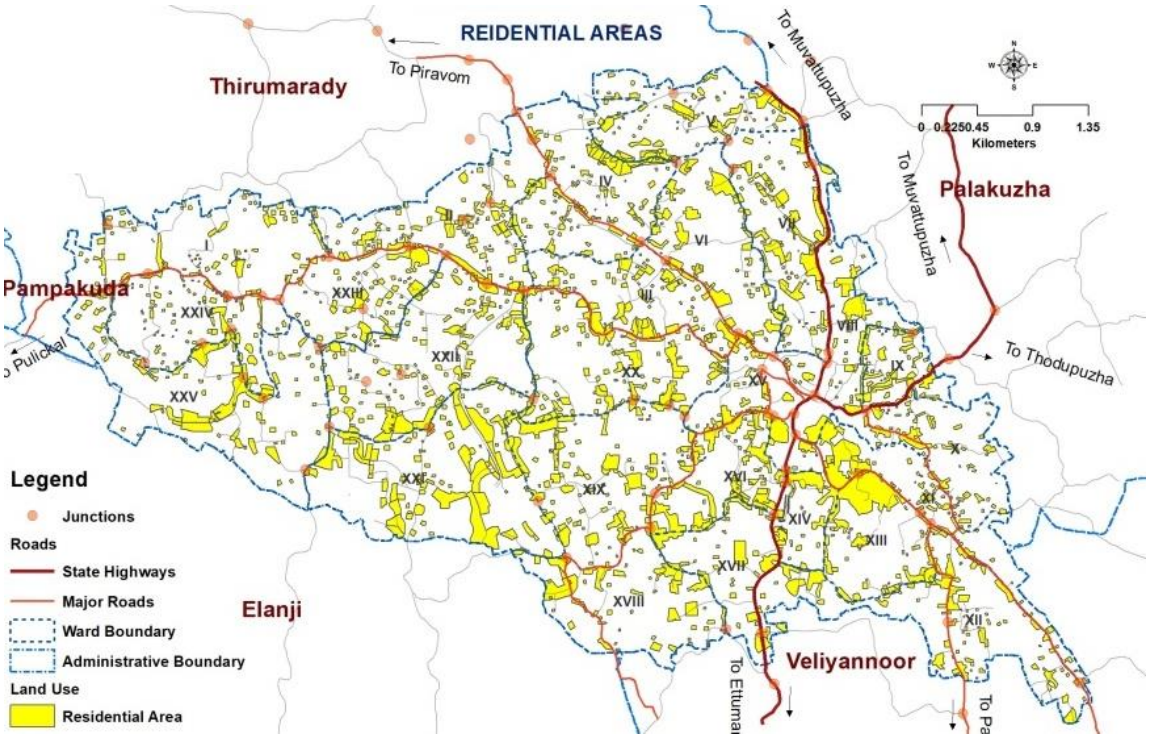


Figure 4-3 : Residential areas in Koothattukulam Town

4.2.2 Commercial Land Use

Commercial area is mainly concentrated in the Town centre along major travel corridors of the Town which constitutes only 1.37% of total land use. The concentration of commercial activity is mainly along M.C. Road and along Koothattukulam Piravom road near M.C.Road. Few pockets of commercial land use are distributed in other parts of the Town also.

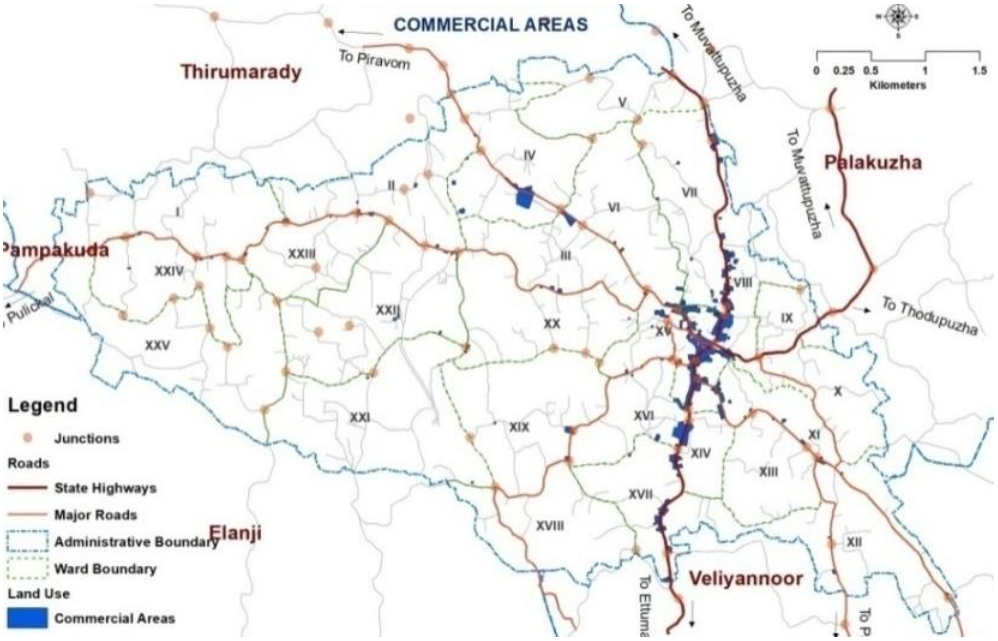


Figure 4-4 : Commercial areas in Koothattukulam Town

4.2.3 Industrial land use

At present, the area under industrial use is around 12.87 Ha, which comes about 0.56% of the total area of Town. Industrial land use is less compared to the norms of UDPFI guidelines which is 8-10% of total land use. Meat Product of India is the only major industry in Koothattukulam Town and all other existing industries are of small scale type. Most of these industries are of agro-based and forest-based such as rice mills, saw mills etc.

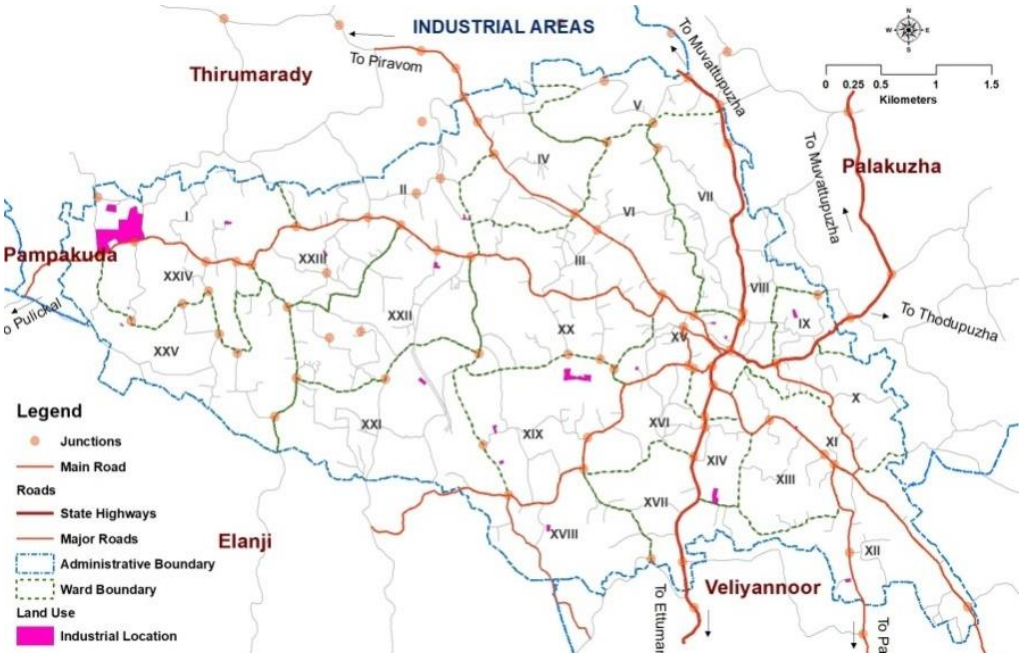


Figure 4-5 : Industrial areas in Koothattukulam Town

4.2.4 Public & semi-public land use

Govt./ Semi Govt. offices, educational and research institutions, medical and health institutions, social, cultural and religious institutions, cremation and burial grounds, Govt. lands etc. are grouped under this category.

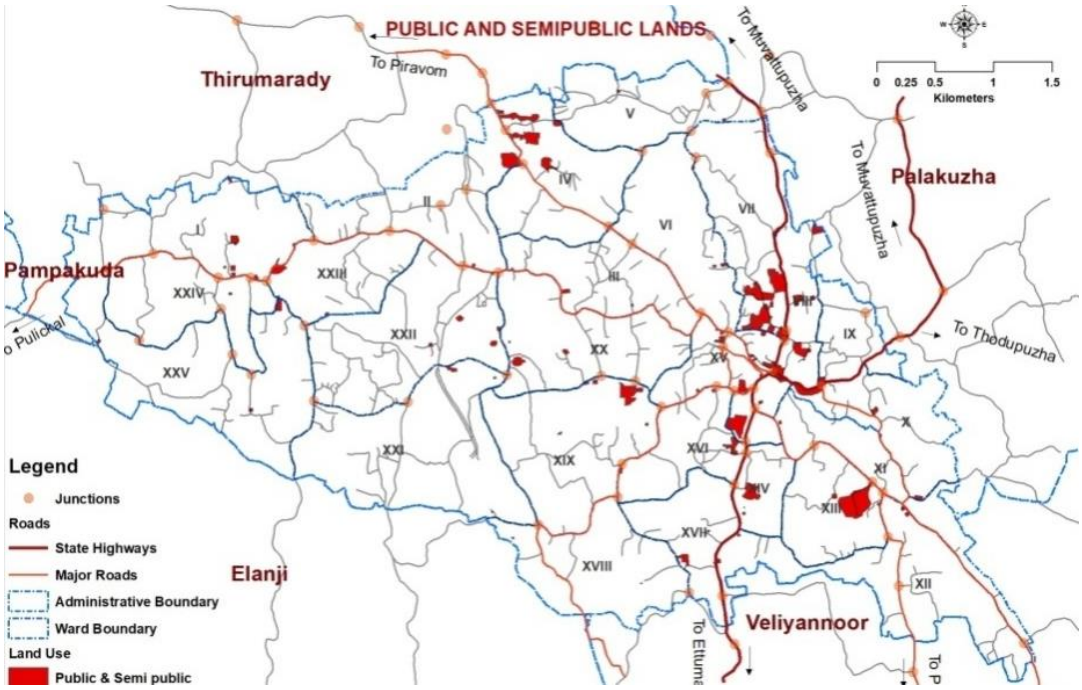


Figure 4-6 : Public and Semi-public areas in Koothattukulam Town

The total area under public and semi-public use is 42.66 hectares which comes only 1.84 % of the total area. It has been observed that the area under this land use category is less than the prescribed norm of 12- 16% which shows that the city lacks in socio-cultural institutions/ facilities such as libraries, museums, exhibition halls, convention centres, music-dance and drama centre, meditation and spiritual centre etc.

4.2.5 Park & open spaces

Recreational facilities like parks, playground, stadium, club etc. are important for leading quality social life in any city. At present only a very small park in the front yard of municipal library is there in the Municipality. Other open grounds available are the school grounds and this area is categorized in the Public and Semi public category. There is lack of open space in the Town. The total area under open space in the Town is 0.24 ha which comes only 0.01 % of the total area. The area under recreational use is much less than the prescribed norms of

18-20%, reflecting that the city lacks recreational spaces, which requires immediate attention.

4.2.6 Traffic & Transportation Land use

Transportation use of the Town mainly consists of roads and terminal areas. As per the land use survey conducted in 2016, the area under transportation land use in Town is 85.67 hectares. Koothattukulam is well connected to nearby places by roadways. There is a KSRTC bus depot and private bus stand in Koothattukulam which is located in the Town ward. Figure 4-7.shows the roads and bus terminals in Koothattukulam Town.

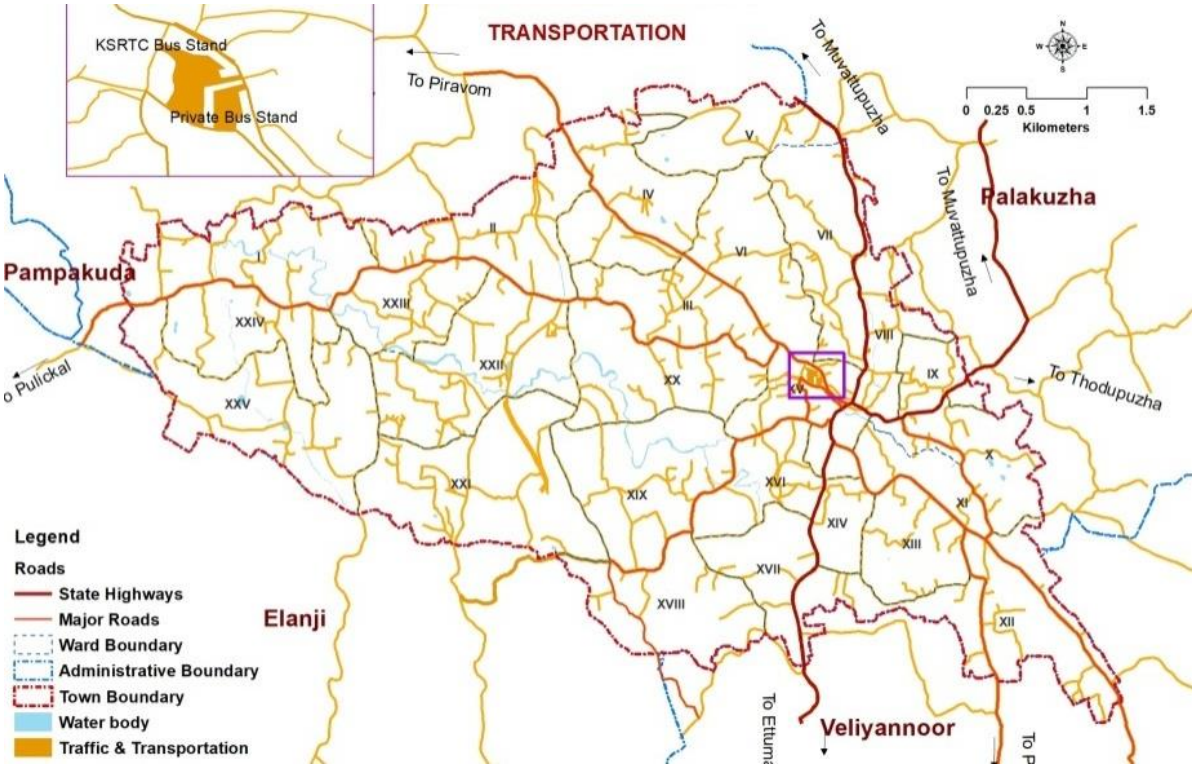


Figure 4-7 : Transportation land use in Koothattukulam Town

4.2.7 Agricultural Land Use

The total extent of land coming under agricultural use is 1694.99 hectares which occupies about 73.12 % of the total area. Wet agriculture is present in an area of 129ha which is 5.58% of the Town area. Dry agriculture occupies an area of 1565.27 hectares which is 67.54% of total Town area. Dry agriculture mainly includes rubber plantations in an area of 1168.6 ha and mixed cultivation such as coconut, nutmeg, pine- apple, pepper etc in an area of 397.03 ha and is distributed in all parts of the Town.

Table 4-2 : Distribution of Agriculture Land Use

Dry agriculture	Plantation	1168.24	50.41
	Mixed crops	397.03	17.13
	Total	1565.27	67.54
Wet agriculture		129.36	5.58
Agriculture-Total		**1694.99**	**73.12**

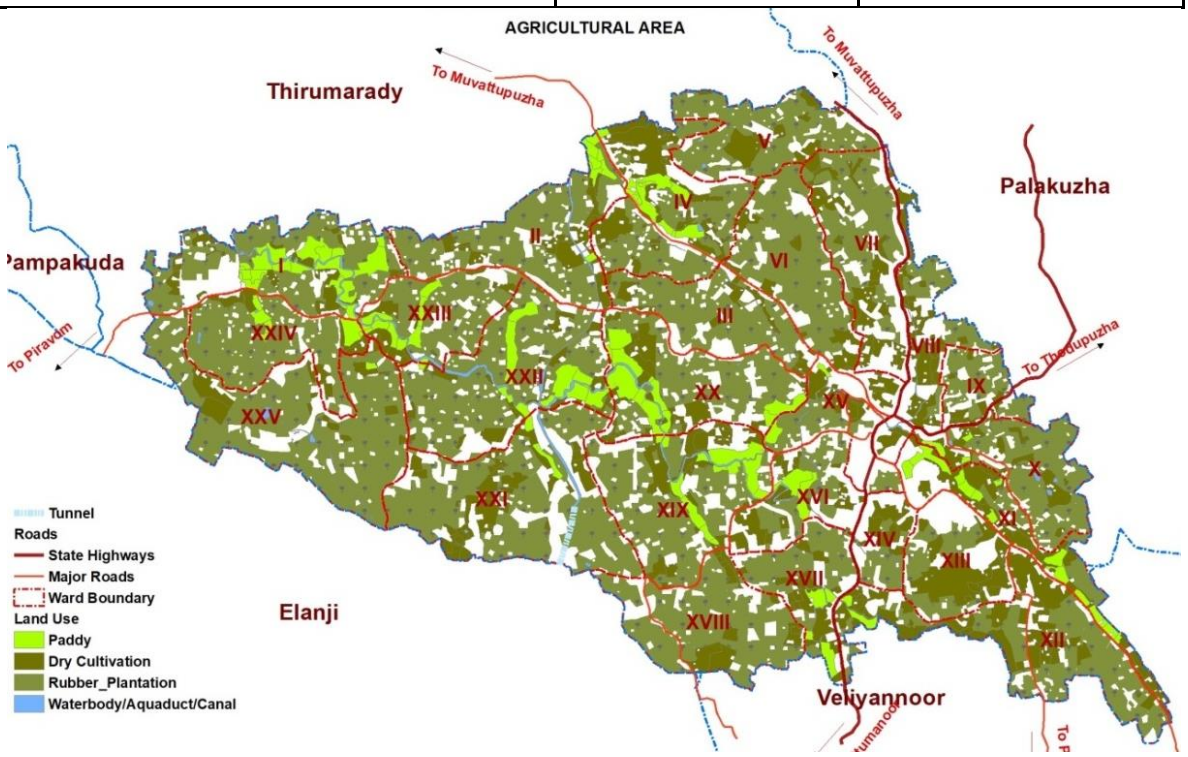


Figure 4-8 : Agricultural land use in Koothattukulam Town

Dry agriculture is the major land use of Koothattukulam Town which occupies 92.34 % of the total agricultural land use. The rubber plantations comes to 50% of total land use of the Town and are mainly concentrated on the northern and western parts of the Town where the altitude is relatively high. Being a Town situated in the midland region, the land in the category of paddy fields is very nominal and only 129.36 ha of land is under this category and are in discontinued pattern in which only 60 ha of paddy cultivation is active at present. As per “Koothattukulam gramapanchayath vikasana report, 1996” the total paddy land was 325ha in which 201 ha paddy cultivation was active, and 102ha was unused agriculture lands. This shows a reduction of 60.19% in total paddy land use and 70.14% reduction in paddy cultivation. Even now majority of these existing fields are not used for paddy cultivation. Most of them are under cultivation of vegetables and other seasonal crops.

4.2.8 Water Bodies

As per the land use survey conducted in 2016, the area coming under water bodies is 23.42 hectares; this is about 1.01% of the gross area of the town. Aquaducts, canals and drains are included under this category.

4.3 COMPARISON WITH PLANNING STANDARDS

A comparison of existing developable land area of Koothattukulam Town with the URDPFI norms for small Towns is shown in the table 4.3. The percentage of land uses are far below the suggested URDPFI standard.

Table 4-3 : Comparison of land use with URDPFI standards

Land use	Area in ha	% of Total area	URDPFI guideline for small Town (% of area)
Residential	421.65	18.19	45-50
Commercial	31.77	1.37	2-3
Industrial	12.87	0.56	8-10
Public & semi public	42.66	1.84	6-8
Open space	0.24	0.01	12-14
Traffic & transportation	85.67	3.70	10-12
Agriculture	1694.99	73.12	Balance
Barren land	0.94	0.04	0.04
Vacant land	3.79	0.16	
Water body	23.42	1.01	
Total	**2318**	**100.00**	

4.3.1 Comparison with Similar Towns

A comparison of percentage of different land uses in Koothattukulam Town with similar Towns like Thodupuzha, Kothamangalam, Piravom and Punalur is shown in the table 4-4.

Table 4-4 : Comparison of land use with similar Towns

TOWN LAND USE	Koothattukulam		Thodupuzha		Kothamangalam		Piravom		Punaloor	
Town Area (ha)	2318		3543		4004		2936		3444	
Residential	421.65	18.19	1051.56	29.68	1022.22	25.53	777	26.46	911	26.46
Commercial	31.77	1.37	56.33	1.59	34.83	0.87	22	0.76	36	1.05
Industrial	12.87	0.56	22.67	0.64	8.80	0.22	4	0.12	27.55	0.80
Public & semi public	42.66	1.84	69.08	1.95	84.88	2.12	42	1.43	70.6	2.05

Agriculture	1694.9	73.12	2096.75	59.18	2489.28	62.17	1869	63.65	2215	64.33
Open spaces	0.24	0.01	4.96	0.14	52.85	1.32	1	0.03	41.6	1.21
Traffic & Transportation	85.67	3.70	110.54	3.12	194.99	4.87	81	2.74	57.17	1.66
Water Bodies	23.42	1.01	73.69	2.08	116.11	2.90	141	4.81	81.9	2.38

The percentage of residential land use is comparatively low in Koothattukulam Town and Thodupuzha Town shows maximum percentage of residential land use among these Towns. The agriculture land use is predominant in all these Towns and Koothattukulam has the highest percentage of agricultural land use among them. Industrial land use is less than 1% of land area in all these Towns. Koothattukulam has the second position in commercial land use after Thodupuzha and Piravom has the lowest commercial land use among them. The percentage of water bodies and open spaces in Koothattukulam is the minimum among the other Towns.

4.4 LAND USE CONCENTRATION PATTERN

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 used. The concentration index of a particular land use for a ward is calculated as the share of that particular land use in the ward divided by the share of the same land use of the planning area. The concentration pattern of a land use gives a clear picture on the relative intensity and concentration of the particular land use among the wards within the Town. Ward with Concentration Index greater than one indicates that the intensity of the land use under consideration is on the higher side in the ward when compared to other wards in the Municipality. Using the above concept, concentration indices of major categories of land use (commercial, industrial, residential, agriculture etc.) are analyzed.

The concentration pattern of a land use can be ascertained by the concentration index of the land use which is calculated as follows.

Concentration index (C.I) of a particular land use in the Municipality =

$$\frac{\text{(Area of that land use in a ward) / (Total area of the ward)}}{\text{(Area of that land use of the Municipality) / (Total area of the Municipality)}}$$

4.4.1 Residential Land Use

The spatial distribution of the concentration index value of residential land use in Koothattukulam Town is shown in figure 4-9. Residential land use is the second major land use of the planning area and is mainly concentrated in the 10 wards. These wards are mainly located in the eastern part of M.C.Road and few to the western side of M.C.Road. Generally wards on the western and southern ends of Town have low concentration of residential land use. Concentration of residential use is seen along the major and minor travel corridors. Wards on either side of M.C.Road, along Koothattukulam-Piravom road, Pala road and other major roads have high value of concentration index of residential land use.

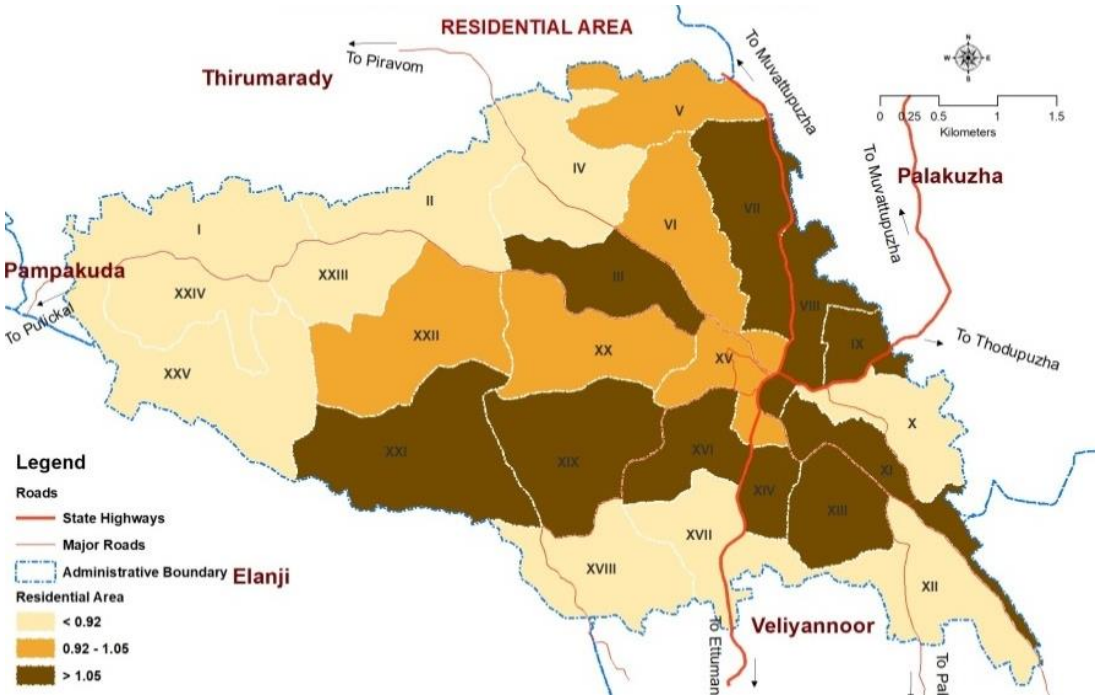


Figure 4-9 : Concentration index of residential land use

4.4.2 Commercial Land Use

The concentration index of commercial land of Koothattukulam Town is shown in figure 4.10. Concentration of commercial use is seen in the Town center and along the major travel corridors. Wards on either side of M.C.Road and along Koothattukulam Piravom road near M.C.Road have high value of concentration index of commercial land use.

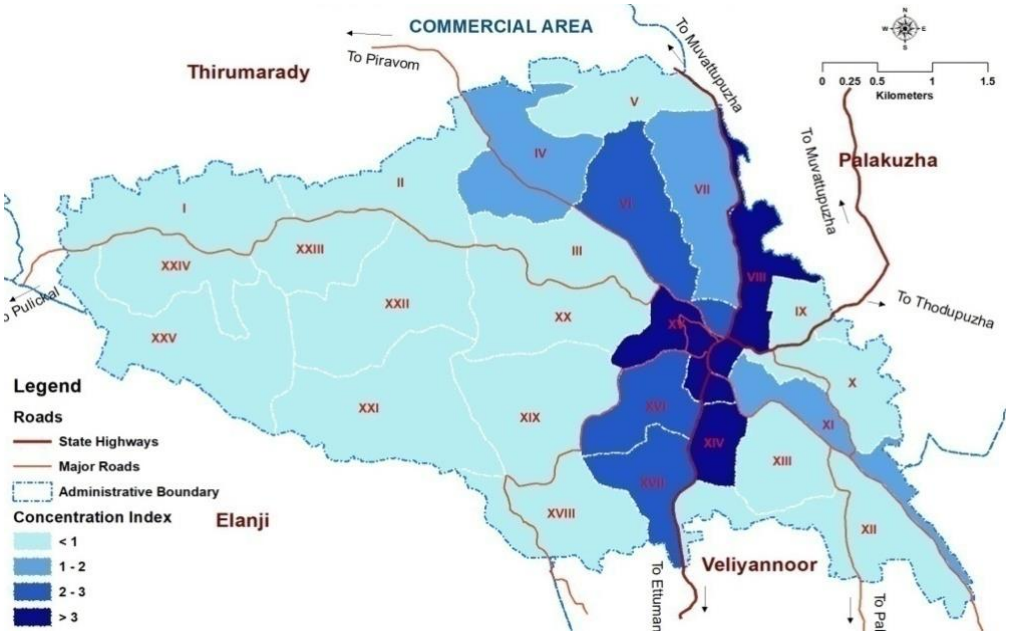


Figure 4-10 : Concentration index of commercial land use.

4.4.3 Industrial Land Use

The concentration index of industrial land use is shown in figure 4.11. MPI, the only major industry in Koothattukulam located in Ward 1, shows highest concentration and other small scale industries are located in a dispersed manner.

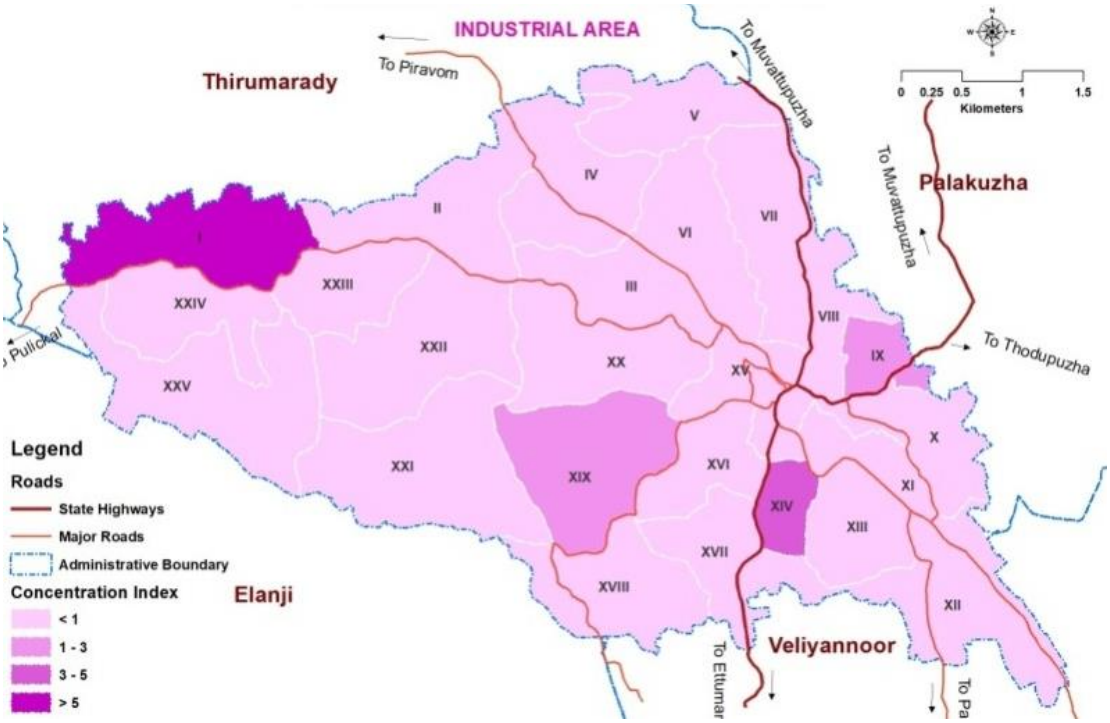


Figure 4-11 : Concentration index of Industrial land use

4.4.4 Public & Semi Public

The concentration pattern of public and semi-public land use, which includes Government institutions, educational facilities, health facilities, social institutions and religious institutions, is as shown in figure 4.12. The concentration index is varying from 0.02 to 4.8 and is high in ward 7 where educational as well as healthcare institutions are located followed by ward 13 where BTC College is located. The pattern shows that in wards with more concentration of public land use, the Commercial concentration of commercial land use is also high except in ward 13. This category of land use is concentrated more along the sides of major travel corridors.

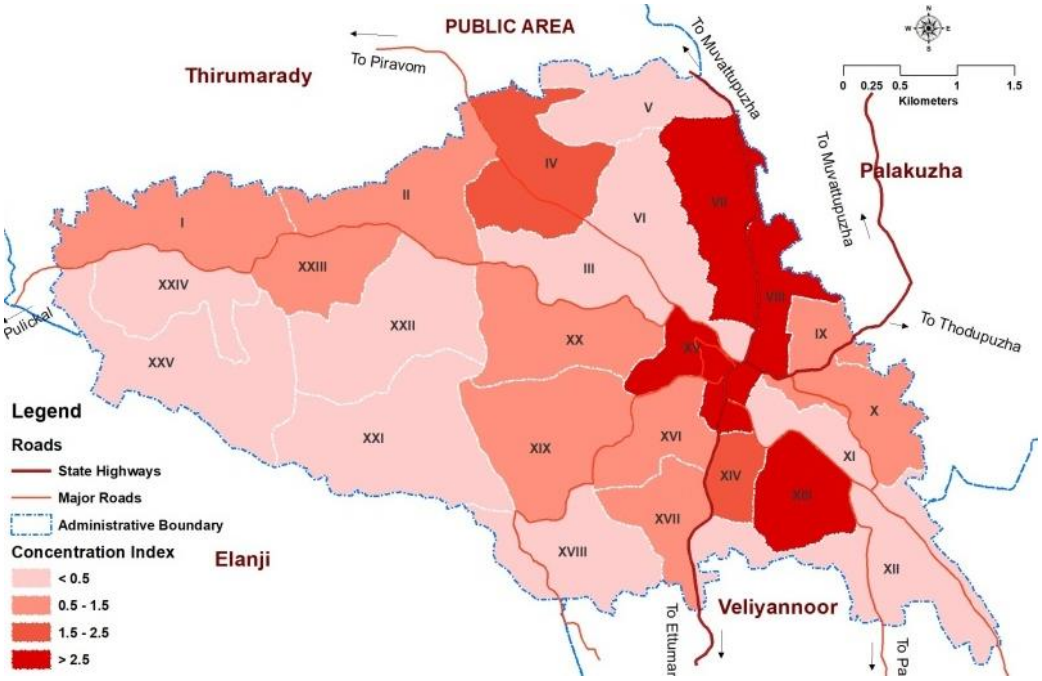


Figure 4-12 : Concentration index of Public and semi-public land use

4.4.5 Agricultural Land Use

The agriculture land in Koothattukulam Town is broadly classified into dry cultivation (rubber plantation, mixed crops etc) and paddy fields. As mentioned above, major portion of the agriculture land is coming under dry cultivation and share of paddy field is very nominal. Overall agriculture is concentrated towards the western and southern part of the Town as moving away from Town center.

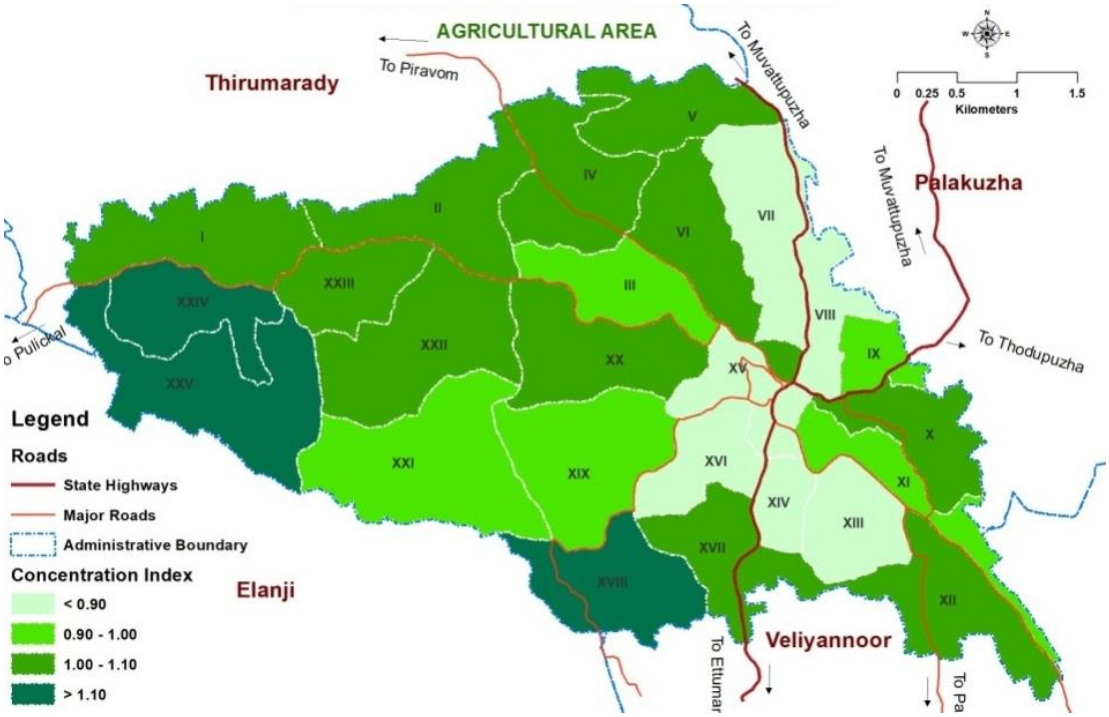


Figure 4-13 : Concentration index of total Agricultural land use

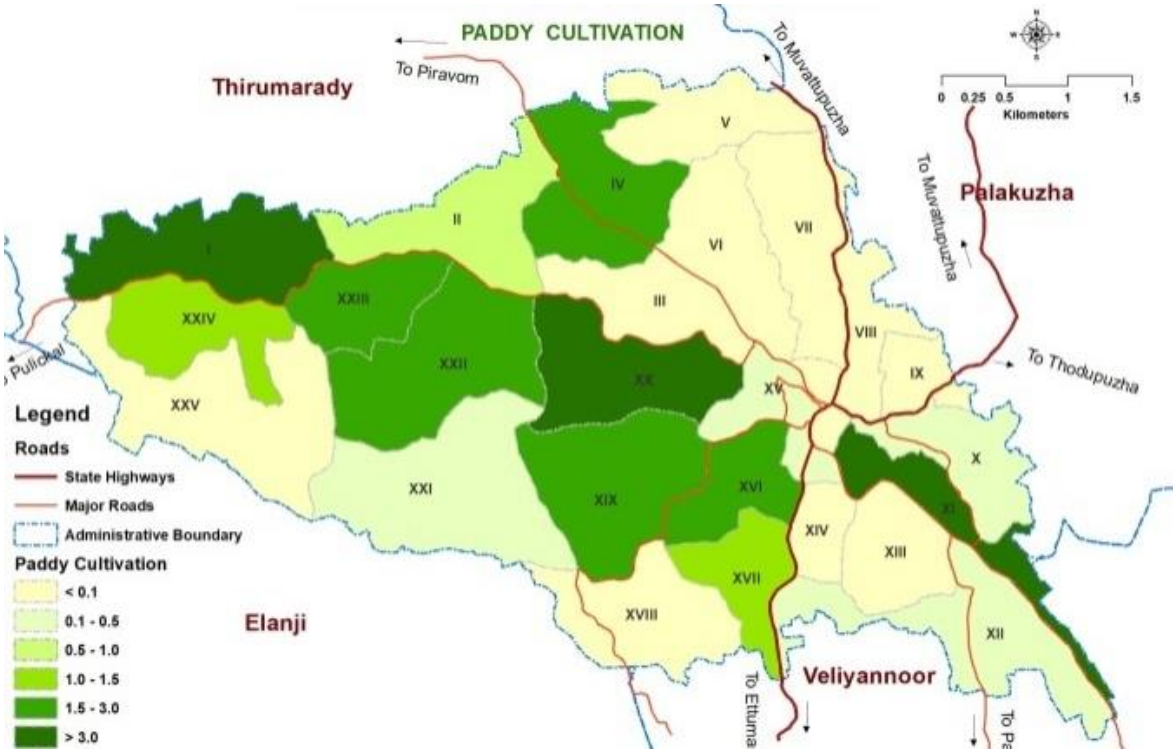


Figure 4-14 : Concentration index of wet agricultural land use

The total agricultural land area is 1694.99 hectares which is 73.12 % of the total Town area. Figure 4.13 shows the concentration pattern of agriculture land use of the Town. Agriculture land is distributed in all wards of the Town with more concentration along the west part of the Town, where both dry and wet cultivation are practised. The more concentration of

agriculture is seen in wards 18, 24 and 25. Concentration index of agriculture is low in the wards at the Town centre where high concentration of Commercial, Public and semi public land use exists.

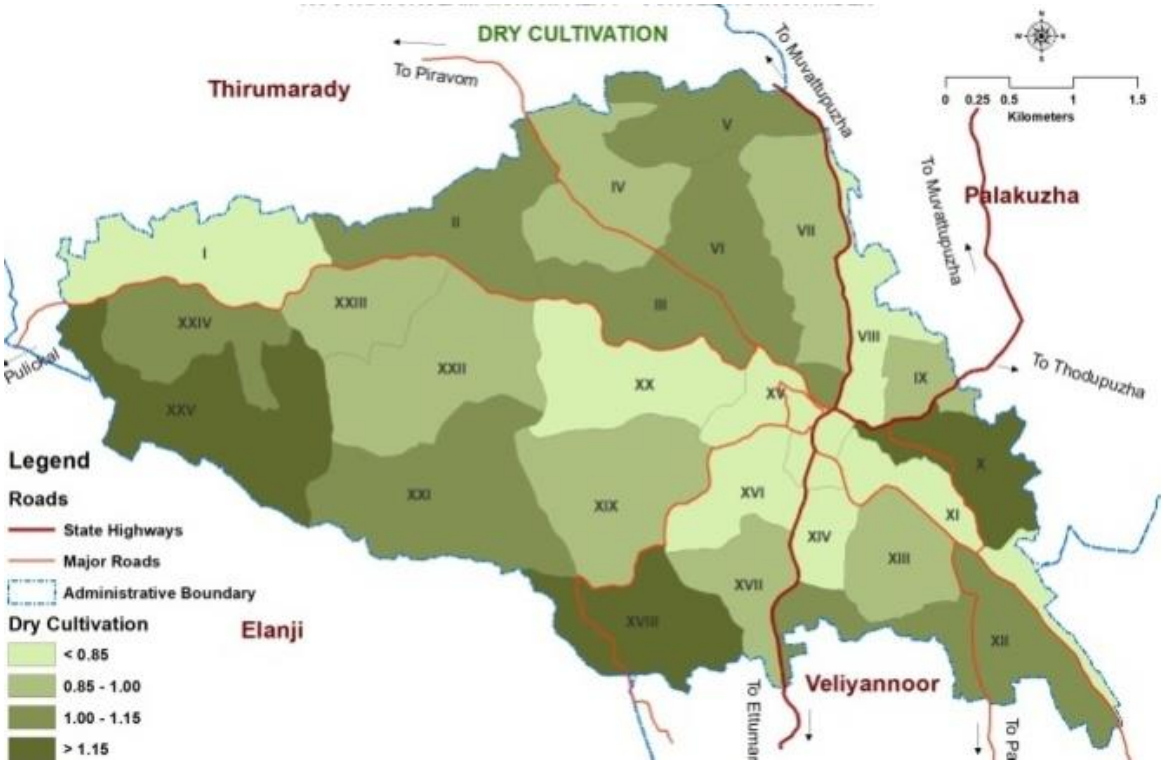


Figure 4-15 : Concentration index of dry agricultural land use

The concentration index of wet agriculture, dry agriculture, dry agriculture- rubber plantation and dry agriculture-mixed crop other than rubber plantations are shown in figure 4.14 to 4.17. Wet agriculture is concentrated in the wards at the valley region along the geographical centre of the Town in the northwest - southeast direction. Dry agriculture is distributed all over the Town except in the wards at the Town core area, and is concentrated towards the peripheral wards of the Town except in ward 1 and 11 at the periphery where more wet agriculture is concentrated.

Rubber plantations are distributed all over the Town area with more concentration towards the hilly regions of the Town at the peripheral wards with high concentration in wards 5,18,24 and25. Mixed crop cultivation is seen away from the Town core areas and are mainly concentrated in wards 18, 24 and 25. The dry agriculture is mainly concentrated in wards 10, 18 and 25.

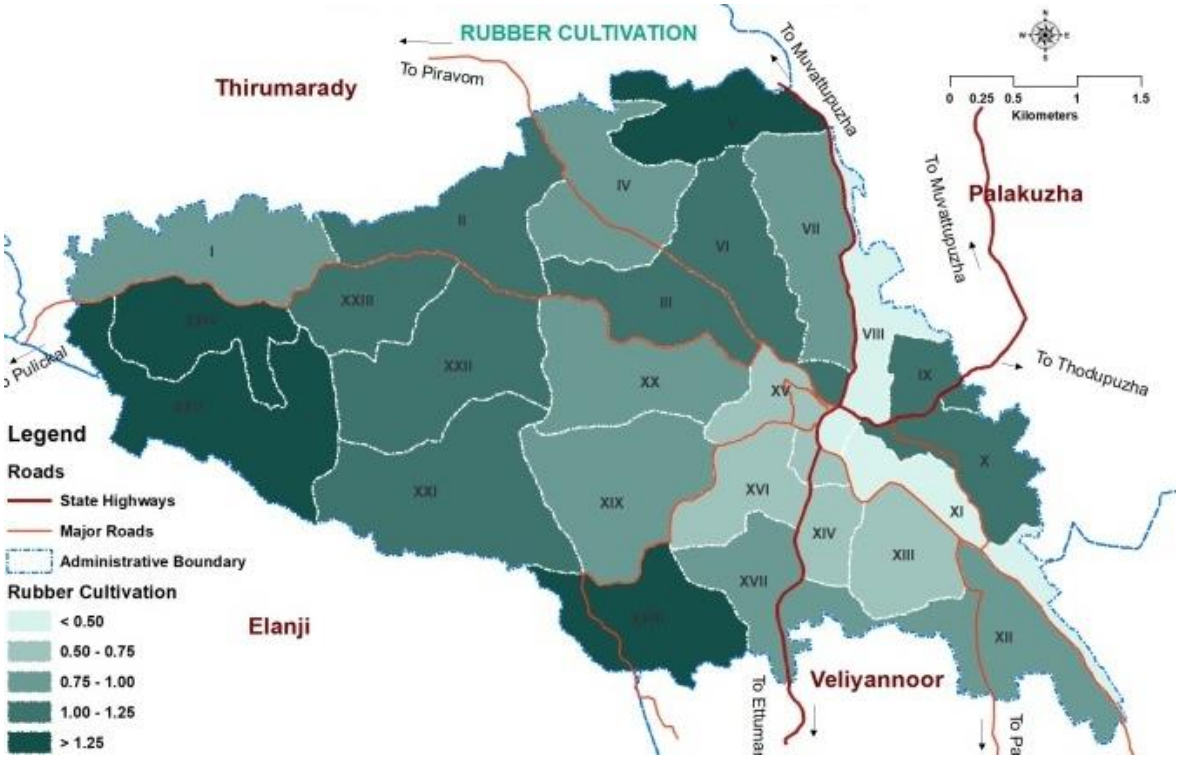


Figure 4-16 : Concentration index of rubber plantation land use

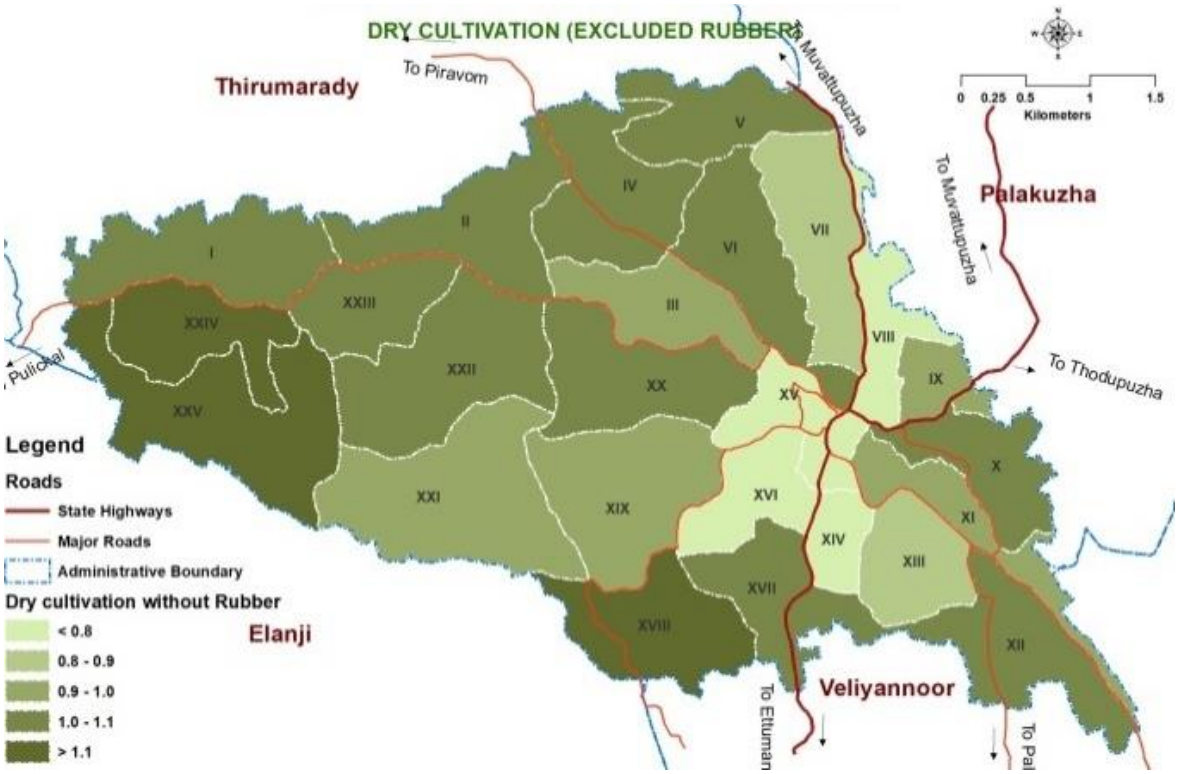


Figure 4-17 : Concentration index of mixed crop cultivation (excluding rubber plantation) land use

4.5 INFERENCE

From the analysis of land use it is observed that more than 70% of the total geographical area is used for agricultural activities and 18% is used for residential activities. The commercial area of the Town is concentrated in the core of the Town and along the side of major road corridors such as M.C.Road and Koothattukulam – Piravom road. Residences are concentrated mainly in the eastern part of M.C.Road and few to the western side of M.C.Road. Generally wards on the western and southern end have low concentration of residential land use. Major portion of the agriculture land is coming under dry cultivation and share of paddy field is very nominal. Overall agriculture is concentrated towards the western and southern part of the Town away from the Town core area. The area under industrial and public use constitutes only 0.56% and 1.84% of the total area of Town respectively. Parks, play grounds, open spaces and other recreational spaces in the Town is very less and it is far below the suggested URDPFI standard requirements.

5 ECONOMIC ASPECTS

5.1 INDUSTRY

5.1.1 Existing Industries

Major large scale industry situated in Town is Meat Products of India (MPI). Industries have a little role in the economic development of the region. Even though environment and social fabric of the area does not support any large scale industries, the Town have potential for agro based and small scale industries. There is only one large scale industry, four small scale industries and 39 micro level industries functioning in Koothattukulam.

5.1.2 Industrial Production

MPI is the large scale industry situated at Olakkad Jn. in ward 1 of Koothattukulam Town and produces meat and meat products. Important commodity exported from Koothattukulam is MPI products whereas most manufactured commodity is rubber. Among the four small scale industrial units functioning in the Town, 2 units are related to ayurvedic medicine research and productions. Due to the availability of hardwood and rubber, most of the micro level industrial production is based on furniture and general engineering works. This shows the potential of farming, ayurvedic, and general engineering industrial development in Koothattukulam Town. Also, there is a scope for rubber based industry, cattle feed factory and bone meal industrial unit. The details of industrial production from micro level industries are as shown in figure 5-1.

It is observed that major share of industrial production of micro level industries cannot be specified into any particular category. However, comparatively food/engineering based industries are dominating over the other types of industries like rubber, cement, chemical, plastic and electronics based industries.

5.1.3 Spatial Distribution

The spatial distribution of small scale industrial units and that of micro industries is shown in figure 5-2. From the spatial distribution map, it is seen that number of small scale industrial units are located mainly along major road corridors.

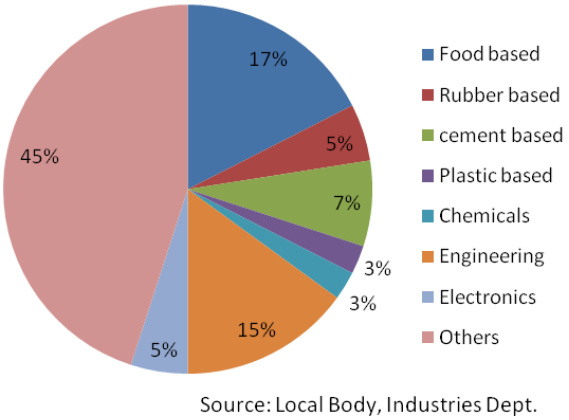


Figure 5-1 : Details of industrial production from micro level industries

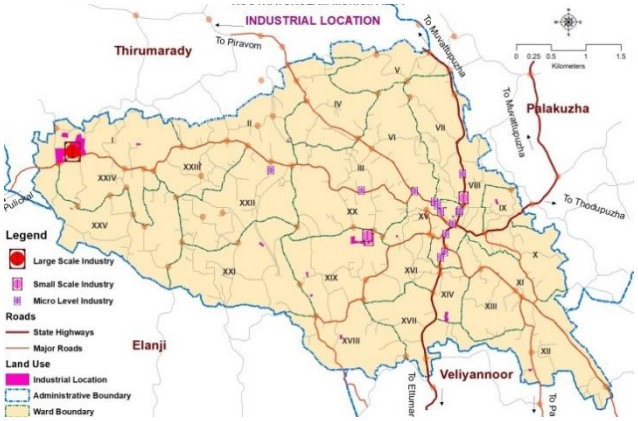


Figure 5-2 : Spatial distribution of large scale, small scale and micro industrial units

5.1.4 Large Scale Industries - Meat Products of India

Meat Products of India is the one and only large scale industry in this Town which is a public sector undertaking industry for the manufacture and marketing of meat and meat products and its preservation. The industry is mainly involved in farming of hen, pig, buffalos and their slaughter houses. The company was established in 1966 as Bakon factory working under animal husbandry department in 25 acre of land. Later in 1968, developed the factory buildings and machineries and renamed as Meat Production of India. Currently 82 people are working with this company.



Meat Products of India

MPI established in 1973, is a Public Sector undertaking of Government of Kerala. The products of MPI are derived from young and healthy livestock and are processed with the help of sophisticated technology to ensure high standards of hygiene, longer storage time and more nutritive value. The products are manufactured under strict Veterinary Supervision from selected animals free from zoonotic disease. Products of MPI range from beef, buffalo, pork, mutton and poultry. They also export a rissole (labelled as continental sausage) to Australia. Currently, the company produces more than 65 varieties of items.

5.1.4.1 Schemes

Various income generating schemes are introduced for the farmers by the MPI. Pig production implies a significant reuse of household/restaurant waste, waste of commercial enterprises (bakery, market, vegetable and fruit leftovers) and industrial (brewery, abattoir) activities. It is said that one pig can convert about 5-7 kg of waste from the environment to nutritious pork meat. In that way pigs can be considered as cleaning machines of our environment. However, the demand of pork is higher than supply. Pig rearing and buy back scheme was implemented by MPI under Rashtrya Krishi Vikas Yojana (RKVY) 2014 – 15. The project proposes to give 25% subsidy for the construction of pig shed, biogas plant, and purchase of piglings, pig feed, and insurance coverage. A total of 20 piglings will be supplied to each farmer in a course of two years, in batches of 10 at 6 month interval. After a period of 6 month rearing all the grown up pigs will be taken back to MPI for meat production. The project also proposes to give a premium price for grown up pigs at the time of purchase. The main objective of the project is to increase the population of quality pigs and to assure the supply of pork products. It also aims in becoming a source of income creating major employment opportunities especially in rural areas. The project also keeps a check on the monopolies from the neighbouring states.

5.1.4.2 Ongoing Projects of MPI

The ongoing project of Meat Products of India Ltd is the installation of Hi-tech Slaughter House at Edayar which is a 100% pollution free slaughterhouse, set up at an estimated cost of Rs 31.02 crores with the support of both central and state government. There are separate plants to slaughter 200 large cattle and 200 swines per day. Animals are directly sourced from livestock farmers. Experts from MPI visit the farms and certify animals before initiating procurement process. The animals are slaughtered in the plant in a scientific manner. It has a facility to process 200 metric tonne meat. The slaughterhouse has an effluent treatment plant to treat the waste water, a rendering plant to process animal waste, recycled meat and a bio-gas plant. Unlike the illegal slaughter houses, there are no issues of waste disposal at the new plant. MPI said it is able to meet only 0.01% of meat requirement in the state. The total meat production during the year 2012-13 was 309.226 MT against 252.245 MT during 2011-12. The livestock feed production for the year 2012-13

was 614.81 MT against 432.00 MT during the year 2011-12. Sale details of MPI for 2014-17 (in kg) are shown in table 5-1.

Area of campus at Edayar : 26 acres

Meat processing capacity : 1 MT in one shift.

Feed Milling Capacity : 12 MT in one shift.

Turnover for 2010-11 : Rs. 326 lakhs.

Table 5-1 : Sale details of MPI for 2014-17 (in kg)

Sl. No.	Year	Pork Products	Beef Products	Chicken Products	Mutton Products	Duck Products
1	2014-15	133913	170656	209380	6148	11400
2	2015-16	157008	196702	353498	6561	2675
3	2016-17	177160	176929	310091	6030	11424

Source : MPI, Koothattukulam

5.1.5 Other Industries

In addition to MPI, few small scale and micro level industries are also functioning in Koothattukulam Town. Sreedareeyam ayurvedic medicines and research Centre, famous ayurvedic and herbal products company classified as a small scale industry functions in this Municipality. The details of small scale and micro level industries in Koothattukulam are shown in table 5-2 and 5-3 respectively. It is estimated that about 329 people are employed in small and micro industrial units in Koothattukulam Town.

Table 5-2 : Details of small scale industries

Sl.No	Ward no	Name of Industry	Others	Type of products	No. Of employees
1	19	SreedhareeyamAyurvedic Medicines Private Limited	1	Ayurvedic medicines	73
2	19	Sreedhareeyam Ayurveda Research Centre	1	Herbal based	18
3	8	Kochuviruppil Digital Solutions	1	Flexography and Advertising materials	11
4	15	Image IV /270A	1	Manufacture of video recording or reproducing apparatus	1

Source : Local Body, Industries Dept.

Table 5-3 : Details of micro level industries

Type of industry	Total Numbers	No.of employees
Food based	7	45
Rubber based	2	10
cement based	3	22
Plastic based	1	7
Chemicals	1	4
Engineering	6	25
Electronics	2	12
Others	18	101

Source : Local Body, Industries Dept.

Industrial land use forms 0.61 % (14.04ha) of the total area of the Town. As per URDPFI the share of industrial land use for a Town like Koothattukulam is 8-10%. Comparison with the standards shows that industrial base of Koothattukulam is weak.

5.1.6 Problems and Potentials

5.1.6.1 Problems

- Major constraints are non-availability of suitable land, undulating terrain and non-availibility of water
- Difficulty in transportation as most of the region is of hilly terrain.

5.1.6.2 Potentials

- Higher scope for food processing, rubber and by-products industries and agro based industries
- Higher potential for Eco green units like production of biodegradable bowls, plates, mats as by-product of rice husk, banana fibre, coconut fibre, palm leaves etc
- Scope of cattle feed factory and bone meal industrial unit.

5.1.7 Inference

Koothattukulam is having a scope for development of small scale industries utilizing the Hardwood and rubber based raw materials. Even though majority of land are undulating, land is available in Koothattukulam, but other infrastructure facilities such as building, power and transportation facilities are not sufficient. There is a scope, associated with MPI such as cattle feed factory, bone meal unit and farming can be promoted. Small scale

industries such as food processing and eco green units can offer a prime contribution to the economic development of Municipality.

5.2 TRADE AND COMMERCE

Koothattukulam, part of Vadakkumkoor kingdom was known as the Agri-Business Center in Travancore as most people were engaged in agriculture, farming and trading. The main cash crops are rubber, paddy, coconut, areca nut, ginger, turmeric and pepper. The public market of Koothattukulam ie, SreeRamavarmapuram Market dates back to hundreds of years. The market was well known for cattle trade, trading of rice and cashcrops. Market also was the center/checkpoints authorized for taxation and inspection. Even though the fame and heritage of trade has faded through years, being an area at the transition of hill land and midland, Koothattukulam is still an important trading centre.

5.2.1 Markets

There are two markets in Koothattukulam Town one is a general market and another is a cattle market. The main market in Koothattukulam Town known as Sreeramavarmapuram Market is located in ward 15 between Private bus stand and KSRTC bus stand and is owned by the Municipality with 56 stalls in an area of 54 cents. This is relocated to the land near cattle market as shown in figure 5-3. As Koothattukulam is a major service area to nearby local bodies, the market also acts as service centre of nearby Panchayats. The commodities traded are mainly vegetables, fruits and fish which come from places like Muvattupuzha, Vaikkam, Udayamperoor, Kayamkulam, Kottayam, Aluva, Kochi, Munambam, Andhra Pradesh and Orissa. The goods traded here are sent to Koothattukulam and nearby Panchayats.



Old market



New market area

5.2.1.1 Cattle Market



Cattle Market

Cattle Market in Town is famous for cattle trade in Kerala. People from far places come here for trading. The cattle market works on Sundays and Wednesdays. The market is located behind the fire force station in ward 15 has an area of 75 cents. The cattle are brought for sale in the market from the local areas, nearby panchayaths, nearby Districts like Idukki, Kottayam and Wayanad and from nearby states like Tamilnadu, Karnataka and Andhra Pradesh. The secondary data from the veterinary doctor and cattle market manager shows that, on Sundays an average number of 400 goats and 150 cows and on Wednesdays an average of 250 buffaloes, 10 goats and 20 pigs are traded through the cattle market. The main purchasers of these cattle include people from all over the nearby regions inside the state including the Districts Ernakulam, Kottayam, Alappuzha and Thrissur.

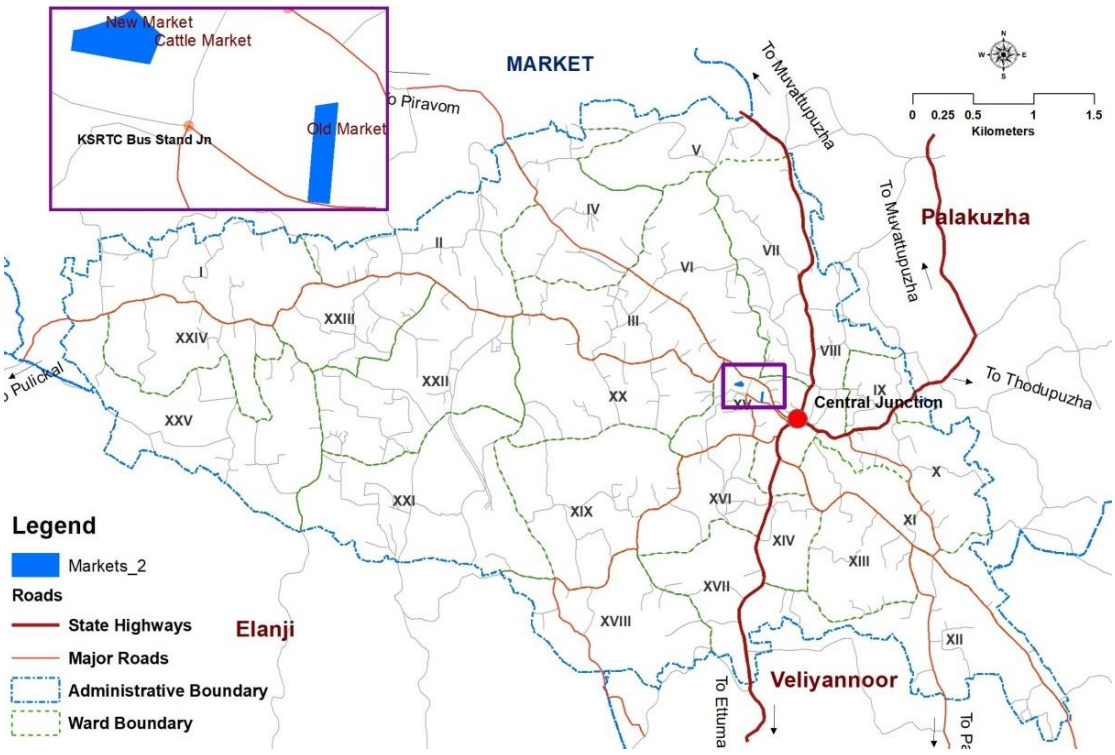


Figure 5-3 : Location of markets in Town

5.2.1.2 Problems

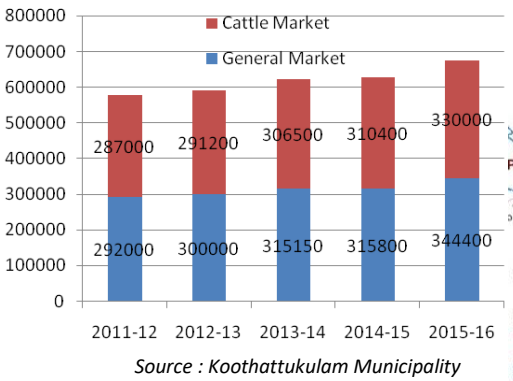
The main issues in the market include lack of ramps, lack of basic amenities like toilets, water storage facilities for adequate water supply and proper lighting during nights and traffic problems including lack of parking facilities and congestions during market working days.

5.2.1.3 Potential

Average Income for the Municipality is 6 lakh per year from general market as well as cattle market. Figure 5-4 shows the income generated from Town market from 2011 to 2016, this shows that general market gives more income than the cattle market and these shows a steady increase in income generation. The potential for animal husbandry sector in the region can develop this area to a cattle market centre. Availability of municipal land at the Town centre for the new market development and reconstruction of market to a modern municipal market will help to generate more municipal revenue.

5.2.2 Commercial Centres

Commercial centres are concentrated only along the major corridor and at the Town centre as shown in figure 5-5. The commercial activities in Koothattukulam are very low when compared to the required standards for a small Town.



Source : Koothattukulam Municipality

Figure 5-4 : Income from market (2011 to 2016)

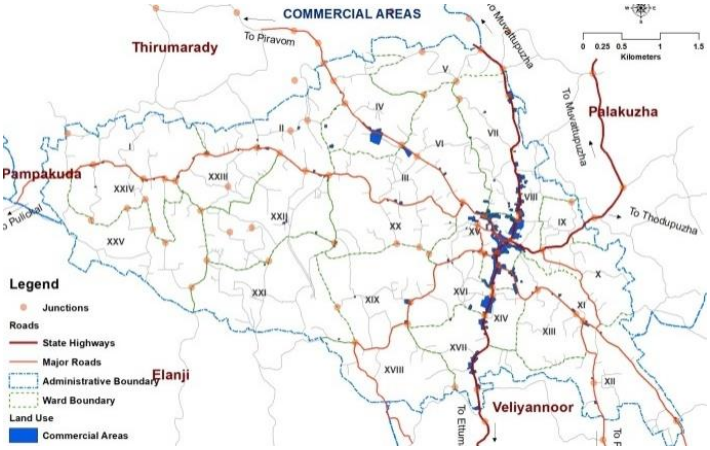


Figure 5-5 : Commercial areas in Koothattukulam Town

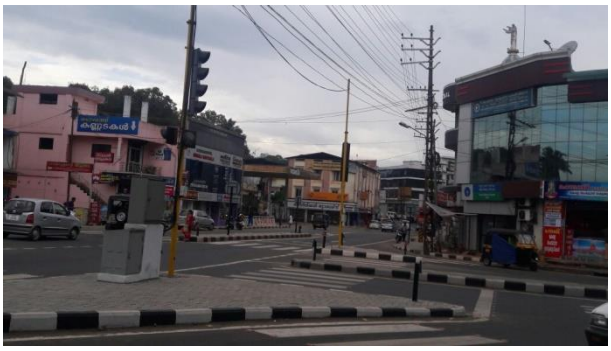
5.2.2.1 Facilities at Commercial Centres

The present status of commercial centres in Koothattukulam Town was assessed based on primary survey. Details collected on retail shops, wholesale shops, commercial offices and

other higher order facilities. The shops / facility are classified into local, sectoral and District level based on the level of service it provided. Local level service is that service in which only local people depends. While in sectoral level facility the neighbouring LSGs also depends and in the District level facility entire people in the District depends.



Commercial area



Commercial area

5.2.3 Existing Hierarchy of Commercial Nodes

After collecting data on various commercial facilities available at the commercial nodes, due weightage is assigned to each type of facilities according to level of service to calculate the Cumulative Commercial Facility Index (CCFI). Further to this the Combined Commercial Index (CCI) of a particular node is obtained by multiplying CCFI with the percentage of commercial land use of that node with that of Koothattukulam Municipal area. From the analysis of facilities, it is found that some facilities such as retail shops and commercial offices are available in all junctions, hence a weightage of 1 is assigned to this facilities. In the case of wholesale shops out of 10 junctions, only 7 junctions have that facility, hence a weightage of 1.4 (10/7) given for that facility. Similarly a weightage of 1.25 to higher order facilities and 1.25 to other facilities are assigned. For local level facilities, weightage of 1 and for sector level facilities weightage of 2 is given. By multiplying the number of facilities with the weightage of that facility weightage due to level of service CCFI will be obtained. The values of CCFI and CCI are shown table 5-4.

Table 5-4 : Values of CCFI, CCI and order of junctions

Sl. No	Junctions	CCFI	% of Commercial Land use	CCI	Order of Junction
1	Central Junction	156.88	46.61	7312.1768	1st
2	Onamkunnu temple Junction	109.54	56.77	6218.5858	1st
3	Keerthi Junction	99.7	57.94	5776.618	1st
4	Aswathy Junction	112.4	47.24	5309.776	2nd
5	Ramapuram Juction	112.54	43.92	4942.7568	2nd

6	Parisudham oil Junction	149.14	19.56	2917.1784	3rd
7	T.B Junction	36.54	21.39	781.5906	3rd
8	Bappuji Junction	31.62	23.31	737.0622	3rd
9	Substation Junction	32	20.48	655.36	3rd
10	Mangalathuthazham Junction	32	9.72	311.04	3rd

Source : Primary Survey

The first order junctions in Koothattukulam are Central junction, Onamkunnu junction and Keerthi Junction which can be considered as a single major node in the region. Aswathy junction and Ramapuram junction belongs to second order. Parishudham oil junction, TB junction, Bappuji junction, Substation junction and Mangalathuthazham junction belongs to third order node. Central junction is proposed as 2nd order junction in the District and Mangalathuthazham junction is classified as fourth order junction in the District in District urbanisation report. The existing hierarchy of commercial nodes in Koothattukulam Town is shown in figure 5-6.

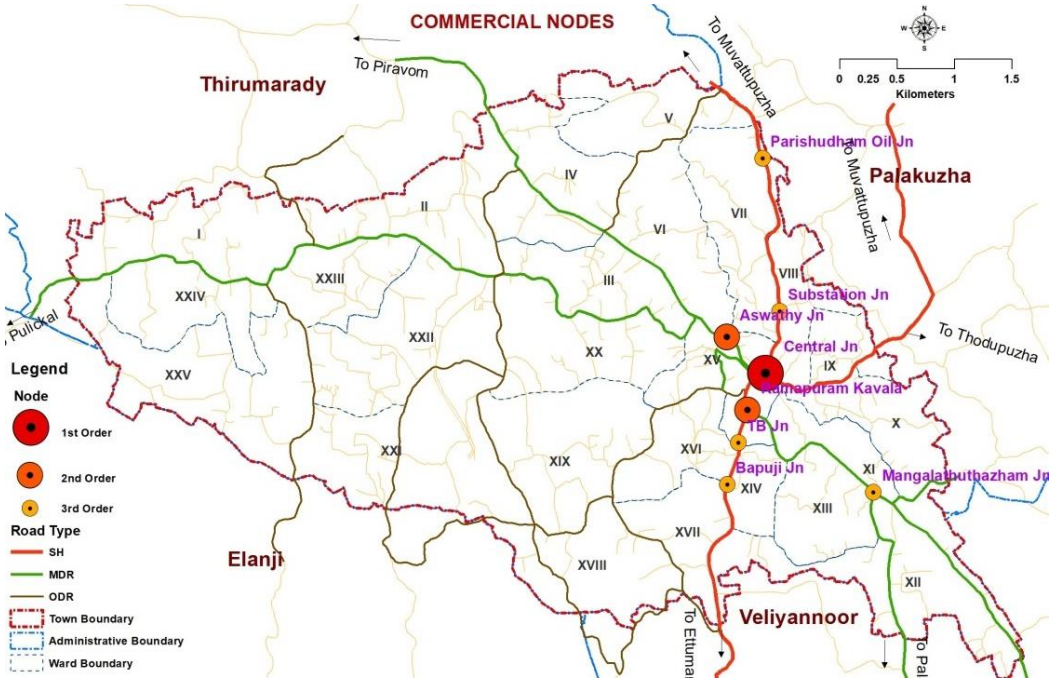


Figure 5-6 : Existing hierarchy of commercial nodes in Koothattukulam Town

5.2.4 Informal sector

Informal activities exist in Koothattukulam Town in a very small scale. 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 is no organized space for hawkers in the Town and they are mainly utilizing road margins and are spread near the market area in the Town centre.

Primary survey identified 54 labourers near the market area engaged in activities like selling of fruits, vegetables, garments, tea and snacks, home appliances, etc. The majority of activity happening is sale of vegetables (44%), home appliances (24%), garments (11%) and fruits (9%). But they don't have any approval of Local body. The secondary data(2016) from the local body shows that there are 36 vendors identified by the Municipality who are engaged in activities like selling of lottery, tea and snacks, garments, plants, etc., repairing works of chapels, bag, umbrella, etc and having petty shops. In which majority of them sells lottery (61%), tea and snacks (14%) and having petty shops (14%).

5.2.5 Inference

Trade and commerce is one of the major economic activities of Koothattukulam from years back. Even though there are markets in the town they lack adequate infrastructure facilities. Proper waste management system, basic amenities, parking areas, truck loading facilities etc. are essential for the smooth functioning of a market. So the existing markets need to be expanded and modified as hi-tech markets by providing all the basic infrastructural requirements. The major commercial centres in theTown are concentrated along the major road corridor and at the Town centre. Informal activities exist in Koothattukulam Town in a very small scale and hence street vending zones should be identified for rehabilitation of street vendors.

5.3 TOURISM

Existing places of interests in Koothattukulam can be classified into Religious destinations (as there are some ancient churches and temples) and Healthcare destinations (since there is a major ayurvedic hospital located in Koothattukulam). It is enumerated that about 12,000 domestic tourists visit Koothattukulam a year, but still tourism is not an established economic sector in Koothattukulam.

5.3.1 Tourism Attractions of Koothattukulam

5.3.1.1 Religious Tourism

From time immemorial, Koothattukulam has been a shining example of religious tolerance and comity. Hindus and Christians live here in complete harmony. Christian churches steeped in the cultural traditions of the Buddhist-Jainist era are a characteristic feature of the area. Though Christians form the majority of the population, there are a number of places of worship belonging to both religions. The Mahadeva temple at Koothattukulam, the Onamkunnu Kavu, the Shiva temple at Arjunanmala, the Devi temple at Kizhakombu, The St. John The Baptist Catholic Church and The St. John's Syrian Orthodox Church at Vadakara are just a few of the places of worship dating back several centuries. Major religious tourism destinations in the region are:

1. Koothattukulam Mahadeva Temple has importance for its architectural aspects including the detailing of the story of Ramayanam on timber.
2. Sandal pond is an attractive place near Arjunanmala Shiva Temple.
3. Arjunan Mala Shiva Temple is dated 500 years old and is famous for Maha Shivarathri rituals.
4. Kizhakkombu Kavu, located 4 km away from Koothattukulam Town which has diverse and rare types of plants and climbing. It has importance for both botanical and religious concerns.
5. Onamkunnu Kavu famaous for Mudiyet and Garudanthookkam.
6. Shirdhi Sai Temple is the only temple for Shirdhi Sai in the region and it is open to all communities, irrespective of any religious affiliations.
7. St. Johns Jacobite Syrian Church is a place showing Persian architectural concepts.



Kizhakombu kavu



Mahadeva temple

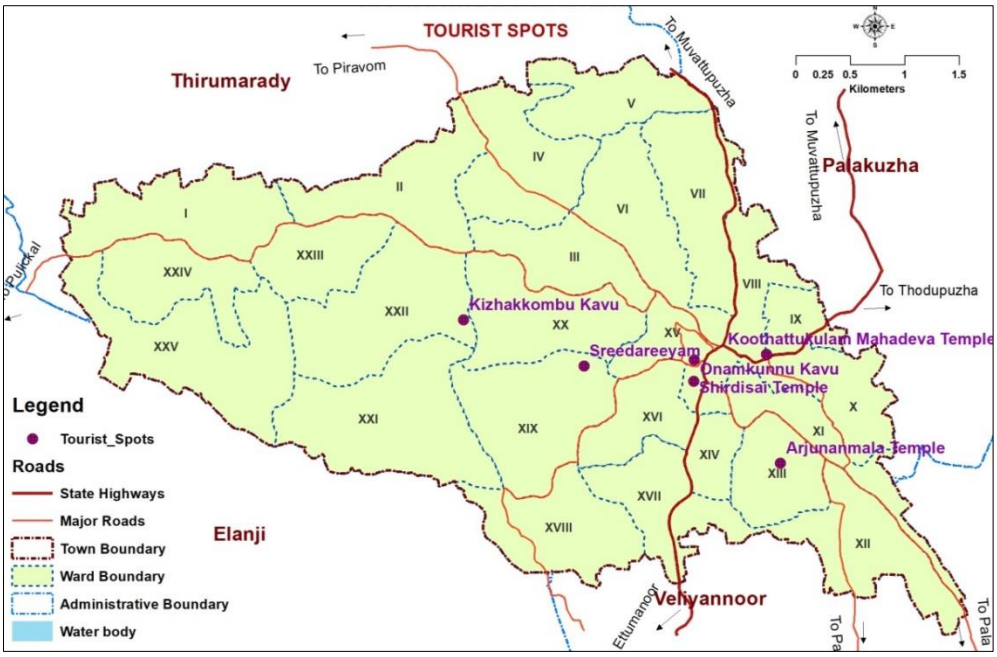


Figure 5-7 : Location of tourist spot

5.3.1.2 Health care Tourism

Medical tourism has a rapidly growing practice of travelling across international borders to obtain healthcare. Health care tourism is already being promoted as a key selling point in Kerala where a number of hotel feature, Ayurveda centers. Sreedhareeyam Ayurvedic eye hospital and research centre is the famous place in Koothattukulam to highlight Ayurvedic treatments. Sreedhareeyam Ayurvedic eye hospital and research centre has successfully leveraged three centuries of traditional ayurvedic wisdom inherited from Nellikkattu Illam. Treatments here are done by referring to the ancient ayurvedic tests and selecting indigenous herbs in the traditional way. It is currently a popular place for curing eye problems of varying degrees.



Sreedareeyam Eye Hospital

5.3.2 Surrounding Areas

5.3.2.1 Areekkal Water falls

Even though not inside the municipal boundary, the water fall is located just 10 km away from Koothattukulam. The location is surrounded by moderate forest and rubber plantations; fresh air and occasional rains making it a cool destination for travellers. Areekkal falls is situated within a steep trench near to highway.

5.3.2.2 Piravom Valiyapalli

Located in Piravom which is 15km away from Koothattukulam is a famous religious tourism destination. It is believed to be the first Christian Church in the world, and it is the only church in the name of the Holy Kings (Magi) a Romish appellation which stands on the solid rock of Christian faith. It is one among the rare churches in Malankara where there has been daily Holy Mass from very olden times.

5.3.3 Hotels and Home stay

There are only 4 hotels in Koothattukulam municipal limit which are 3 star and below. However there are home stay which are of 10 numbers. Home stay facilities are to be arranged for tourists. For this, people interested in providing home stay facilities may be identified and shall be given financial incentive for the above purpose.

5.3.4 Problems

- Lack of proper infrastructure facilities
- Roads to destination need to be improved and maintained properly
- Proper parking spaces are required at all destinations

5.3.5 Inference

Tourism is not an established economic sector in Koothattukulam but, there is a scope to improve healthcare tourism sector in Town. There is a scope to develop ayurvedic treatment centre by utilizing the existing benefits and providing more facilities, which will fetch more tourists as there are people coming to Kerala for rejuvenation and treatment through ayurveda.

5.4 AGRICULTURE

As per current land use survey nearly 73.12% of the total land area of the Town is coming under agricultural use. The overall functional character of the Town shows rural character with few wards urban & semi urban in nature. This indicates that agriculture and allied activities has a major role in the economy of the Town.

5.4.1 Agricultural land use

Agriculture is found to be the major economic activity in Koothattukulam. Rubber, Pineapple, Coconut, Banana, Paddy are the major crops being cultivated. Other crops include nutmeg, cocoa, vegetables etc.

As per the land use survey 2016, only 129.36 hectares land, which is 5.5 % of the total area is wet land and 60 ha paddy cultivation is present. But as per "Koothattukulam grama panchayath vikasana report, 1996" the total paddy land was 325ha in which 201 ha paddy cultivation was present, and 102ha was unused agriculture lands. This shows a reduction of 60.19% in total paddy land use and 70.14% reduction in paddy cultivation. Wet agriculture is concentrated more towards the valley region and plantation crops are concentrated towards the higher altitudes.

As per the land use survey 2016, dry agriculture land dominates in the Town and consists of 1565 ha of land which is 67.54% of total Town area. The terrain, soil fertility and water availability are the basic factors which decide on the concentration of different types of crops and their location in the Town area. Area occupied by rubber is 1168 ha which is 70% of the total cropped area. This is followed by other dry cultivation of 397 ha which includes vegetables, tapioca, banana, nutmeg and similar crops. The topography, soil and climate of the Town are more suitable for cultivation of rubber and other dry agriculture.

5.4.2 Spatial distribution

The main agricultural area, plantations are seen distributed throughout the Town. Plantations are more concentrated towards the Western side of the Town area. Figure 5-8 shows the spatial distribution of wet agriculture areas and Figure 5-9 shows distribution of dry agriculture in the Town. Paddy cultivation is distributed in 10 wards of the Town.

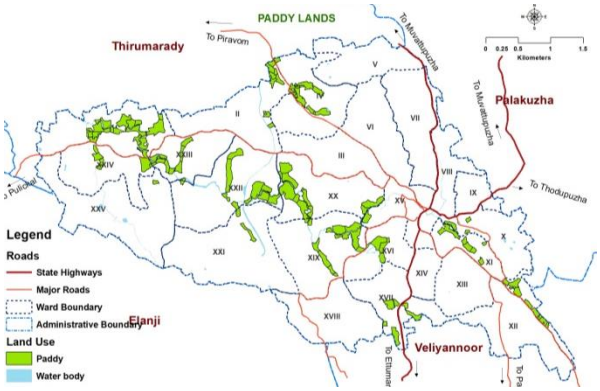


Figure 5-8 : Spatial distribution of wet agriculture areas

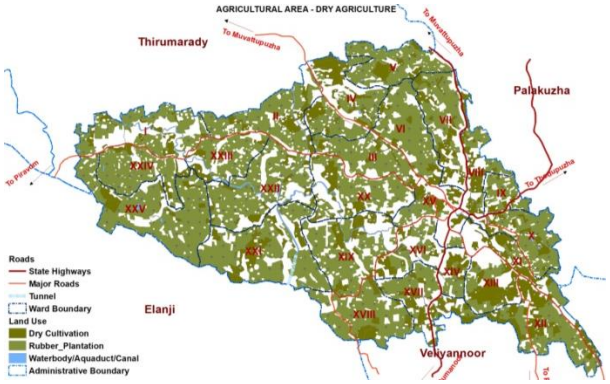


Figure 5-9 : Spatial distribution of dry agriculture

5.4.3 Concentration of agriculture land use

The agriculture area is distributed in almost all parts of the Town. In fact it is mixed with other land uses especially the residential area. More concentration of agriculture land is along the west part of the Municipality, where both dry and wet cultivation is practised. Except in Town centre where the commercial land use is concentrated, agriculture area is predominant in all parts of the Town. The concentration pattern of agriculture land use is shown in Figure 5-10.

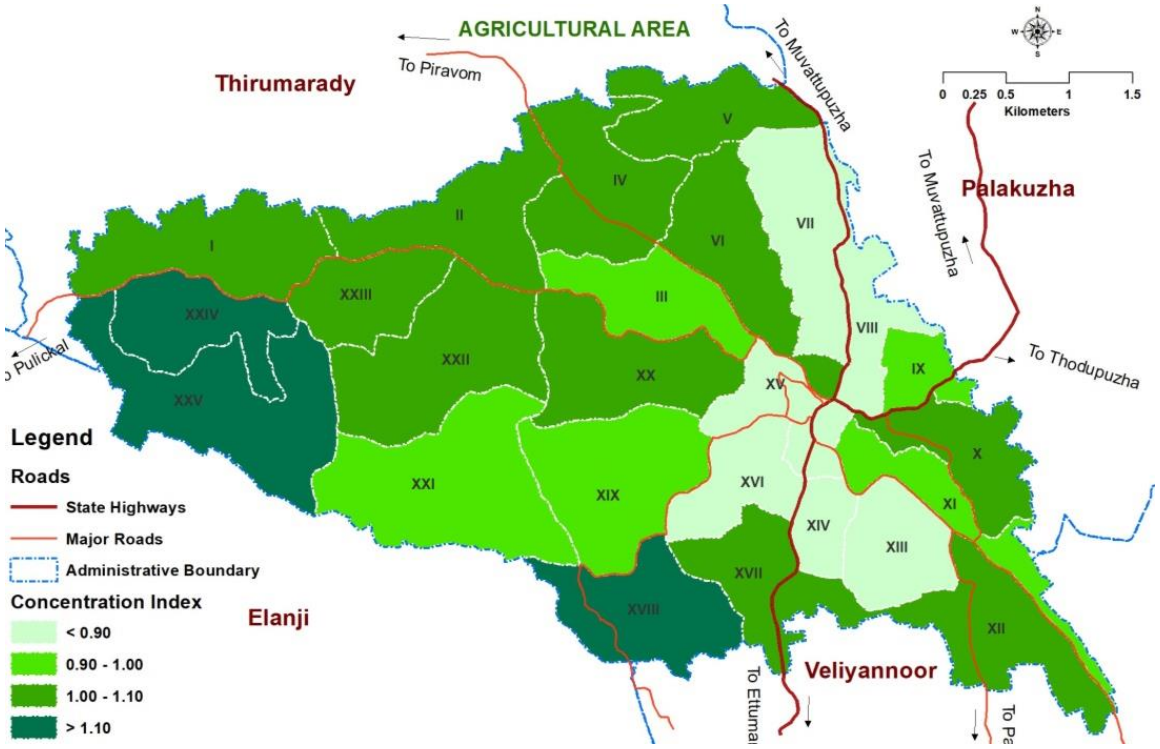


Figure 5-10 : Concentration pattern of agriculture land use in Koothattukulam



Dry agriculture in Koothattukulam

5.4.4 Important Crops and Production Details

Important crops and its production in the Town is shown in table 5-5. From the table it can be observed that rubber, banana and coconut are the major crops in Koothattukulam. Paddy cultivation is marginal as far as area under cultivation of crops is considered. However paddy / low laying land need to be preserved for maintaining environmental balance. Hence a detailed analysis of major crops and paddy is carried out and reported as follows.

Table 5-5 : Details of Important crops and its production in Town

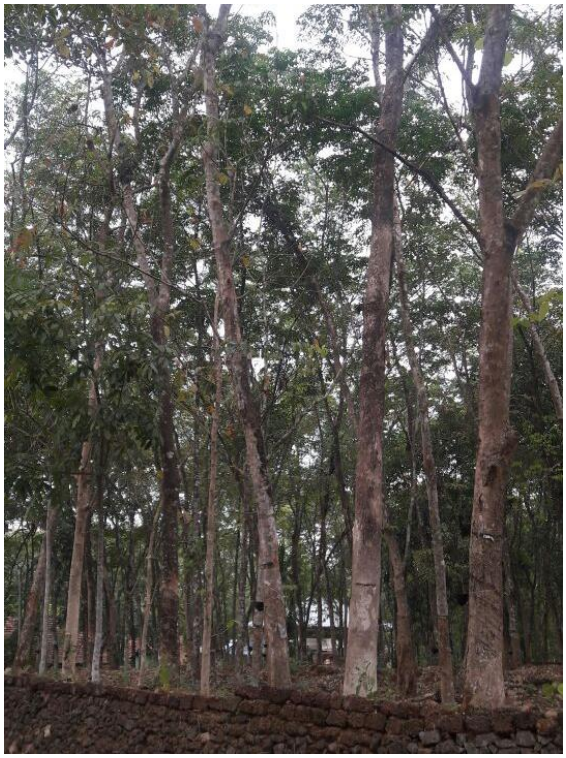
Sl No	Type of crops	Area (Ha)	Production/yr	Productivity
1	Coconut	480	32.2 lakh nuts	6708 nuts/ha
2	Banana	50	1500 Ton	30 Ton/ha
3	Vegetables	25	375 Ton	15 Ton/ha
4	Paddy	60	156 Ton	2.6 Ton/ha
5	Rubber	1050	3150 Ton	3 Ton/ha
6	Pineapple	60	156 Ton	2.6 Ton/ha
7	Pepper	35	70 Ton	2 Ton/ha
8	Nutmeg	35	70 Ton	2 Ton/ha
9	Arecanut	25	200 Ton	8 Ton/ha
10	Ginger	5	90 Ton	18 Ton/ha
11	Turmeric	8	144 Ton	18 Ton/ha
12	Cocoa	28	112 Ton	4 Ton/ha

Source : EARAS 2016

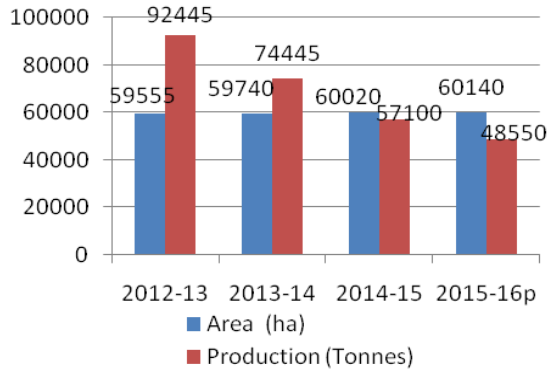
5.4.4.1 Rubber

Kerala has production of 4,38,630 Tonnes of rubber from an area of 5,50,840 hectares of land. Ernakulam District contributes 11% of production from an area of 60,140 which is 10% of total rubber area of state. Analysing the previous years, production is getting reduced while the area of cultivation is same.

Comparing the production and area of cultivation District wise, Ernakulam stands second after Kottayam followed by Pathanamthitta. Figure 5-12 shows the area and production of Rubber over last 5 years in Ernakulam District and Figure 5-13 shows the District wise rubber cultivation in last year. Figure 5-14 shows comparison of area under rubber cultivation of koothattukulam and nearby panchayaths and similar Towns over last 4 years. Rubber is one of the major cash crops in the Town. It is cultivated in almost all the wards of the Town. According to land use survey by Town planning department in 2016, rubber occupies 1168 ha of land area. Out of the 1168 ha, only 1050 ha are mature area which is being tapped. The rubber cultivation increased by 104% from 1996 when there was only 570 ha rubber cultivation in Town. Rubber board is providing assistance for the cultivators in the area with subsidies, incentives and other technical support. There are also sufficient schemes for the survival of the industry. Production in Koothattukulam Town is 3150 T and that of District 48,550 T. The productivity of Rubber is 3000 Kg/Ha which is more than that of District productivity (807 Kg/Ha).

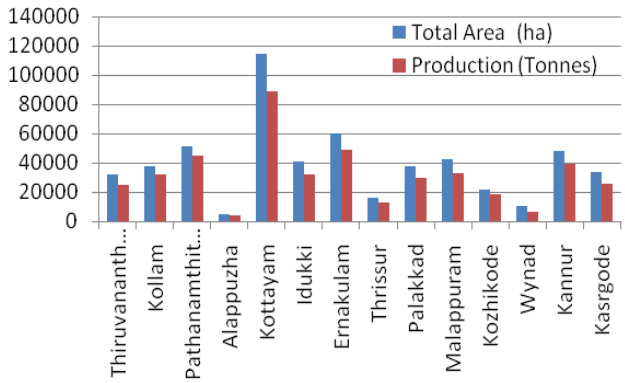


Rubber cultivation



Source : Rubber Board

Figure 5-11 : Area and production of Rubber over years in Ernakulam District



Source : Rubber Board

Figure 5-12 : District wise Rubber cultivation

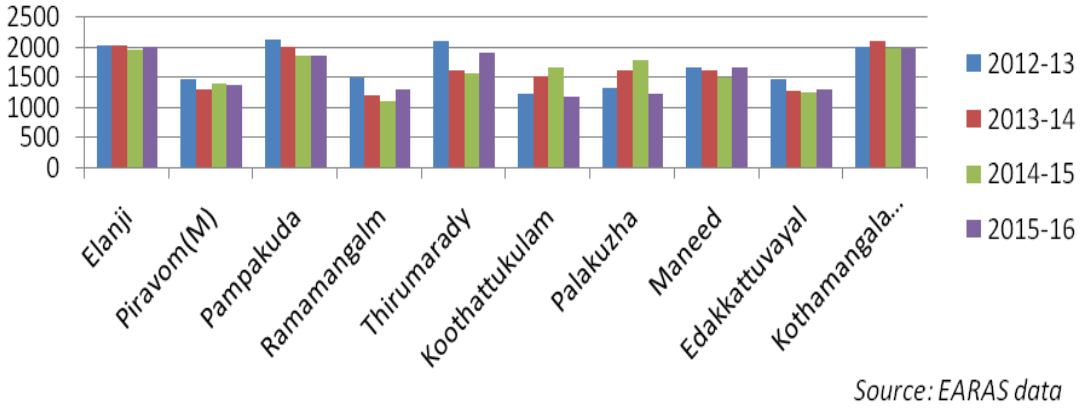


Figure 5-13 : Comparison of area under rubber cultivation

5.4.4.2 Paddy Cultivation

The paddy cultivation is comparatively less in Koothattukulam Town. The figure 5.8. shows the spatial distribution of paddy land. Out of 5950 ha of paddy in Ernakulam District and 129.36 ha in the town, only 60 ha is now cultivated in Koothattukulam Town. Production is 156 Ton and productivity is 2600 Kg/Ha which is high compared to District (2126 Kg/Ha).



Paddy cultivation in Koothattukulam

Paddy is cultivated mainly during the winter season as the mundagan crop as well as virippu in the Muncipality. Group cultivation called padashekharam is practised in Paddy cultivation. Koothattukulam has 4 such padashekharam with its own centres. The details of all

padashekhara samithis and location and current issues to be addressed are shown in Table 5.6.

Table 5-6 : List of Paddy Group farming and locations

Sl. No.	Name of samiti	Ward No:
1	Edayar Padashekhara Samiti	24,1,23
2	Kizhakombu Padashekhara Samiti	12,21,20
3	Perumattom Palathanam padashekhara Samiti	16, 17
4	Town Padashekhara Samiti	19, 20

Source : Koothattukulam Municipality, Agriculture Dept.



Paddy land- uncultivated and used for other agricultural purposes

5.4.4.3 Coconut

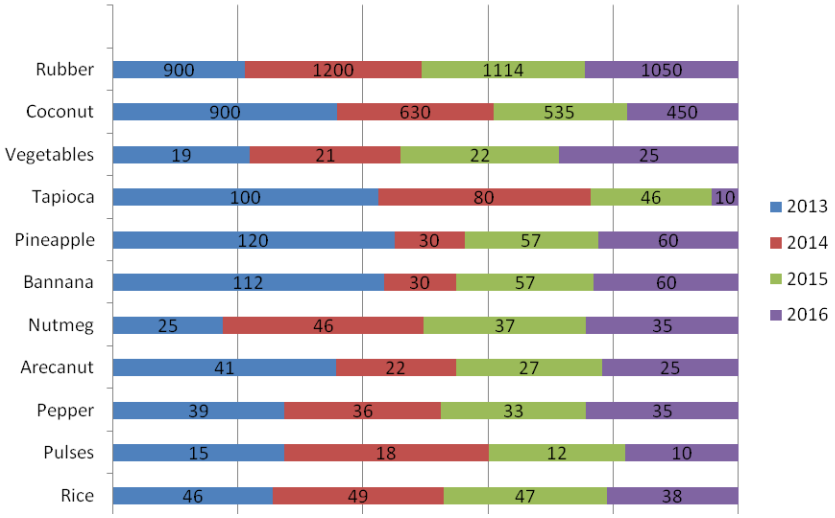
Coconut is the traditional crop of Kerala. Only 480 ha area is used in coconut cultivation, which is 1.15 % of the total coconut cultivated area in the District (41915 ha). Production of coconut in Koothattukulam Town is 32.2 lakh nuts and productivity is 6708 numbers which is higher than that of District production (4485 numbers).

5.4.4.4 Banana

An area of 50 ha is used for banana cultivation in Koothattukulam Town, which is just 1% of the total banana cultivated area in the District (4993 ha). The production of banana in Town is 1500 T and that of District is 46730 T. Productivity of banana is 30,000 Kg/Ha which is much higher than that of District figure (9359 Kg/Ha).

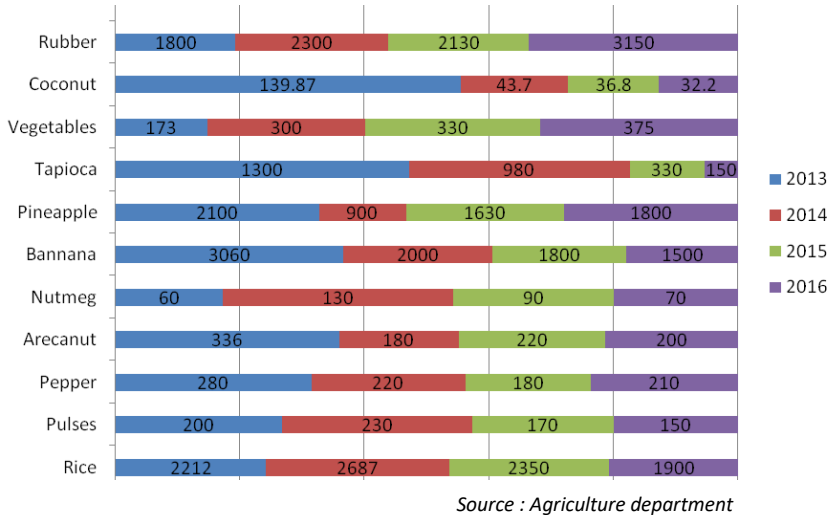
5.4.4.5 **Other Crops**

Analysing the area under cultivation of different crops for the past five years in Koothattukulam Town, it is seen that the area of most of the crops are decreasing and some are stable. This clearly shows agriculture is reducing in the Town. The crop wise area under cultivation for 2013-2016 is shown in Figure 5-15 and crop wise production for 2013-16 is shown in Figure 5-16. Agricultural land area for crops such as vegetables, rice, pineapple and banana has been increased and crops like rubber, cocoa and arecanut are found reducing. The main reason for reduction is low market rate for the crops.



Source : Agriculture department

Figure 5-14 : Crop wise area under cultivation



Source : Agriculture department

Figure 5-15 : crop wise production

5.4.5 Irrigation Facilities

As per Panchayath level statistics 2011, there are 3 ponds with an area of 220 cent, 3 streams out of which 2 are not affected by drought and one irrigation canal in Koothattukulam. Due to the undulating terrain of the region, water available through rainfall drains out to the river at a faster pace. The area also benefits from Muvattupuzha Valley Irrigation Project (MVIP).

Koothattukulam comes under Piravom Division No.4 of the Muvattupuzha Valley Irrigation Project (MVIP). The Left Bank Main Canal starting from Malankara Dam enters the Town at a distance of 28 km and runs through the Town for an approximate length of 10.8 km which have an ayacut area of 580 hectares. Its Koothattukulam distributary has an approximate length of 3725m and the MVIP Koothattukulam lift irrigation together have an ayacut of 540 hectares. The Edayar distributary with a total length of 4.215km ha has length of 2.75km passing through the Town has an ayacut of 225 ha in the Town, which is an ongoing project. The MVIP Koothattukulam lift irrigation scheme is for Koothattukulam Town and Veliyannur panchayath. The other lift irrigation in the Town is the proposed extension of MVIP Palakkuzha lift irrigation scheme.



Pallipady check dam- existing crossbars/ irrigational facilities

The minor irrigation in Koothattukulam consists of one check dam cum bridge of 12m span with two openings with an approximate ayacut of 30 hectares. There are 9 crossbars existing in Town used for irrigation purposes and one crossbar with span of 3m adjoining to chethamba drinking water project as a new proposal. The proposed schemes under Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) include 3 projects one in each year from 2016 to 2019 but these have not happened till now. This includes Karapadavu leading channel near Edayar RPS with an ayacut of 18 ha (2016-17), Kizhakombu- muttumugam chira crossbar and leading channel of an ayacut 10 ha (2017-18) and leading channel at Chettail chira crossbar (Kizhakombu) with an ayacut of 24 ha (2018-19).

5.4.6 Soil Series & Crop Suitability

The soil survey report based on cadastral level mapping published by of Soil Survey Department, Kerala during 2011 classified soils of Koothattukulam into five soil series based on its characteristics. They are Kothamangalam, Mulamthuruthy, Irapuram, Odakkali and Perumbavoor.

Among this two soil series namely Kothamangalam and Mulamthuruthy are wetland soils found in the valley regions of the Municipality. The valley soils are well drained soils with very fine texture. They have brownish colour with moderate to strong acidic nature. As they are located in plain region they are less vulnerable to erosion except the area near the stream side.

The other three series namely Irapuram, Odakkali and Perumbavoor series are garden land soils found in the side slopes and submit regions. The garden land soils of Koothattukulam are brownish to reddish in colour indicating the presence of iron mineral. All the three soils are strongly acidic in nature. The texture extends from gravelly nature to clayey. Even though all these soils are prone to erosion, Perumbavoor series is severely affected with it.

There are soils identified in the converted wet land areas and are grouped separately under miscellaneous soil series. They exhibit heterogeneous character and hence studying it as single unit is not possible.

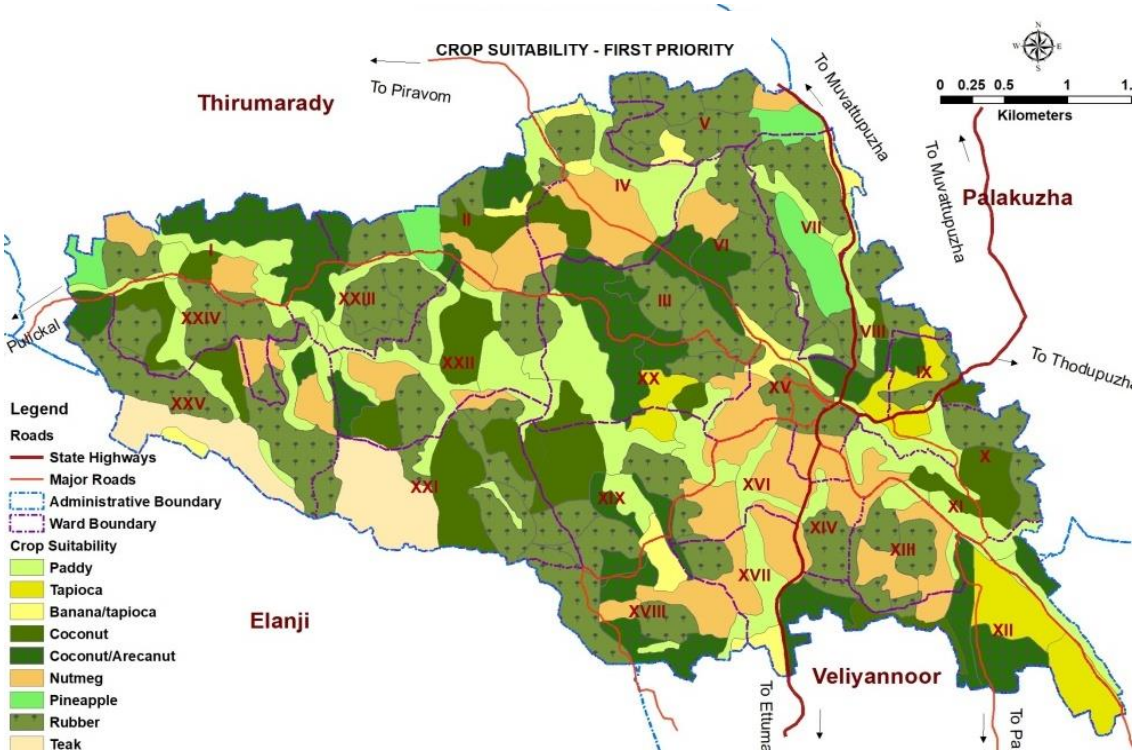


Figure 5-16 : First Priority Crop suitability map based on soil series

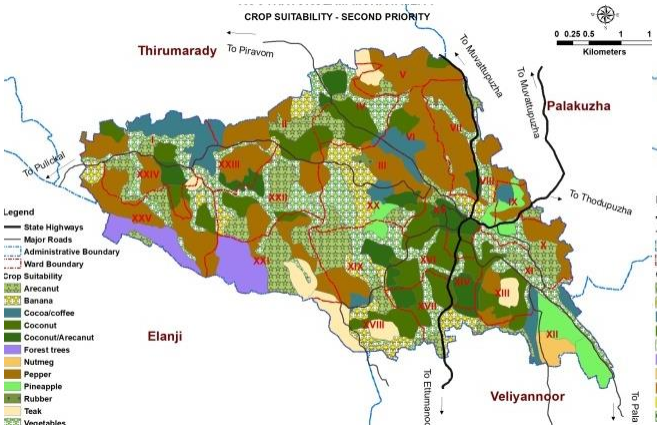


Figure 5-17 : Second Priority Crop suitability map based on soil series

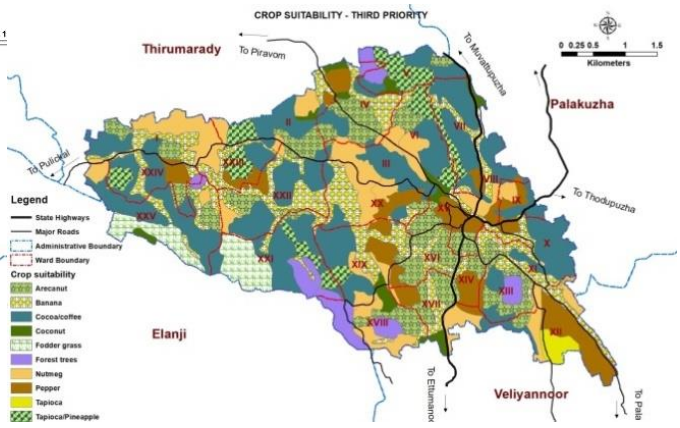


Figure 5-18 : Third Priority Crop suitability map based on soil series

In the Valley regions where soil is more fertile and water availability is more, wet land crops like paddy, banana and tapioca should be given first priority. Vegetables can also be cultivated in a seasonal basis in this region. In the side-slopes the soils support dry crops like Rubber, coconut, and Arecanut. Other than these crops nutmeg, pineapple, pepper, cocoa and coffee are also suitable for this soil. In the hill submits and steep slopes teak and rubber plantation are good option. Forest trees and fodder grass are also suits this regions.

5.4.7 Land Capability

Land Capability is the grouping of one or more individual soil mapping units having similar potentials and continuing limita¬tions or hazards. It is very useful in the assessments of land in terms of agricultural versatility. Sharma H.S (1972), defines, “land capability classification as a field investigation of soil properties, slope, degree of soil erosion and changing Land-use patterns which form the basis for future planning of soil and water conservation”. Based on these factors the capability of a region is divided into different units, sub classes and classes.

‘Capability Unit’ is a grouping of one or more individual soil-mapping units having similar potentials and continuing limitations or hazards. The ‘Capability Sub-Class’ is a grouping of capability units having similar kinds of limitations. ‘Capability classes’ are groups of capability sub-classes or capability units that have the same relative degree of hazard or limitation. Basically there are eight classes of capabilities extending from Class I to Class VIII. Class I is a very good region with no or small limitation. With the progress of Class the quality diminishes and limitation increases.

The subdivisions of capability classes, made on the basis of four dominating limitations, namely, (i) risk of erosion (e), (ii) wetness, drainage or overflow (w), (iii) rooting zone limitations (s), and (iv) climatic limitations (c). The sub-classes are mapped by adding the limitation symbol to the capability class number, e.g., IIe, IIIs, etc. There are no sub-classes in Class I.

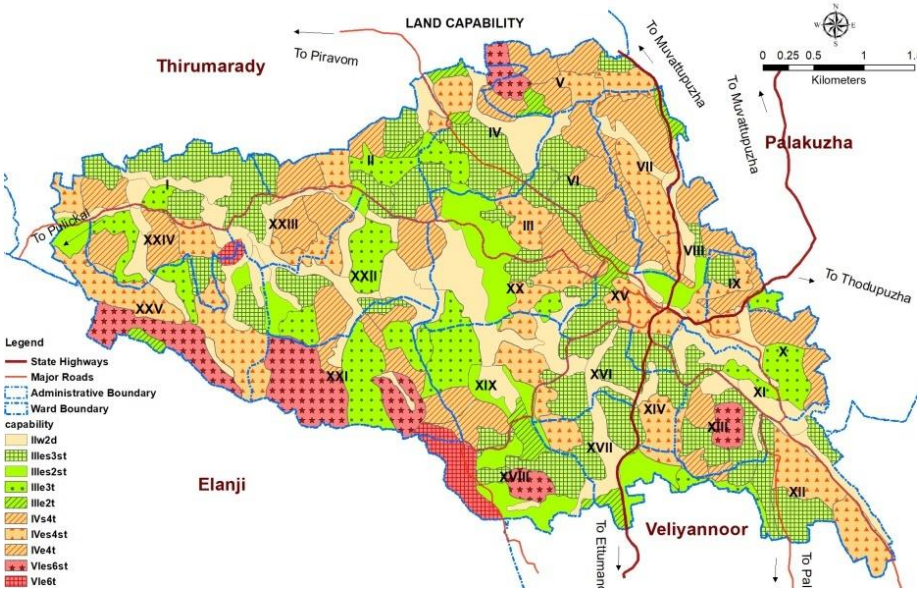


Figure 5-19 : Land capability based on soil

Koothattukulam Town has got moderate land capability regions except the valley region which is good for cultivation. The land capability of Koothattukulam includes Class-II, III, IV and VI. Only 17% of the Koothattukulam comes under land capability II class. These lands are excellent for cultivation, but some limitation is possible, which may restrict the choice of crops to some extent. Soils of this group can be cultivated with easily applied practices, and a majority of crops can be grown. Soils of this group have gentle slopes and are subject to moderate erosion (e). They are also subject to moderate overflows (w). This area can be exclusively used for intensive Agricultural purposes. Areas of Kothamangalam, and Mulamthuruthy soil series comes under the 'Class-II' land capability which shows these areas are good cultivable land with less vulnerability to hazards.

Class III and IV group is moderately good cultivable land but erosional, climatic and topographical limitation is very severe in this region. Class lll occurs in moderate slope while Class IV is seen in moderately steep slope. Area under Irapuram soil series portions of Odakkali and Perumbavoor soil series come under this two capability region. Cultivation of erosion resistant crops and adoption of soil preservation technique can help in improving productivity in these regions.

Class VI group of capability of land have very high restriction of erosion and slope. Suitability of crop is limited to plantation crops. This area due to steep slope characteristics, require crops with minimum tillage. This land is best suitable for forest and grass land. This zone is considered as environmentally fragile zone. Hence large scale construction should be limited. Most of the south-western boundary of Koothattukulam Town comes under this zone.

5.4.8 Problems and Potentials

5.4.8.1 Problems

- Scarcity of labourers and high production cost.
- Difficulty for irrigation and non availability of adequate irrigation facilities.
- Conversion of paddy land into other crops, garden land and residential land and Less productive paddy fields
- Scarcity of rubber tapping labour
- Low return from agricultural produces
- Lack of mechanized facilities and product varieties

- Lack of cold storage facilities and marketing facilities for perishable items

5.4.8.2 Potentials

- Paddy land which is kept fallow can be brought under cultivation by providing adequate irrigation facilities and improving the existing facilities
- Existing paddy can be strictly conserved for paddy cultivation
- Adoption of modern mechanism for the solution of scarcity of labours
- 50.41% of the land is occupied by Rubber plantation and hence revenue and employment opportunities can be increased by promoting Rubber Based Industries
- Possibility of additional revenue from Rubber cultivated land through Apiculture, Intercropping of Banana and Pineapple etc
- Promotion of Organic farming

5.4.9 Inference

Agriculture and allied activities has a major role in the economy of the Town. Rubber, Coconut, Pineapple, Paddy, Banana are the major crops being cultivated. Dry agriculture land dominates in the Town over wet agriculture and agriculture area is distributed in almost all parts of the Town. Rubber is one of the major cash crops in the Town, which is cultivated in almost all the wards. There is less paddy cultivation in Town and a reduction in paddy cultivation due to a shift towards cultivation of garden land crops; but, paddy fields need to be maintained due to its environmental importance and benefits like ground water recharge, natural drainage for flood water, etc. Statistics shows that there is a reduction in agriculture in the Town. Measures to ensure availability of proper Irrigation facilities by improving the existing facilities, ensuring more agricultural labours, mechanisation, etc to all areas can increase the total productivity in agricultural sector.

5.5 ANIMAL HUSBANDRY

5.5.1 Existing Scenario

Cow, buffaloes, hen, dog, goat, pig etc. are the main livestocks in Koothattukulam Town. Livestock population in Town is 5231 as per the municipal data and veterinary department. Total Livestock population of Koothattukulam as per panchayath statistics 2011 which was enumerated in 2007 is 3629. The secondary data obtained from local body on existing population of livestock is as shown in table 5-7.

Table 5-7 : Existing live stocks in Town

Name of Place	Livestock population						
	Cow	Buffalo	Goat	Dog	Pig	Rabbit	Others
Koothattukulam Municipality	1046	138	2074	1182	456	333	Elephant -2

Source : Koothattukulam Municipality

The temporal variation (2007 to 2016) of livestock population of the Town is shown in figure 5.21. It shows a reduction in number of cows and pigs, and a marginal increase in number of buffalos and dogs.

Comparing the livestock population of Koothattukulam and neighbouring Town/ villages in figure 5-22, Koothattukulam contributes 12.5%, 17.74% and 61.6% of the total population of cattle, buffaloes and pigs in the block respectively. It has the highest share for pig population and also third highest in the cattle population

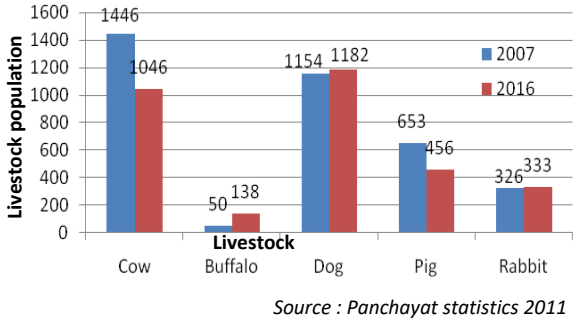


Figure 5-20 : The temporal variation of live stock population of the Town 2007-2016

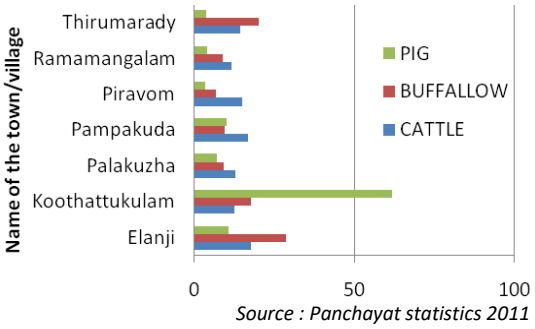


Figure 5-21 : Livestock population in percentage

5.5.2 Production

5.5.2.1 MEAT

No authorized slaughter houses in Town hence details of meat production & monthly consumption are not available, but as per panchayath statistics 2011 there are 2 unauthorised slaughter houses in Koothattukulam. There are 6 pig farms and 10 broiler farms functions in the Town.

Meat products of India limited, Koothattukulam was registered in 1973 under Indian Companies Act (1956) with the objective of establishing an export oriented buffalo meat processing project. The company took over the Bacon factory under the Animal Husbandry Department and started functioning in 1976. The company started its diversification in the

field of beef apart from its original scheme of processing of pigs, poultry, goat, rabbit, quail etc. At present the Company is producing meat products derived from pork, cattle, buffaloes, poultry, rabbit, quail etc. Recently, the Company has developed a pet food, Meat Ind's Dog Chow. The company is processing only less than 1% of meat consumed in the State. For reducing power consumption and for treating waste, Biogas plant is constructed in the Edayar site of MPI.

Its activities include:

- Production of meat and meat products (240 MT per year).
- Production and supply of feed to poultry and pig farms of Kerala State Animal Husbandry Dept.
- Training to students in food processing and farm management
- Production of pet foods
- Maintaining piggery, poultry and rabbitry at the campus
- Production of feather meal, bone meal, meat cum bone meal, lard, tallow
- Distribution of piglets and rabbits to farmers under buy back scheme.

The low residential density in majority of wards and availability of large extent of agriculture land are additional potentials of the Town to promote livestock activities and promotion of farms

5.5.2.2 DAIRY

There are six dairy Farms with a total of 88 cattle in Koothattukulam Town and their production in total is about 607 litres per day. Details of Dairy farms and co-operative societies are shown in table 5-8. Apart from these, 12 other individual dairy farm functions in the Town limits.

Table 5-8 : Details of Dairy farms in Town

Sl.No.	Location	No. of milking animals	Daily production of milk (in litres/day)
1	Sreedhareeyam	40	310 l/day
2	Edayar	12	55 l/day
3	Koothattukulam Milk Co-operative society	11	55 l/day
4	Koothattukulam Milk Co-operative society	10	72 l/day
5	Koothattukulam Milk Co-operative society	7	55 l/day
6	Koothattukulam Milk Co-operative society	8	60 l/day

Source : Koothattukulam Municipality, Dairy Dept.

There are three outlet and collection centers in Koothattukulam Municipality and average quantity collected from these three centres is 47000 litres per month. Details are shown in table 5-9. There is no hatchery in Town. One Govt. Veterinary Hospital with one doctor located at ward no. 15.

Table 5-9 : Details of Milk co-operative societies

Sl.No	Name of Unit	Location	Quantity
1	Edayar Milk Co-operative society	Edayar	3000 ltr/month
2	Kizhakkomb milma centre	Kizhakkomb	22000 ltr/month
3	Koothattukulam Milk Co-operative society	Koothattukulam	22000 ltr/month

Source : Koothattukulam Municipality, Dairy Dept.

Annual growth in milk production of the co-operative societies is as shown in the table 5.10. 75% of the productions from Kizhakombu and Edayar cooperative society are sold to milma whereas only 5% of production is sold from Koothattulam co-operative society

Table 5-10 : Annual growth in milk production of the co-operative societies

Sl. No.	Year	Kizhakkombu milma centre	Edayar milk- co-operative society	Koothattukulam milk co-operative society
1	2011-12	271000	190160	184523
2	2012-13	226000	242006	231776
3	2013-14	244300	244259	199967
4	2014-15	244000	279815	226925
5	2015-16	249000	341898	288185

Source : Koothattukulam Municipality, Dairy Dept.

5.5.3 Problems and Potentials

5.5.3.1 PROBLEMS

Increasing feed cost results in cattle rearing a non profitable activity for small scale unorganized farmers. Conversion of agricultural land and reduced plot size reduced the availability of fodder. Moreover production expenses do not go with market prices in the sector of milk production.

5.5.3.2 POTENTIALS

Animal husbandry sector has more potential in the regions like Koothattukulam in Ernakulam District. Presence of veterinary hospital / clinics increases the potential for animal husbandry. Availability of six milk societies also enhances the potentiality of this sector. MPI plays a very important role in animal husbandry sector in Koothattukulam.

5.5.4 Fisheries

The Municipality has no worth-mentioning history in the area of pisciculture due to lack of any back waters, rivers or coastal area. At present there is no production of fish within Town. However there are various canals and small ponds in the Town in which varieties of local fish such as Varaal, Moozhi, Kuruva, Paral etc are naturally grown and available. Inland fishing is the only fishing activity that can be practiced within Town due to the absence of coastline. There is a potential of inland fishing due to the presence of several ponds within the Town.

Farmers use conventional methods and devices such as Kooda, Ottal, Choonda etc for catching the fish from these local ponds. Extensive use of pesticides in the agricultural farm and drop in availability of sources of water has led to almost extinction of local fish deposits and also local fish farming methods. The fish markets existing in Piravom, Moovattupuzha and Vaikom mainly cater to the fish requirements of people in the Town. Even now, fish traders bring fish from these distant places mainly carrying on bicycles or in autorikshaws. However dried fish is available in plenty in the local Koothattukulam weekly market. The decline in local fish production can be overcome by adopting scientific methods of fish farming.

Municipality has got own pond extending an area of nearly 5 ha. Besides this there are number of small ponds attached to the private properties. Today rearing of fresh water fish seeds in small ponds is a profitable venture which can be promoted through the involvement of marginal farmers. Small water holds and domestic ponds can be utilized for the rearing of carp fish seeds through the involvement of local farmers. Seasonal ponds and small water bodies can be surveyed and selected for the purpose. Rotation of crop with fish culture proved to be a prosperous integrated system of faming in which both the culture practices are benefited. The refuse generated from paddy farming can be utilised to practise trench type fish culture by making use of potential Fisheries. Aquaponics which is the combination of aquaculture (raising fish) and hydroponics (the soil-less growing of plants) that grows fish and plants together in one integrated system has come in to practice now a days and this can be promoted in Koothattukulam. The fish waste provides an organic food source for the plants, and the plants naturally filter the water for the fish. Fish is a very tasty

and wholesome food and should be promoted. It will also help to empower the rural economy of the area.

5.6 INFERENCE

Industries have a little role and Agriculture and allied activities plays the major role in the in the economic development of the region. MPI is the only large scale industry functioning in the Town. In addition to MPI there are some small and micro level industries. But the Town has potentials for development of small scale industries utilizing the agriculture produces and rubber based raw materials. The major commercial activities are concentrated along MC road and along the major road corridors at the Town centre. Tourism is not an established economic sector in Town.

Rubber, Coconut, Pineapple, Paddy, Banana are the major crops being cultivated. There is less paddy cultivation in Town and a reduction in paddy cultivation due to a shift towards cultivation of garden land crops. By ensuring proper Irrigation facilities, more agricultural labours, mechanisation etc. to all areas can increase the total productivity in agricultural sector. Animal husbandry sector has more potential to develop as a major sector in the region. The Cattle Market in Town is famous for cattle trade in Kerala. So there is scope to develop it as a market Town by expanding existing markets by providing all the basic infrastructural facilities.

6 TRAFFIC AND TRANSPORTATION

6.1 INTRODUCTION

Road transport is the only mode of transport available in Koothattukulam. Koothattukulam is well connected to different parts of the states through road transport. Other modes of transport such as waterway and railway infrastructure are absent in Koothattukulam region. The nearest railway station is Piravom Road station situated in Velloor grama panchayath of Kottayam District (22km). Cochin International Airport is 50km away from Koothattukulam.

6.2 CHARACTERISTICS OF TRANSPORT NETWORK

6.2.1 Roads

6.2.1.1 Existing Road Networks

Road network of Koothattukulam consists of State Highways, Major District Roads (MDR), Others District Roads (ODR) and Local body roads. State Highway 1, widely known as Main Central Road (MC Road) traversing from Thiruvananthapuram to Angamaly passes through Koothattukulam and is the most important road in Koothattukulam. New State Highway-40 from Alappuzha to Madurai also passes through Koothattukulam Town. State Highway-42 from Kumarakom to Cumbummettu passes through outskirts of Koothattukulam Municipality. Apart from the state Highways mentioned above, several MDRs and ODRs also serve the transport needs of the people.

Major District Roads and Other District Roads and their length in municipal limits are given below:

Major District Roads

i. Koothattukulam- Ramapuram Road (3.9km)

ii. Koothattukulam - Oliyappuram Road(3.8km)

iii. Uzhavoor - Koothattukulam Road (1.6km)

iv. Koothattukulam- Edayar- Piravom Road (6.8km)

v. Koothattukulam - Marika Road via Karamala (0.6km)

vi. Moovattupuzha- Koothattukulam Road via Pandappally (1.3km)

Other District Roads

i. Koothattukulam - Kizhakombu Road (3.1 km)

ii. Mutholapuram-Edayar Road (2.2km)

iii. Kizhakombu-Mutholapuram Road(1.8km)

iv. Vadakara-Chakkalpara Road(4.7km)

v. Paittakkulam-Kukkumassery(1.8km)

vi. Thirumarady-Edayar Road(0.2km)

vii. Mutholapuram - Kizhakombu Road (2.1km)

The above mentioned state highways and major District roads form the primary links of the road network. Other District roads and local roads serve as secondary and tertiary links of the road network. Category wise length of road in Koothattukulam Municipality is shown in Table 6.1 Transport network of Koothattukulam Town is shown in Figure 6.1. and Figure 6.2.

Table 6-1 : Category wise road length in Koothattukulam Municipality

Sl. No.	Road Category	Length of the road in km
I	**PWD Roads**	
1	State Highway	6
2	Major District Roads	16.7
3	Other District Roads	15.9
II	**Municipal Roads**	
4	Concrete Road	1.5
5	Tar Road	57.6
6	Metal Road	1.8
7	Gravel road	35.2
8	Katcha Road	6.3

Source : NATPAC Survey, 2016

6.2.2 Transport Terminal

State owned Kerala State Road Transport Corporation (KSRTC) has a station at Koothattukulam near Central Junction shown in Figure 6.3. As the Town is located on MC Road, ample connectivity is available to all major cities in the state. Private bus stand at Koothattukulam is situated on the side of KSRTC Bus Stand shown in Figure 6.3. Private

buses are operated to District head quarter Ernakulam and other Towns including Thodupuzha, Pala, Ramapuram, Moovattupuzha.

6.2.3 Railways

Railway infrastructure is absent in Koothattukulam and the nearest railway station is Piravom road (22km), but only 12 express trains and 18 passenger/MEMU services halt at this station. Lack of sufficient public transport connectivity between Koothattukulam and Piravom Road station is another intricacy for the people of Koothattukulam. Other nearby railway stations are Kuruppanthara (23km), Kaduthuruthy (24km), Vaikom Road(25km), Ettumanoor (28km) and Kanjiramattom (28km)- but have stops for few number of trains only. Passengers bound to southern parts of the state use Kottayam Railway Station located at a distance of 37km and passengers bound to northern parts of the state use Ernakulam (49km) or Aluva station (50km).

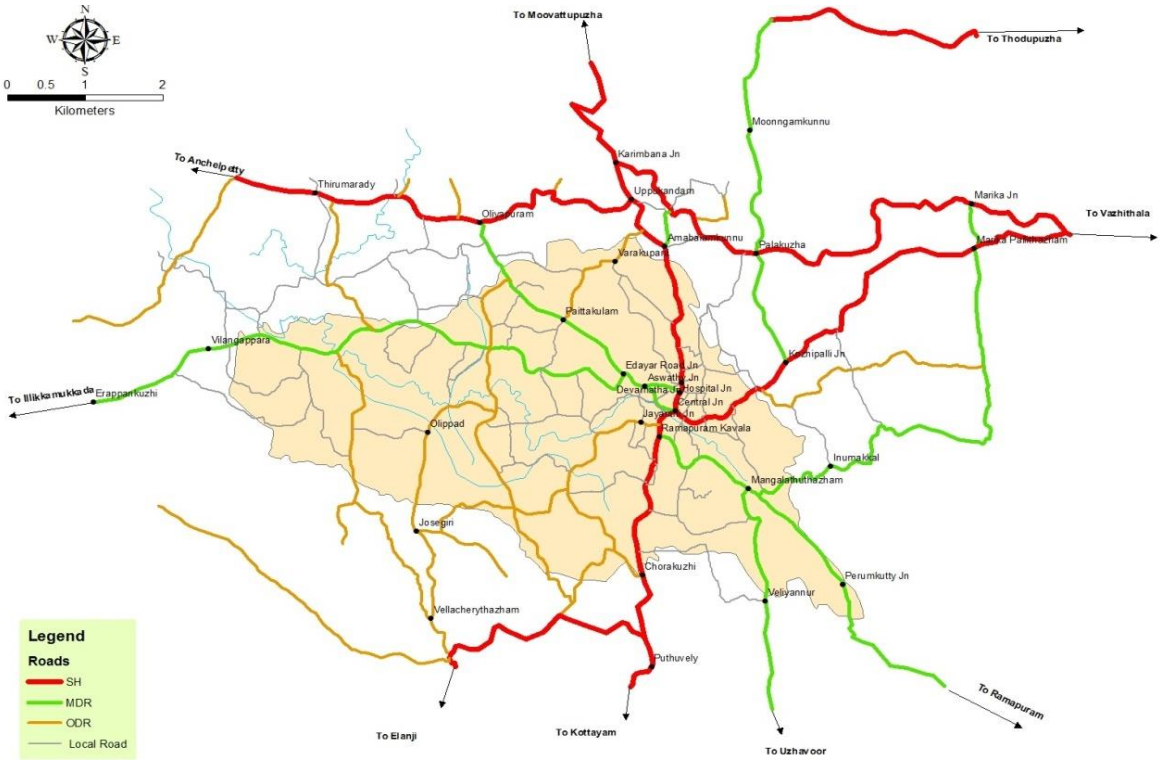


Figure 6-1 : Road Network Map of Koothattukulam Region

6.2.4 Existing Traffic Characteristics

6.2.4.1 Existing Traffic Regulation

In order to avoid traffic congestion in the CBD area, one-way system is adopted in certain stretches of the road. The details of the traffic regulation are given below:

- One-way regulation in Town Link Road (from Keerthi Jn to Aswathy Jn only)
- One-way regulation in Koothattukulam- Oliyappuram Road (from Aswathy Jn to Central Jn only)
- One-way regulation in Nadappuram- Bypass road (from Central Jn to Jayanthi Road only)

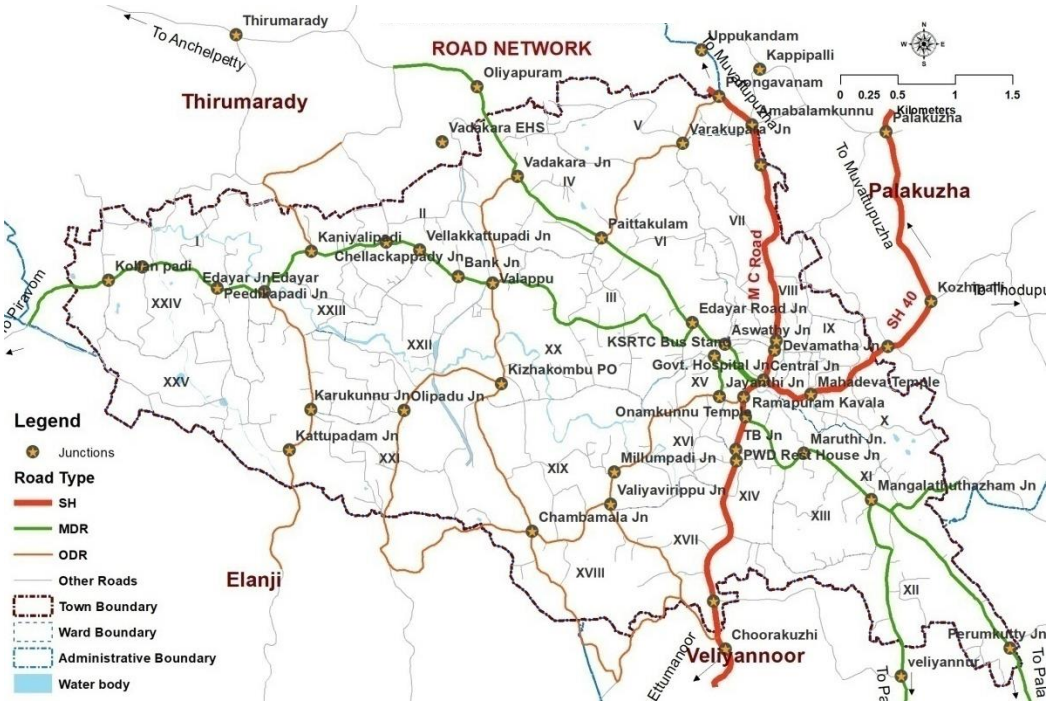


Figure 6-2 : Road Network Map of Koothattukulam Town

6.2.4.2 Major corridors

SH 1, popularly known as MC Road (Main- Central road) is the most preferred road for north- south movement in midland region of the state and is the widely used route to Sabarimala. MC Road pass through Koothattukulam and main activity centers of the Town are spread on either side of MC road. MC road is over utilized even in normal days. Sabarimala bound vehicles which pass through Koothattukulam causes heavy strain on traffic and transportation system of the Town especially on MC Road and Koothattukulam-Ramapuram road. New State Highway-40 from Alappuzha to Madurai also passes through Koothattukulam Town

6.2.5 Public transport operations

6.2.5.1 Bus terminals

Public transport services are run by both KSRTC and private buses in Koothattukulam Town. KSRTC and Private Bus stand in Koothattukulam are situated side by side.

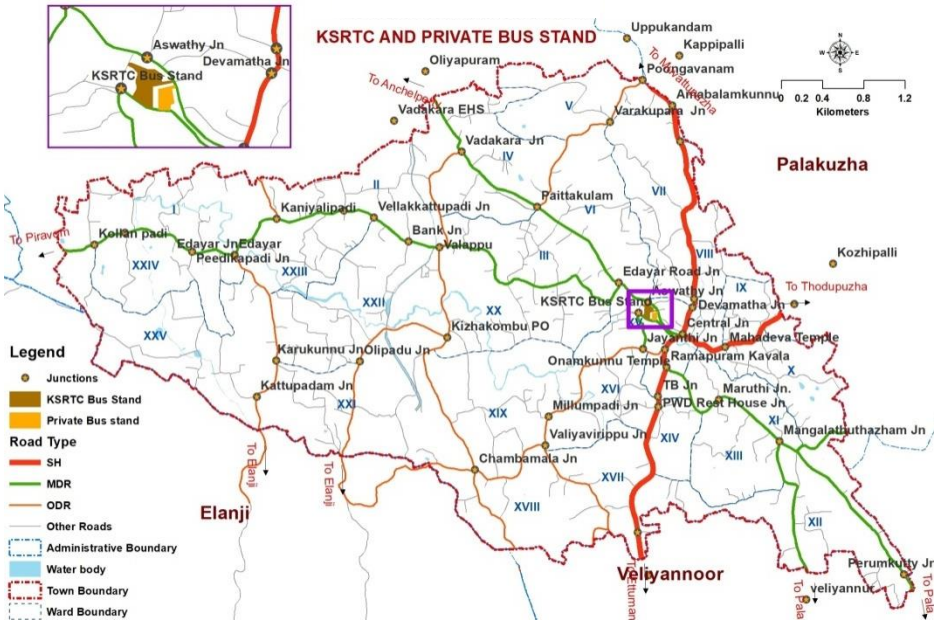


Figure 6-3 : Location of KSRTC and Private Bus stand in Koothattukulam Town

6.2.5.2 Bus operation through Koothattukulam KSRTC stand

Koothattukulam KSRTC bus stand is located on the side of Koothattukulam private bus stand. Buses from Moovattupuzha side enters Koothattukulam bus stand via Koothattukulam Town link road, Jayanthi road and buses from Kottayam side enters bus stand via Nadappuram bypass. As per NATPAC study on Traffic and Transportation in



KSRTC bus stand



Private bus stand

Koothattukulam Town, the data compiled from KSRTC Station at Koothattukulam reveal that 639 trips are operated from/through the KSRTC bus station in Koothattukulam in a day. As MC road passes through Koothattukulam, buses from different depots across the state pass through Koothattukulam KSRTC. Table 6-2 gives the destination wise details of bus operation from/through Koothattukulam KSRTC Bus stand.

Table 6-2 : Bus Operation from/through KSRTC Bus Station Koothattukulam

Sl. No	Destination	Trips/ Day
1	Trivandrum	69
2	Ernakulam	69
3	Vaikom	60
4	Kottayam	59
5	Pala	58
6	Thodupuzha	58
7	Thrissur	49
8	Kozhikode	45
9	Guruvayoor	23
10	Palakkad	21
11	Kottarakkara	19
12	Pathanamthitta	17
13	Munnar	17
14	Sultan Bathery	15
15	Coimbatore	12
16	Perinthalmanna	12
17	Thiruvalla	9
18	Mananthavady	8
19	Kannur	7
20	Kothamangalam	6

Bus boarding and alighting count survey was carried out at KSRTC Bus stand from 15:00 - 17:45 Hrs. Highest hourly boarding and alighting in KSRTC ordinary services were observed during 16:30-17:30 period, the number alighting passengers were 160 and boarding passengers were 307. Highest hourly boarding and alighting in KSRTC Fast Passenger/ Super Fast services are observed during 15:15-16:15 period, the number alighting passengers was 155 and boarding passengers were 136.

6.2.5.3 Bus operation through Koothattukulam Private Bus Stand

The existing private bus stand in Koothattukulam is situated on southern side of Koothattukulam- Oliyappuram road. The bus stand is located in a two-acre plot owned by Koothattukulam Municipality and the Private Buses in Koothattukulam are operated through this private Bus stand located at the heart of the Town.

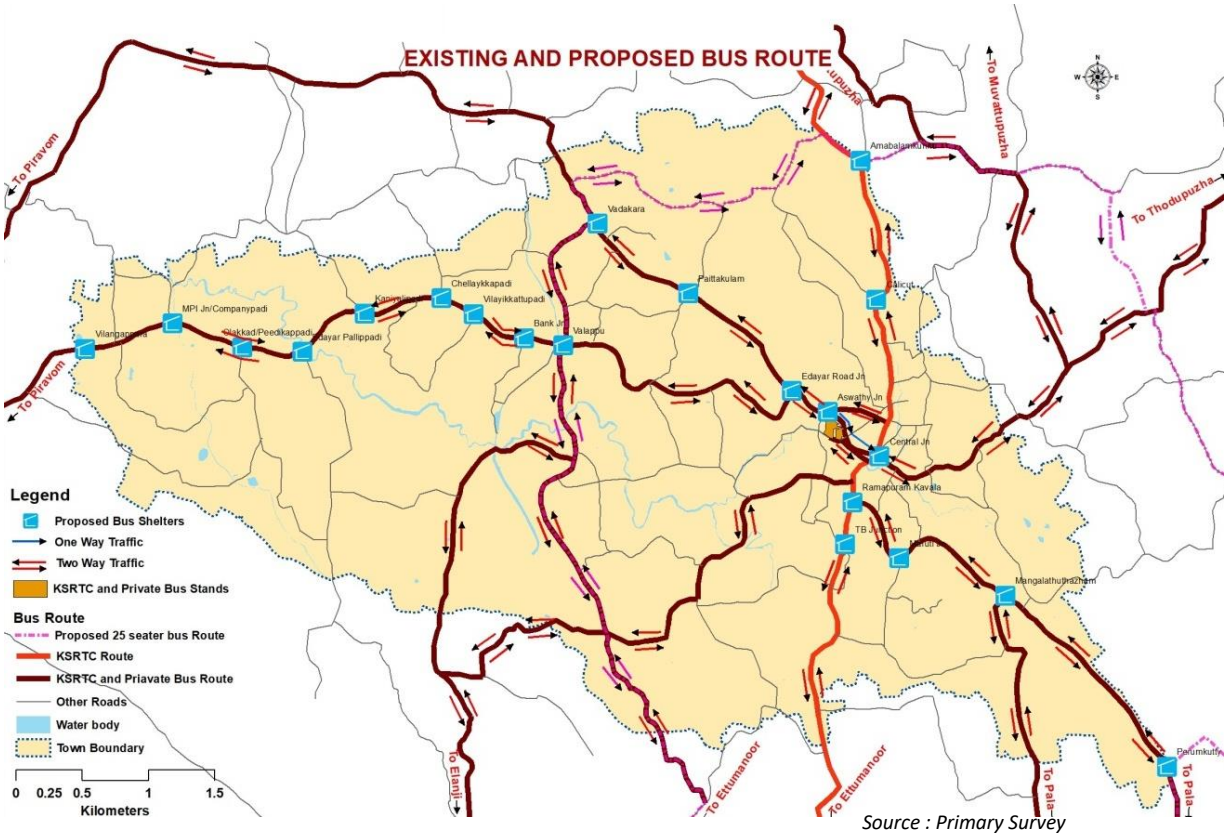
A fleet of 75 buses are operated through Koothattukulam Bus Stand and all together they perform 221 trips in a day. Buses are operated to Towns in Ernakulam, Kottayam and Idukki Districts. The important destinations served by private buses are Ernakulam, Piravom,

Thodupuzha, Ramapuram and Pala. Numbers of buses as well as trips performed to various destinations are given in table 6-3. Major roads in the Town have bus services operating through them. The MC Road is having only KSRTC bus services through it. Some major roads have both KSRTC and private bus service operation through them as shown in figure 6-4.

Table 6-3 : Bus Operation from/through Private Bus Stand Koothattukulam

Sl .No	Route	No of Buses	No. of Trips
1	Koothattukulam - Piravom – Ernakulam	22	35
2	Koothattukulam - Edayar - Piravom – Ernakulam	4	12
3	Koothattukulam - Andichira - Ernakulam	1	2
4	Koothattukulam - Edayar – Piravom	1	6
5	Koothattukulam – Piravom	2	5
6	Koothattukulam - Edayar - Piravom – Kolenchery	1	4
7	Koothattukulam – Edayar	1	1
8	Koothattukulam – Moovattupuzha	3	8
9	Koothattukulam – Thodupuzha	2	5
10	Koothattukulam - Vazhithala – Thodupuzha	1	3
11	Koothattukulam- Moolamattom	1	1
12	Koothattukulam – Bisanvalley	1	1
13	Koothattukulam- Karingunnam	1	1
14	Koothattukulam – Kolenchery	3	10
15	Koothattukulam- Ramamangalam – Kolenchery	2	8
16	Koothattukulam - Ramamangalam – Kolenchery	1	4
17	Koothattukulam - Pambakuda – Kolenchery	3	8
18	Koothattukulam – Pambakuda	1	1
19	Koothattukulam - Ramapuram – Pala	14	55
20	Koothattukulam - Uzhavoor – Pala	5	15
21	Koothattukulam - Puthuvely – Pala	1	4
22	Koothattukulam - Methiri – Pala	1	4
23	Koothattukulam – Vazhakkulam	1	5
24	Koothattukulam - Vazhakkulam – Kothamangalam	1	3
25	Koothattukulam - Kalloorkadu –Kothamangalam	2	5
26	Koothattukulam – Neendapara	1	1
27	Koothattukulam - Kottayam	3	5
28	Koothattukulam - Aluva	2	5
29	Koothattukulam - Vaikom	1	2
30	Koothattukulam - Kanjirapally	1	2
31	Koothattukulam - Pathanamthitta	1	1
32	Koothattukulam - Kumali	1	1
33	Koothattukulam - Mundakkayam	1	1

Source: NATPAC, 2016



Source : Primary Survey

Figure 6-4 : Bus routes in Town

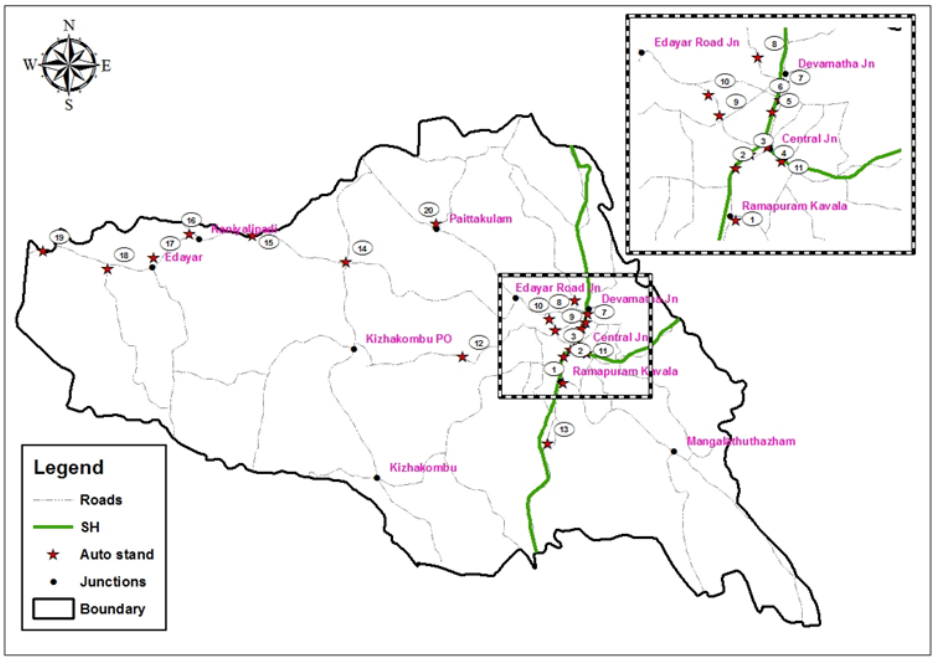
6.2.5.4 Intermediate Transportation Modes in Koothattukulam

Like other medium sized Towns in Kerala, Koothattukulam also has significant number of auto rickshaws serving the needs of intra city travel as well as to neighbouring Panchayaths. Many remote locations in Koothattukulam Town have poor accessibility by public transport and people are forced to depend on these intermediate transportation modes. Location-wise details of passenger auto rickshaws operating in Koothattukulam Municipality are given in figure 6-5.

Some of these auto stands have numerous vehicles parked on it without making any trips for a longer duration. Hence, it is suggested that the number of parking spaces be limited to five in various auto stands especially within the CBD area of Koothattukulam Town and other vehicles shall be parked elsewhere and make it to the stand on demand. A taxi stand is located near Private bus stand and parking is provided for limited vehicles.

Stand for taxi, goods auto rickshaw, jeep, pickup van and mini buses are provided on the side of MC road near Devamatha Junction. This stand is situated in an area of 2,000 sq m

(approximately) and is provided with shelter for taxis and pickup van. A bus shelter is also provided at this location.



Sl. No.	Name of Auto Rickshaw/Taxi Stand	No.of Vehicles
1	Ramapuram Kavala	17
2	People Theatre	30
3	Central Jn	25
4	Front side of Municipality Office	20
5	State bank	30
6	Hospital Junction	14
7	Devamatha Jn	35
8	Devamatha Hospital	5
9	Private Bus stand	40
10	KSRTC Stand	17
11	Co- Operative Hospital	12
12	Sreedhareeyam Hospital	8
13	Bappuji Jn	5
14	Edayar Valappu	13
15	Chelakkapadi	4
16	Kaniyalippadi	5
17	Edayar	8
18	Peedikappadi	5
19	MPI	8
20	Payattakkulam	8
21	**Taxi near Devamatha Jn**	
	Taxi	15
	Goods Auto	16
	Pickup/LCV	7
	Jeep	5
22	Taxi Stand near Private Stand	5

Source : NATPAC, 2016

Figure 6-5 : Location of Auto/Taxi stands in Koothattukulam Town

6.2.6 Traffic Volume- Capacity Studies

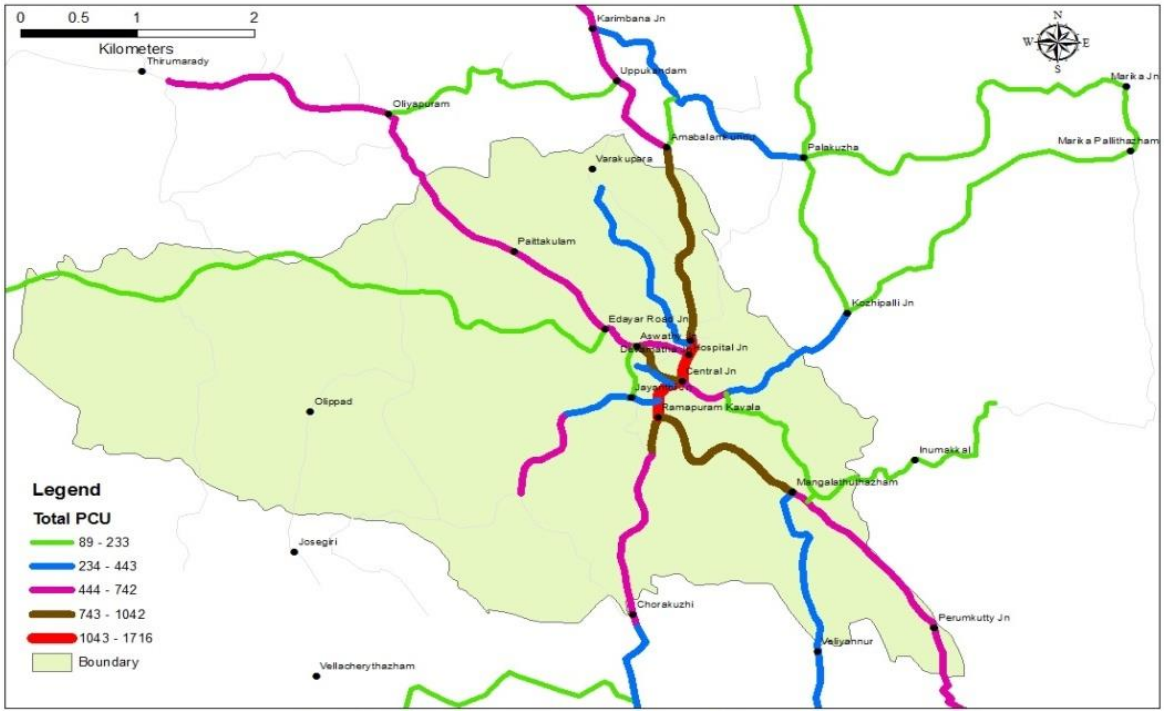
6.2.6.1 Link volume

Link volume survey was conducted at identified mid-block sections by manual traffic volume count classified by the type of vehicle moving in opposite direction. The traffic volume observed at different road stretches were compared with the capacity of road sections, to calculate the volume - capacity ratio (V/C ratio) of different road sections within the study area. The peak hour traffic volume (in PCU) on major roads in Koothattukulam Town is shown in figure 6-6.

6.2.6.2 Capacity Utilization

Capacity utilization of the road stretches was measured by volume-to-capacity ratio (V/C Ratio). It is the ratio of volume of peak hour traffic plying on the road stretch to the capacity of the road stretch. The volume capacity ratio of major roads with in Koothattukulam Town area is given in Table 6.4. It is seen that v/c on MC road from Ramapuram Kavala to Devamatha Jn is greater than 1 in the base year itself. The v/c ratio on the adjoining links on north and south side of the Ramapuram Kavala - Devamatha Jn stretch is greater than 0.8.

Koothattukulam- Kizhakombu road has low capacity due to single lane carriageway there by resulting in v/c value greater than 1. The v/c ratio of roads in Town is shown in figure 6.7.



Source : NATPAC, 2016

Figure 6-6 : Peak hour traffic volume (in PCU) on major roads in Koothattukulam Town

Table 6-4 : Capacity Utilization in Homogeneous sections of Koothattukulam Town

Road No	Road Link	Volume (PCU)	Capacity (PCU)	V/C ratio
1	**SH 1 (Main Central) Road**			
HS01	Puthuvely -Chorakuzhy	**371**	1200	0.31
HS02	Chorakuzhy - TB Jn	**690**	1200	0.58
HS03	TB Jn - Ramapuram Kavala	**966**	1200	0.80
HS04	Ramapuram Kavala - Onamkunnu Temple Jn	**1657**	1200	1.38
HS05	Onamkunnu Temple Jn - Central Jn	**1716**	1200	1.43
HS06	Central Jn - Keerthi Jn	**1565**	1200	1.30
HS07	Keerthi Jn - Devamatha Jn	**1533**	1200	1.28
HS08	Devamatha Jn - Ambalamkunnu	**1042**	1200	0.87
HS09	Ambalamkunnu - Uppukandam	**696**	1200	0.58
HS10	Uppukandam - Aaroor	**708**	1200	0.59
2	**SH 40 (Alappuzha Madurai Highway)**			
HS11	Mutholapuram - Chorakuzhy	**151**	1200	0.13
HS12	Central Jn - Mahadeva Temple Jn	**515**	600	0.86

Road No	Road Link	Volume (PCU)	Capacity (PCU)	V/C ratio
HS13	Mahadeva Temple - Kozhippally	**372**	600	0.62
HS14	Kozhippally - Marika	**195**	200	0.98
3	**SH 42 (Kumarakom - Cumbummettu Highway)**			
HS15	Thirumarady - Oliyappuram	**530**	1200	0.44
HS16	Oliyappuram - Uppukandam	**170**	1200	0.14
HS17	Karimbana - Palakuzha	**300**	1200	0.25
HS18	Palakuzha - Marika	**233**	1200	0.19
4	**Koothattukulam - Oliyappuram Road**			
HS19	Central Jn - Ashwathy Jn	**812**	1400	0.58
HS20	Ashwathy Jn - Edayar Road Kavala	**742**	1200	0.62
HS21	Edayar Road Kavala - Oliyappuram	**592**	1200	0.49
5	**Ramapuram Road**			
HS22	Ramapuram Kavala - Mangalathuthazham	**901**	1200	0.75
HS23	Mangalathuthazham - Ramapuram	**533**	1200	0.44
6	**Moovattupuzha - Pandappally – Koothattukulam**			
HS24	Pandappally- Palakuzha	**225**	600	0.38
HS25	Palakuzha-Kozhippally	**224**	600	0.37
7	**Koothattukulam - Edayar - Piravom Road**			
HS26	Edayar Kavala- MPI	**172**	600	0.29
HS27	MPI- Vilangappara	**167**	600	0.28
8	**Uzhavoor Koothattukulam Road**			
HS28	Veliyannoor - Mangalathuthazham	**443**	1200	0.37
9	**Koothattukulam - Marika Road via Karamala**			
HS29	Mangalathuthazham- Inumakkal	**194**	600	0.32
10	**Koothattukulam - Kizhakombu Road**			
HS30	Onamkunnu Temple - Jayanthi Jn	**308**	200	1.54
HS31	Jayanthi Jn - Kizhakombu	**371**	200	1.86
11	**Other Roads**			
HS32	Keerthi Jn - Aswathy Jn (Oneway)	**602**	600	1.00
HS33	Central Jn - KSRTC (Oneway)	**293**	200	1.47
HS34	Mangalathuthazham - Mahadeva Temple Road	**89**	200	0.44
HS35	Jayanthi Jn - Ashwathy Jn Road	**226**	600	0.38

Road No	Road Link	Volume (PCU)	Capacity (PCU)	V/C ratio
HS36	Devamatha Hospital Road	**268**	200	1.34
HS37	Ambalamkunnu - Kappippally	**144**	1200	0.12

Source: NATPAC, 2016

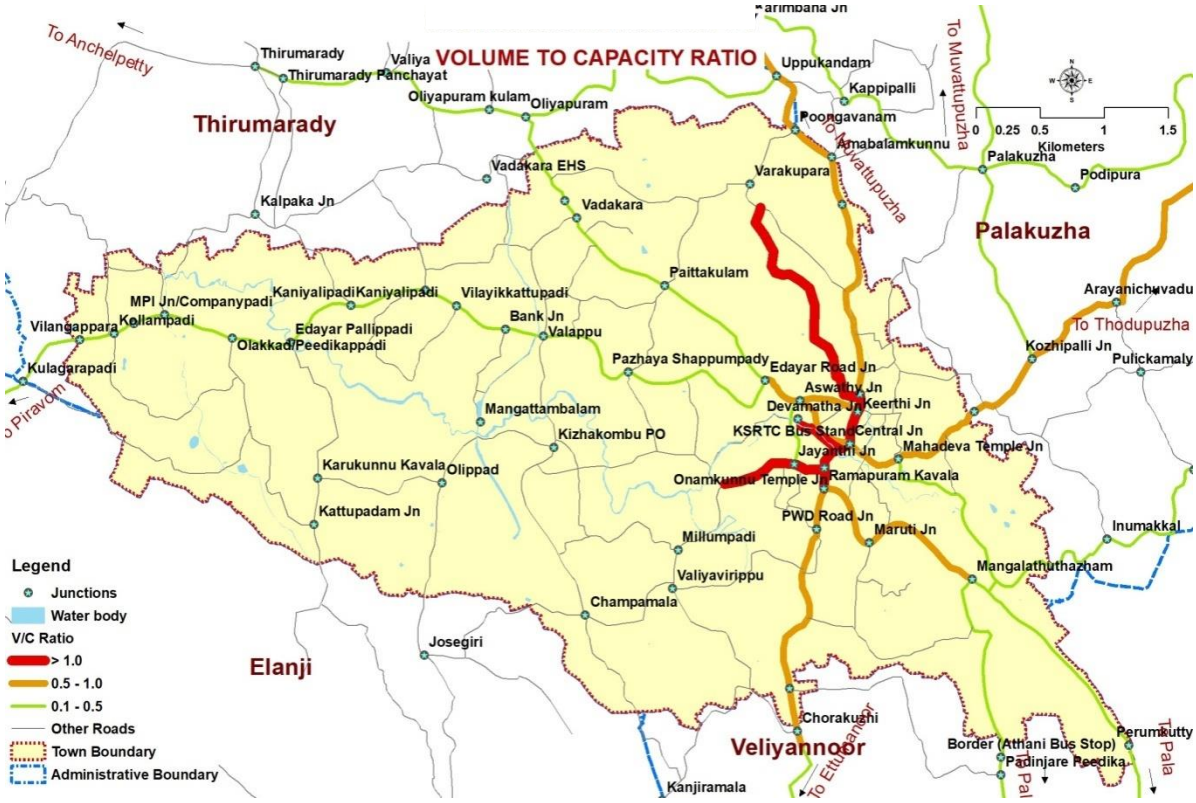


Figure 6-7 : V/C ratio of roads in Koothattukulam

6.2.7 Speed and delay studies

For determining the journey speed, running speed and delay of traffic flow on the road network, speed and delay survey was conducted on all radial roads of Koothattukulam Town. The survey was carried out by moving car observer method during peak and off peak hours of the day. All major arterial roads of 24 km in length were considered for the survey. The results of speed and delay survey on the major roads are shown in Figure 6-8.

6.2.7.1 Average Speed

The average speed during peak hour of all the roads taken together was 23 kmph whereas during off peak hour the value was 27kmph. Minimum average journey speed during peak hour and off peak hour was observed in MC road with values of 19km/h and 26kmph respectively. Maximum average journey speed during peak time was observed on Koothattukulam-Ramapuram Road as well as Uzhavoor- Koothattukulam road with a value

of 29kmph. The stretch of MC road from Substation junction to Ramapuram Kavala is the slowest link in the study area where the journey speed during peak time is only 11kmph. Aswathy Jn - Central Jn (one way) of Koothattukulam- Oliyappuram road is the next slowest link in the study area.

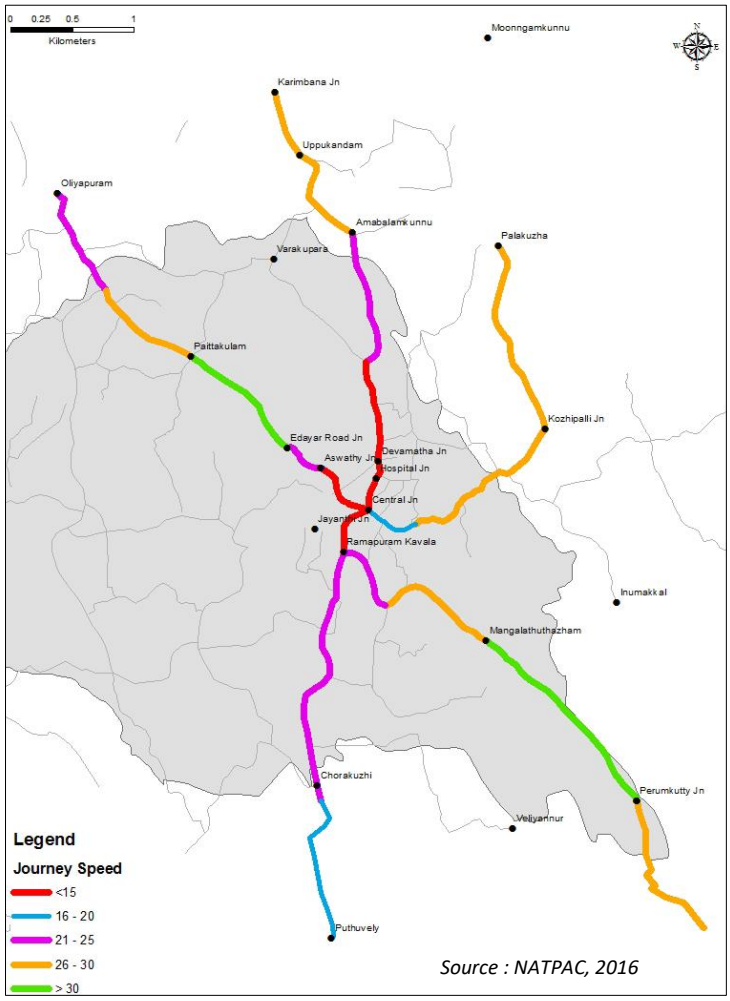


Figure 6-8 : Speed and Delay Characteristics of Koothattukulam Town

6.2.7.2 Cause of Delay

Delays are mainly occurred in Sub Station- Ramapuram Kavala stretch (1.1km) of MC road and Aswathy Jn- Central Jn stretch (0.5km) of Koothattukulam- Oliyappuram road. These stretches are situated in the CBD area of the Town. Commercial establishments of the Town are mostly situated on either side of these two stretches. As far MC road is concerned, there are around 10 side roads originating from the above mentioned 1.1km stretch. Considerable vehicle turning movements occur at these junctions which cause traffic hold ups on the

main road.MC road is being developed under KSTP and construction activities are also causing hindrance to traffic movement.

Koothattukulam Market is situated on Koothattukulam- Oliyappuram road between Central Jn and Aswathy Jn. Vehicles coming to the market are parked haphazardly in this stretch. Exit for buses from KSRTC stand as well as private bus stand are through this road there by resulting in delay for traffic movement.

6.2.8 Turning movement at intersections

The capacity of urban roads to a great extent depends on capacity of intersections. Thus intersections have an important role to play in efficient and smooth traffic flow in the urban network. Turning movement surveys were conducted at 17 major intersections in Koothattukulam Town to ascertain the peak hour demands. The summarized traffic flows in PCU at these 17 intersections are given in table 6.5. It could be seen that Central junction witnessed the maximum peak hour traffic flow of 2331 PCU, followed by 1899 PCU at Keerthi Jn. 1,763 PCU at Ramapuram Kavala, 1743 PCU at Onamkunnu Temple Junction and 1549 PCU at Devamatha Hospital Jn.

Table 6-5 : Summary of Turning Volume Count at Intersections in Koothattukulam

Sl.No.	Name of Intersection	No of arms	Peak time (hours)	Peak Traffic (PCU)
1	Uppukandom Jn	3	3:00 PM-4:00 PM	788
2	Ambalamkunnu Jn	3	11:30 AM-12:30 PM	768
3	Devamatha Hospital Jn	3	3:45 PM-4:45 PM	1549
4	Keerthi Jn	3	11:00 AM-12:00 PM	1899
5	Central Jn	4	5:00 PM-6:00 PM	2331
6	Onamkunnu Temple Jn	3	11:00 AM-12:00 PM	1743
7	Ramapuram Kavala	3	11:00 AM-12:00 PM	1763
8	TB Jn	3	11:45 AM-12:45 PM	1000
9	Vaikom Kavala	3	3:45 PM-4:45 PM	474
10	Aswathy Jn	3	10:45 AM-11:45 AM	976
11	Edayar Road Jn	3	4:30 PM-5:30 PM	759
12	Oliyappuram Jn	3	8:45 AM-9:45 AM	629
13	Mahadeva Temple Jn	3	5:00 PM-6:00 PM	469
14	Kozhippilly Jn	3	8:00 AM-9:00 AM	406
15	Palakuzha Jn	4	3:00 PM-4:00 PM	472

16	Mangalathuthazham Jn	3	8:15 AM-9:15 AM	859
17	Jayanthi Jn	3	5:00 PM-6:00 PM	465

Source: NATPAC, 2016

6.2.9 Pedestrian survey

Provision of pedestrian facilities is very important to ensure the safety of pedestrians who are the most vulnerable among the road users. The pedestrian cross and lateral movements were taken at six major locations in Koothattukulam Town during peak hours. Road stretches selected for pedestrian survey is shown in Figure 6.9. The junctions selected for survey are:

(i) Ramapuram Kavala - Three arms
(ii) Central Jn - Four arms
(iii) Hospital Jn - Three arms
(iv) Devamatha hospital Jn - Two arms
(v) Aswathi Jn – Three arms
(vi) Near KSRTC bustand

The intensity of pedestrian-vehicle conflict represented by PV2 value (where P is the number of pedestrians crossing a link during peak hour and V is the number of vehicles passing through the link during peak hour) was analysed. For a road section with central median refuge, value of PV2 greater than 2x108 and for a road section without central median refuge, PV2 value greater than 108 indicates a higher level of conflict and warrants grade-separated pedestrian facility. It implies that a divided carriageway could be considered to have reduced impact of PV2 value by 50%. Based on the above criterion, the critical locations where pedestrians are in sharp conflict with vehicular traffic have been identified.



Central junction



Ramapuram Kavala

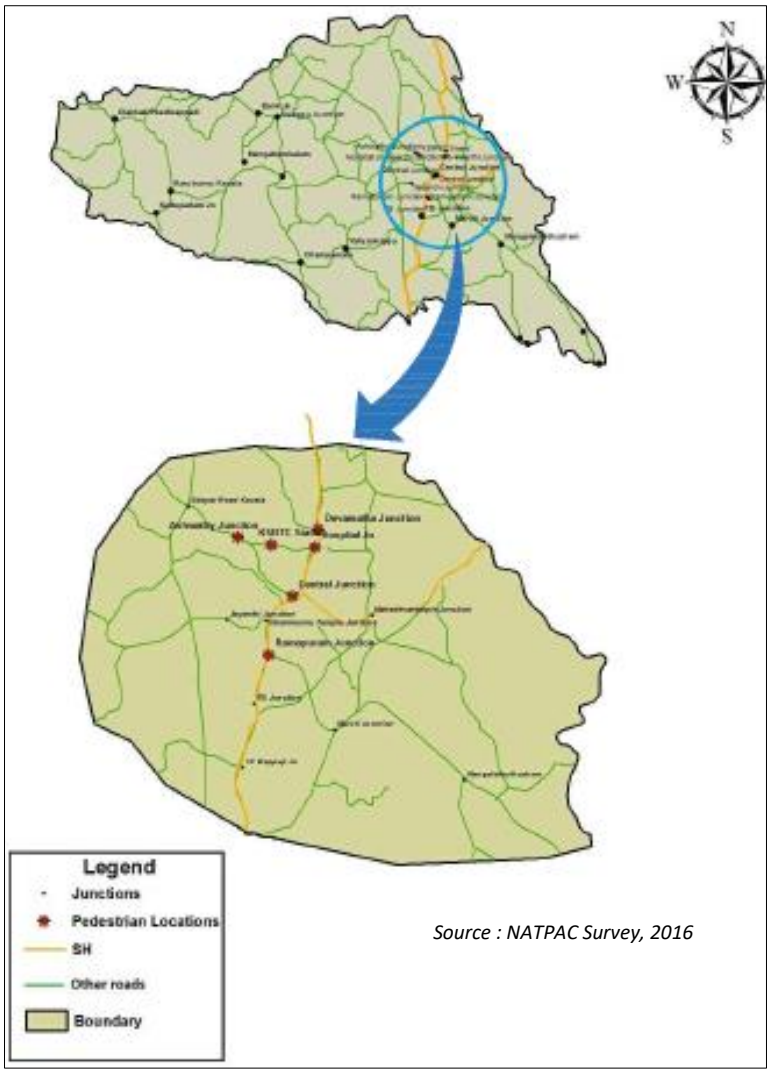


Figure 6-9 : Map showing pedestrian survey locations in Koothattukulam Town

Pedestrian movements in Koothattukulam Town are shown in Table 6.6 and table 6.7. It is evident from Table that PV^2 value exceeds $1x10^8$ at many locations in MC road between Ramapuram Jn and Keerthi Junction. PV^2 values observed on three arms of Central Junction are above the reference range of $1x10^8$. Lateral movements of pedestrian along all the four arms of Central are high except for the SH40 arm.

Table 6-6 : Pedestrian Cross Movements at Major Junctions in Koothattukulam

Sl. no.	Name of location	Peak hour	Name of arm	Pedestrian	Vehicle	Pv^2 (10^8)
1	Rampuram kavala	17.00 - 18.00	Mangalathuthazh am	68	802	0.44
		16.00 - 17.00	Kottayam arm	65	934	0.57
		15.30 - 16.30	Koothattukulam arm	56	1494	**1.25**
2	Central Jn	16.00 - 17.00	Kottayam arm	225	1653	**6.15**

Sl. no.	Name of location	Peak hour	Name of arm	Pedestrian	Vehicle	Pv^2 (10^8)
		15.30 - 16.30	Moovattupuzha arm	169	1444	**3.52**
		16.00 - 17.00	Thodupuzha arm	65	630	0.26
		15.45 - 16.45	Oliyappuram arm	171	818	**1.14**
3	Keerthi Jn	17.00 - 18.00	Moovattupuzha arm	91	1416	**1.82**
		15.15 - 16.15	Aswathy Jn arm	163	571	0.53
		15.15 - 16.15	Central Jn	139	1444	**2.90**
4	Devamatha hospital Jn	10.15 - 11.15	Moovattupuzha arm	29	856	0.21
		10. 00 - 11.00	Devamatha hospital	235	306	0.22
5	Aswathy Jn	14.30 - 5.30	Central Jn arm	132	818	0.88
		14.30 - 15.30	Hospital arm	27	571	0.09
		14.45 - 15.45	Oliyappuram arm	47	811	0.31
6	Near KSRTC Bus Stand	9.45 - 10.45	Mid section between private bus stand & central Jn	35	708	0.18

Source: NATPAC, 2016

Table 6-7 : Pedestrian Lateral Movements in Major Junctions in Koothattukulam

Sl. No.	Name of location	Peak hour	Name of arm	Pedestrian
1	Rampuram kavala	17.00 - 18.00	Mangalathuthazham arm	235
		15.45 - 16.45	Kottayam arm	129
		17.00 - 18.00	Koothattukulam arm	209
2	Central Jn	17.00 - 18.00	Kottayam arm	310
		17.00 - 18.00	Moovattupuzha arm	480
		17.00 - 18.00	Thodupuzha	81
		17.00 - 18.00	Oliyappuram	306
3	Keerthi Jn	17.00 - 18.00	Moovattupuzha arm	357
		17.00 - 18.00	Aswathy Jn arm	136
		17.00 - 18.00	Central Jn	325
4	Devamatha hospital junction	17.00 - 18.00	Moovattupuzha arm	107
		10.15 - 11.15	Devamatha hospital arm	114
5	Aswathy Jn	17.00 - 18.00	Central Jn arm	403
		17.00 - 18.00	Keerthi Jn arm	60
		17.00 - 18.00	Oliyappuram arm	136
6	Near KSRTC Bus Stand	9.45 - 10.45	Mid section b/n private bus stand & central junction	361

Source: NATPAC, 2016

6.2.10 OD Survey

The objective of Origin-destination survey (O-D Survey) is to determine the origin and destination details of through-traffic, inter-city and intra-regional passenger and goods movement across the external cordons. An analysis of the traffic movements will provide the proportion of bye-passable traffic along with the major external interaction areas.

O-D survey was conducted at selected entry/exit points on all the six major roads leading to the study area as shown in figure 6.10. The survey was carried out for a duration ranging from 12 to 24 hours depending on the importance of the road. In a similar way, outside study region was divided into 56 traffic zones, which include 25 zones inside the Koothattukulam municipal boundary and the immediate surrounding areas, adjoining Districts and states. Base year inter-city travel characteristics of passenger and goods movements were obtained by conducting O-D survey of a sample number of motor vehicles passing through major outer cordon locations on roads.

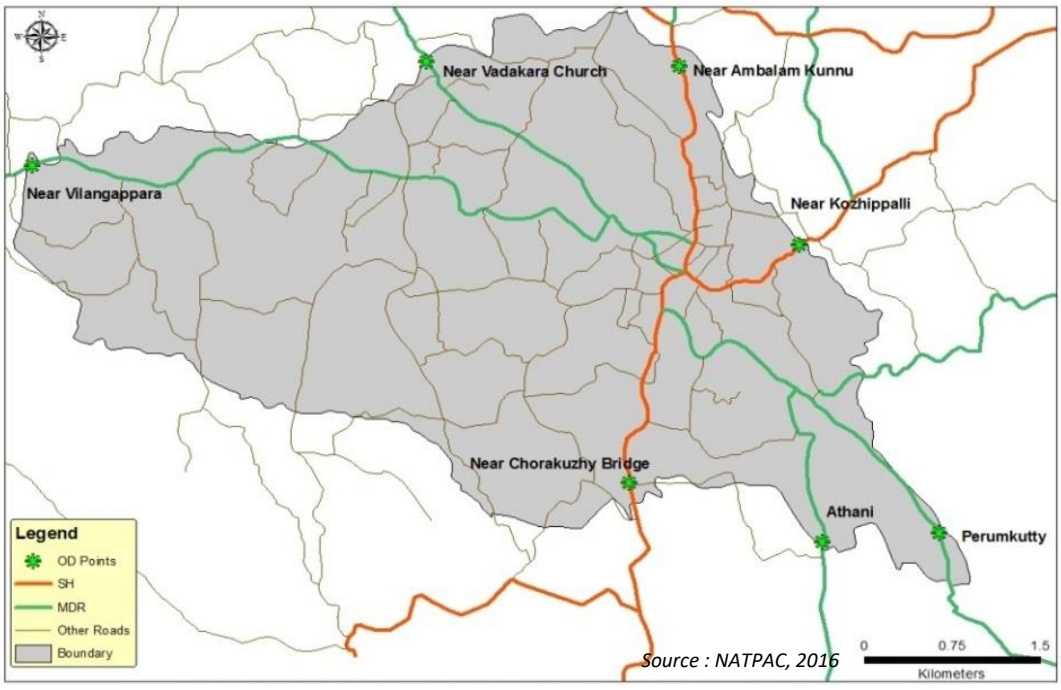


Figure 6-10 : Map showing the location of cordon points in Koothattukulam Town

6.2.10.1 Traffic Volume at Outer Cordon Points

The maximum daily traffic volume of 13,337 PCU was observed at Ambalamkunnu on Koothattukulam – Moovattupuzha Road. This includes 5,853 PCU of inbound traffic and 7,484 PCU of outbound traffic. A daily traffic volume of 8,195 PCU was observed at

Chorakuzhy on Koothattukulam – Kottayam Road. 6,776 PCU of vehicles was found to be traversing through Koothattukulam – Ramapuram Road at Permkutty and a total traffic of 6,189 PCU was found at Uzhavoor – Koothattukulam Road at Athani Bus Stop. On Koothattukulam – Oliyappuram Road, a daily traffic volume of 7,026 PCU was found at Vadakara Church survey location. A total of 5,771 PCU of vehicles were found to have interaction with Koothattukulam Town from Thodupuzha at Kozhipally, followed by 1,472 PCU of vehicles at Vilangappara location on Koothattukulam - Piravom Road.

6.2.10.2 O-D of passenger trips

The O-D pattern of inter-city passenger traffic revealed that out of the 1,11,778 passenger trips, there were 35,393 external - external trips, which constituted 32 per cent of total trips. Similar pattern was observed in external – internal trips, forming 41 per cent of the total trips. Internal – external trips to the Town of 30,886 were performed through the study region which accounted for about 28 per cent of the total trips. Pattern of inter-city passenger trips is presented in table 6.8. Figure 6-11 shows the desire lines showing the intercity passenger movements in Koothattukulam Town. Figure 6-12 represents the modal split of passenger trips in Town

Table 6-8 : Modal split of inter-city daily passenger trips in Koothattukulam Town

Sl. No	Mode	Internal - Internal	Internal - External	External - Internal	External - External	Total	Total vehicle trips (%)
1	Bus	0	18,040	26,820	16,399	61,259	**54.80%**
2	Minibus	0	209	271	433	913	**0.82%**
3	Car	0	4,854	7,547	13,982	26,384	**23.60%**
4	Autorikshaw	0	2,539	3,211	938	6,689	**5.98%**
5	Two Wheeler	0	5,243	7,649	3,641	16,533	**14.79%**
Total passenger trips		**0**	**30,886**	**45,498**	**35,393**	**1,11,778**	**100%**
In percentage		**0%**	**27.63%**	**40.70%**	**31.66%**	**100%**	

Source : NATPAC, 2016

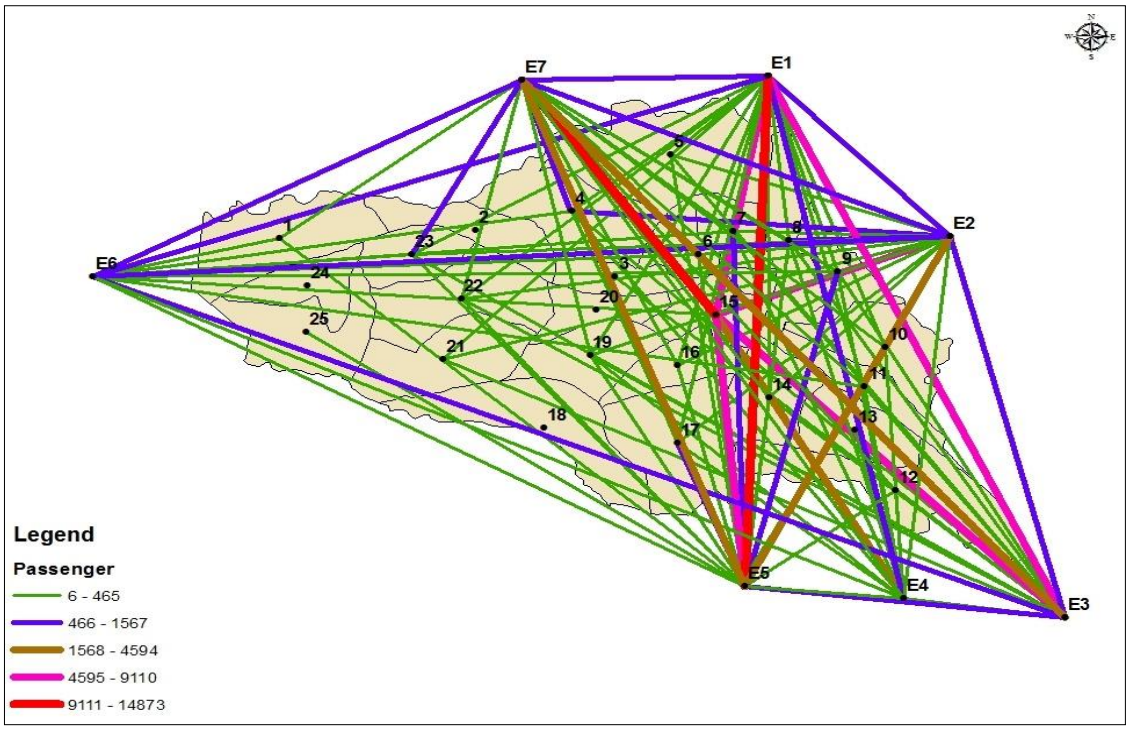


Figure 6-11 : Desire lines showing pattern of intercity passenger trips

In Koothattukulam Town, the inter-city passenger transport is mainly through road based transportation. An analysis of the O-D survey data collected from outer cordon survey locations revealed that an estimated 27,600 inter-city vehicle trips were performed in the study region on a reference day consisting of 10,634 car, van, jeep trips (39 %), 3,458 auto rickshaw trips (13 %), and 11,978 two wheeler trips (43%).

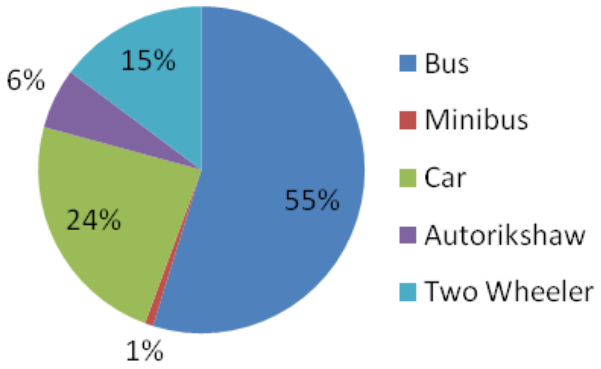


Figure 6-12 : Modal split of inter-city passenger trips in Koothattukulam Town

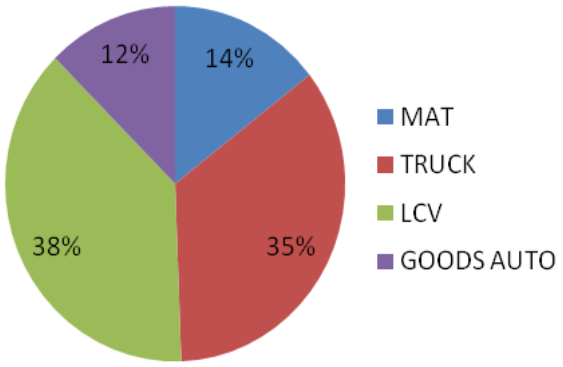


Figure 6-13 : Modal split of inter-city goods vehicle traffic in Koothattukulam Town

6.2.10.3 **O-D of goods transportation**

Intercity goods transportation was arrived at by conducting classified volume counts and road side interview of goods vehicles at outer cordon points. The O-D pattern of inter-city

goods traffic revealed that about 3,508 inter -city vehicle trips were performed by goods traffic in Koothattukulam Town. Table 6.9 shows the inter-city goods vehicular traffic in Koothattukulam Town, figure 6.13shows the same in pie chart. The maximum goods transported from the CBD area to Palakuzha Grama Panchayath area. The desire lines of goods traffic is shown in figure 6-14.

Table 6-9 : Modal Split of Inter – City Goods Vehicle Traffic in Koothattukulam Town

Sl. No.	Mode	Internal - Internal	Internal - External	External - Internal	External - External	Total	Total vehicle trips (%)
1	MAT	0	77	82	349	508	**14.48%**
2	TRUCK	0	221	135	871	1,226	**34.95%**
3	LCV	0	230	335	772	1337	**38.11%**
4	GOODS AUTO	0	164	71	203	437	**12.46%**
Total Vehicles		**0**	**691**	**622**	**2,195**	**3,508**	**100%**
In percentage		**0%**	**19.70%**	**17.73%**	**62.57%**	**100%**	

Source : NATPAC, 2016

A total of 3,508 goods vehicles were found to be involved in carrying goods traffic to and from the study region, consisting of 508 Matador, 1226 trucks, 1337 mini-trucks and 437 goods autos. The O-D pattern of inter-city goods traffic revealed that about 8,813 tonnes of goods were transported through the Town on a reference day. Multi Axial Trucks carried the maximum goods (42%), followed by Trucks carrying 31% of goods and the remaining 27% by mini trucks and Goods Auto.

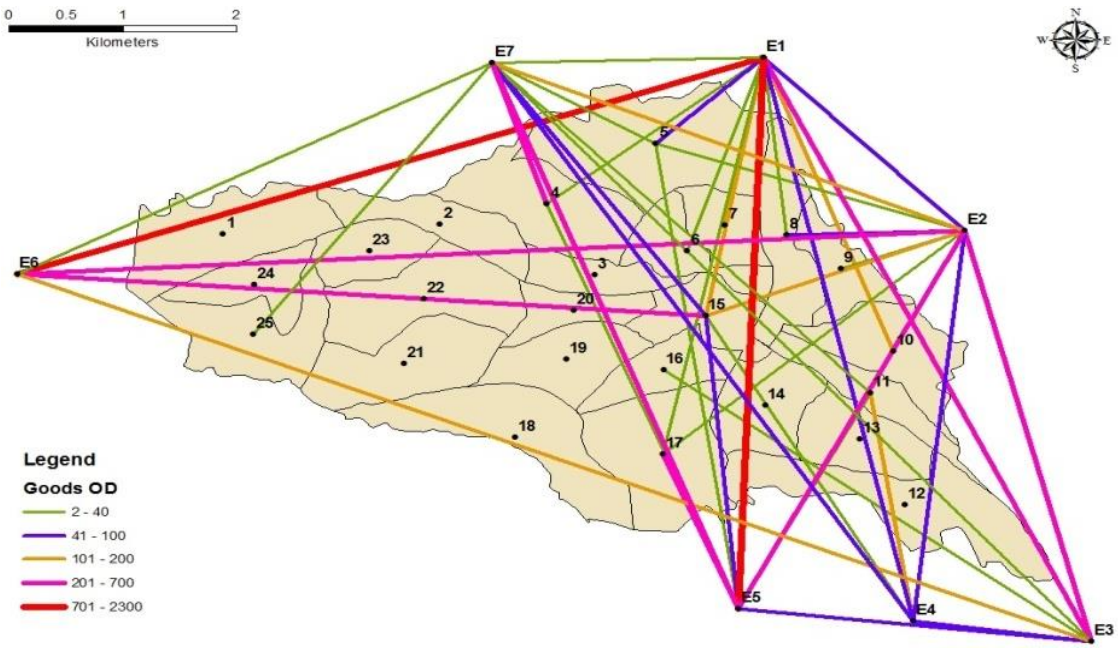


Figure 6-14 : Desire lines showing the intercity goods pattern (in tons)

6.2.11 Parking survey

6.2.11.1 Parking Characteristics

Parking survey was conducted to assess the extent of on-street parking on the road stretches in the study area where significant amount of parking has been observed. A total of nine stretches have been selected for the survey and is given in Figure 6.15. Parking accumulation and parking duration were observed for all the stretches.

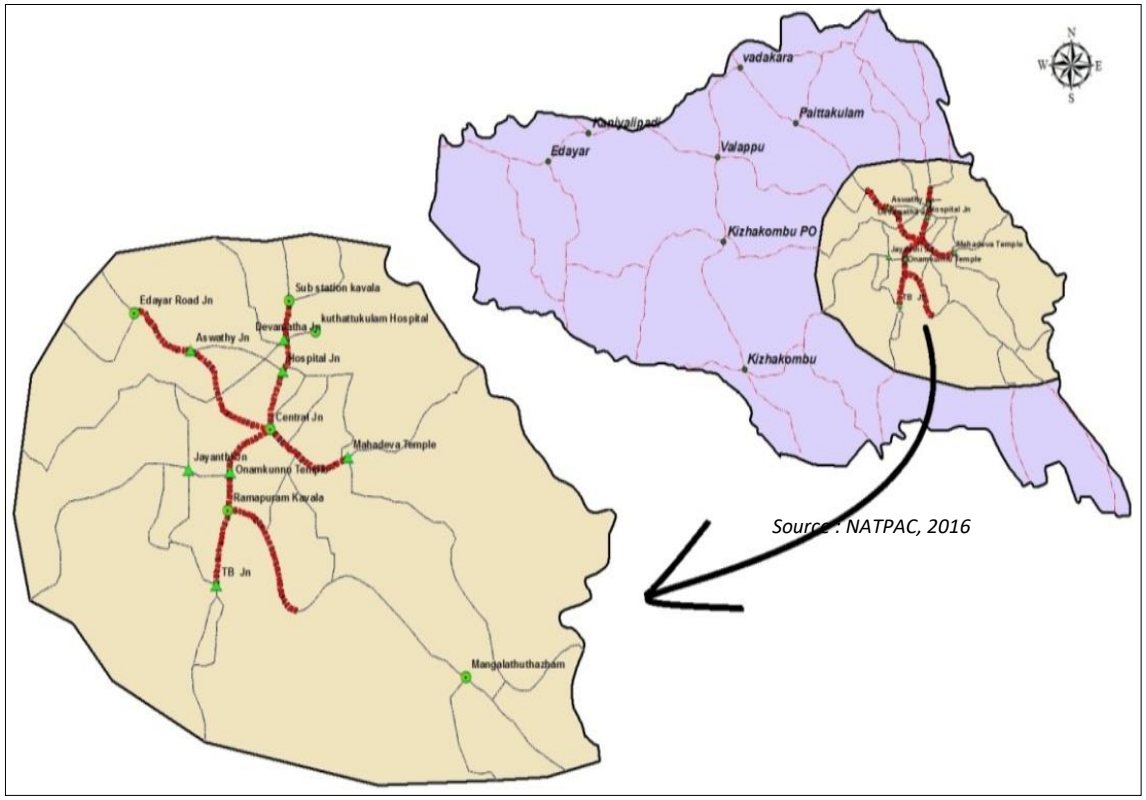


Figure 6-15 : Road Stretches selected for Parking Survey in Koothattukulam Town

Peak parking accumulation observed on various road stretches of Koothattukulam Town is summarized in Table 6.10. It is seen that, of the nine stretches where parking accumulation survey was conducted, parking of vehicles was found to be quite high at the Central Junction to Keerthi Junction stretch of MC Road with 300 vehicles, followed by 218 vehicles at Ramapuram Kavala – Central Junction stretch of MC Road. Parking in private bus stand-central junction stretch is also high due to market and the peak hour accumulation recorded was 170 vehicles at 11:15 AM.

Table 6-10 : Parking accumulation at different road sections in Koothattukulam Town

Sl No	Name of road stretch	Length (km)	Time	Type of vehicles									
				Bus	Mini Bus	Car	Pass auto	Two Wheeler	Truck	Mini-Truck	Goods auto	Total (No)	Total (ECS)
1	TB Jn - Ramapuram Kavala	0.4	10.15AM	2	0	25	1	75	0	1	1	**105**	**51.50**
2	Ramapuram - Central Jn	0.5	11.00AM	0	0	45	27	137	3	4	2	**218**	**108.25**
3	Central –Keerthi Jn	0.4	12.15PM	0	0	135	30	135	0	0	3	**300**	**185.25**
4	Keerthi Jn - Substation Kavala	0.4	9.30AM	0	0	46	8	53	0	2	0	**2**	**109.00**
5	Edayar Kavala - Private bus stand	0.5	10.45AM	0	0	49	9	20	1	1	2	**82**	**63.75**
6	Private Bus Stand Jn - Central Jn	0.3	11.15AM	0	0	85	0	85	0	0	0	**170**	**106.25**
7	Central Junction - Koothattukulam High School	0.4	12.30pm	0	0	30	10	29	0	0	0	**69**	**42.25**
8	Ramapuram Kavala - Maruthi Jn	0.5	12.10PM	0	0	11	14	51	12	1	0	**89**	**62.50**
9	Keerthi Jn - Aswathy Jn	0.45	4.45Pm	0	0	6	4	21	0	0	0	**31**	**13.25**

Source : NATPAC, 2016

6.2.11.2 **Parking Duration**

Detailed analysis of the parking data has indicated that there is no significant variation in terms of duration of parking. At all the nine locations, 64-81 percentages of the vehicles are parked for a short duration of less than 15 minutes. It is estimated that 3-16 percentages of the vehicles are parked for duration of 15-30 minutes. In the following four stretches vehicles are parked for longer duration compared to other.

(i) Central Jn – Keerthi Jn
(ii) Edayar Kavala - Private bus stand
(iii) Private Bus Stand Jn - Central Jn
(iv) Keerthi Jn - Aswathy Jn

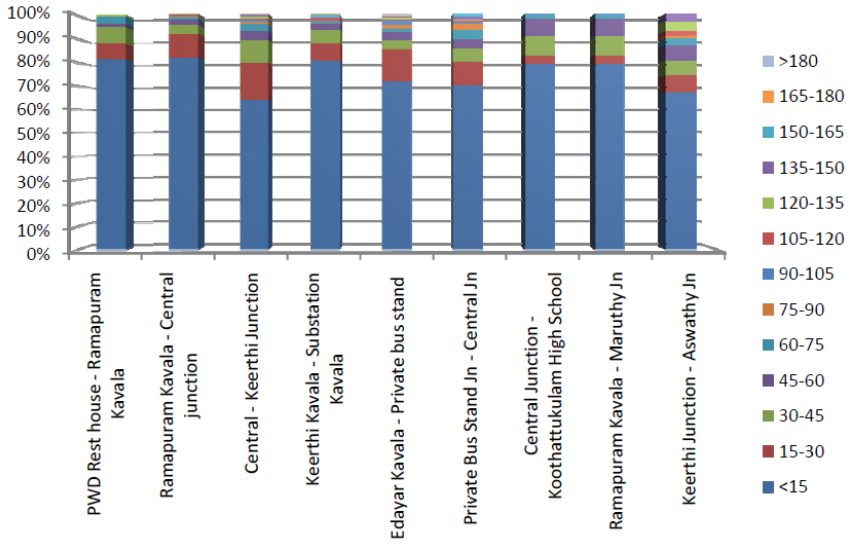


Figure 6-16 : Parking Duration at Various Stretches in Koothattukulam

On – street parking duration analysis shows that 80 percentages of the vehicles are parked for duration less than 45 minutes in all the parking stretches. Parking duration at nine stretches selected for parking study in Koothattukulam is given in Figure 6.16.

6.2.11.3 **Composition of Vehicles**

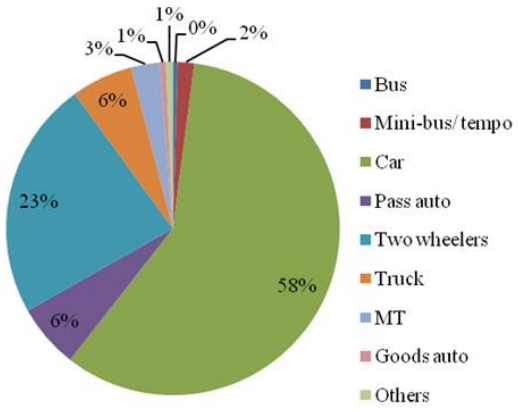


Figure 6-17 : Composition of Parked Vehicles in Koothattukulam

Composition of vehicles parked at all locations in Koothattukulam is shown in Figure 6.17. Two wheelers constituted majority of the total vehicles parked with 23%. Car and auto rickshaw shared 58% and 6% respectively. LCV, Truck, Goods auto and buses constituted a negligible share of the total vehicles parked.

6.2.11.4 **Parking Facilities**

Parking remains to be a major problem in the Town due to non availability of adequate off street parking facility. Parking generally happens along the roads in the market areas. There are three off street pay and parks available near the CBD area and are given below.

i. Near Devamatha Junction
ii. Near KSRTC
iii. Near Co- operative Hospital



Goods / taxi parking near Devamatha jn



Parking near KSRTC

6.3 IDENTIFICATION OF GAPS IN NETWORK

- Intermixing of local traffic with through traffic in the absence of Bypass

MC road is the main arterial road in Koothattukulam Town and it carries considerable traffic in north - south direction. Koothattukulam does not have a bypass for MC road forcing intercity and intra-city traffic to travel through the Town. Considerable amount of Nedumbasserry airport bound traffic from eastern region of Kottayam District such as Ramapuram, Uzhavoor, Pala, Erattupetta etc., and southern parts of Idukki District pass through Koothattukulam via Koothattukulam- Ramapuram and Uzhavoor- Koothattukulam road. These vehicles are also forced to travel through the CBD area as the Town does not have a ring road.

- Unscientific design of intersections.

Intersections are conflict areas in a road system. Intersections in MC road such as Vaikom Kavala, Ramapuram Kavala, Central Junction, Keerthi Junction, Ambalamkunnu, Uppukandam etc are uncontrolled intersections and lack proper channelization. The intersecting arms of Vaikom Kavala, Ambalamkunnu Jn, Jayanthi junction meet at a gradient causing unsafe through movement. Junctions like Central Junction, Aswathy Junction etc., are staggered intersection.



On- Street Parking on various road stretches in Koothattukulam

- Extensive on-street parking of vehicles and allied reduction in road capacity

State highways are considered to be primary roads in any Town ensuring speedy movement of vehicles. Two State Highways pass through Koothattukulam Town and another one passes through outskirts of the Town boundary. The geometry of many stretches of state highways and the intersections are not desirable as per the norms and standards. Inadequate carriageway, absence of adequate sight distance, turning radius, acute angle of intersections, occurrence of dangerous curves including reverse curves etc are some of the problems related to geometry of highways.

- Disorganized On Street Parking

Extensive unorganized parking is present on most of the arterial roads and intensive haphazard parking is visible on MC road, Koothattukulam- Oliyappuram road and SH-40. The illegal on-street parking on either side of TB Jn- Devamatha Jn stretch adds to the severity of congestion on MC road. Similarly intense disorganized parking causes serious traffic problem in Central Jn- Aswathy Jn stretch where Koothattukulam market area is situated. Koothattukulam market attracts huge number of people especially on Wednesdays.



Disorganized On street Parking and lack of pedestrian friendly infrastructure




Absence of pedestrian friendly infrastructure

- Absence of Pedestrian Facilities

The pedestrians are largely ignored in the existing transportation system of the area even though all trips start and end in walking. Like many other similar Towns in Kerala, pedestrian are the most vulnerable road user in Koothattukulam as well. Most of the road stretches in Koothattukulam Town including the MC road lack adequate and continuous footpath. Most of the roads are devoid of footpath and on road stretches where covered drain serves as footpath, encroachment for commercial activities restrict the smooth flow of pedestrian. High number of lateral as well as cross movement of pedestrian is observed during school time at Marymatha School, Keerthi Jn, Central Jn and Koothattukulam market. Segregated walkways and crosswalks are necessary in pedestrian rich areas proximate to schools, bus stands and market.

- Passenger unfriendly Bus stand

In Koothattukulam town, both KSRTC bus stand and private bus stand are situated adgacent to each other. Both these bus stands lack adequate passenger amenities such as waiting area and seats, drinking water and toilets, passenger information system etc. Unhygienic condition of the private bus stand is a matter of public concern and immediate intervention is required.

- Absence of sign boards & road marking,
- Improper location of bus stops and absence of bus bays
- Encroachments by shops and vendors



Unhygienic condition of Private Bus Stand



Passenger unfriendly KSRTC Bus Stand

6.4 INFERENCE

Road transport is the only mode of transport available in Koothattukulam. Koothattukulam is well connected to different parts of the states through road transport. Other modes of transport such as waterway and railway infrastructure is absent in Koothattukulam region. State Highway 1, widely known as main central road (MC Road) traversing from Thiruvananthapuram to Angamaly passes through Koothattukulam and is the most important road in Koothattukulam. New State Highway-40 from Alappuzha to Madurai also passes through Koothattukulam Town. The road inventory shows that majority of roads are with inadequate right of way and carriage way width. The local road network system is needed to be improved. Some roads in Town core area are exceeding its capacity; and congestion exists at the Town centre. The configuration of the road network system of Koothattukulam exhibits radial pattern. The road system has many inadequacies such as poor road geometry, insufficient carriageway width and ROW, nonstandard alignment, poor surface condition etc.

7 WATER SUPPLY

Water supply is a key concern when it comes to the problems of physical infrastructure. It is essential to ensure adequate supply of water in terms of reliability, quality and quantity. A broad augmentation plan to meet the projected requirement is essential. In this chapter the availability of safe drinking water, the source, existing distribution system, treatment facilities and nature of scarcity of water are detailed out.

7.1 SOURCE OF WATER

Water Supply system is majorly depended on ground water. As per socio economic survey, wells are the major source of drinking water in the Planning area. Out of the total households, about 54.86% of households depends their own well for drinking water, 17.46% has individual house connections and depends on KWA water whereas 15.71% of households depends on both well as well as KWA. Public tap, pond and tube wells are the sources of water for the remaining households and it is shown in Figure 7.1.

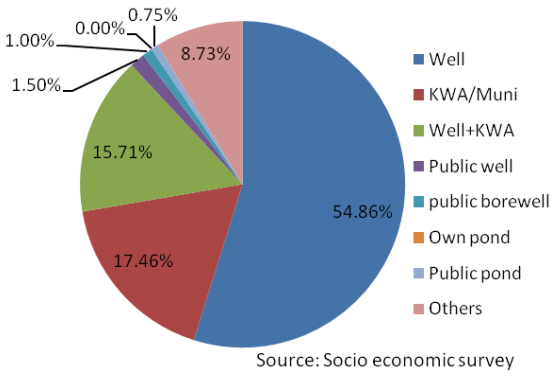


Figure 7-1 : Source of Water

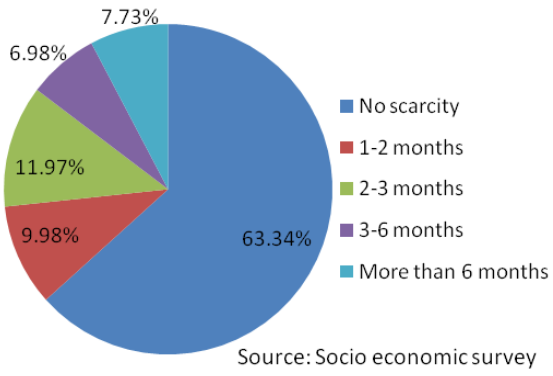


Figure 7-2 : Duration of scarcity

The socio economic survey shows that 91.77 of the houses surveyed have accessibility to the main source of water within their compound, 7.48% of the houses depend on the main water source which is about 50m away from their compound and 0.75% of houses depend on the main source which is 50-100m away from the compound.

7.1.1 Watershed

Watershed based analysis is done in Koothattukulam Town area for understanding the present water security status. A watershed is a hydrologic unit in which water entering inside will drain to a common outlet. Koothattukulam Town is a part of three sub-

watersheds. They are Pinmatom, Mangalathuthazham and Chandhathodu. Only the upper and middle portions of these sub-watersheds are coming within the Town limit. Hence watershed analysis is limited to these areas. Ten morphometric parameters are chosen for current study. Among this five are basic parameters and the other five are derived parameter. They are represented in table 7-1.

Table 7-1 :Basic and Derived morphometric parameters

MORPHOMETRY	
Basic Parameters	
Stream Order	Order of streams from Head stream to major channel
Perimeter(P)	Total length of outer boundary
Area of Basin (A)	Total space occupied by watershed or basin
Number of streams	Total number of streams
Stream Length	Total length of all streams together
Derived Parameters	
Bifurcation ratio	Ratio between given order stream to its higher order
Drainage Density	Ratio between total stream length and total area
Stream Frequency	Number of streams in unit area
Circularity Ratio	Ratio of area between basin and circle having same perimeter
Length of overland flow (Lo)	Area where non-concentrated water flows

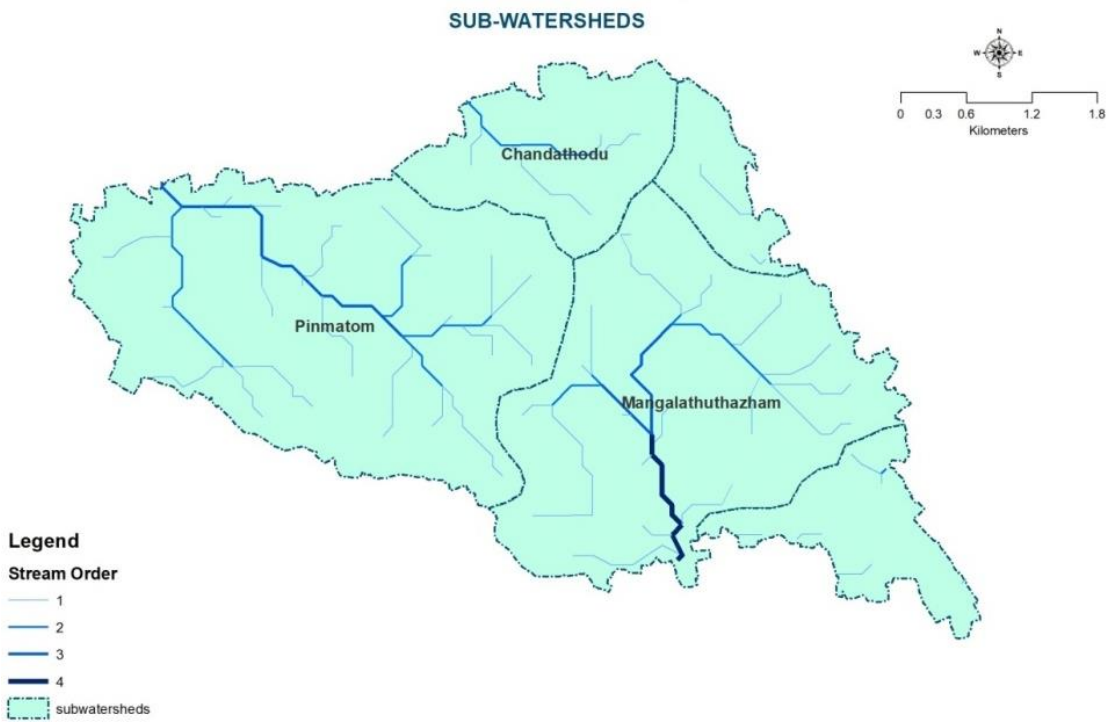


Figure 7-3 : Sub watersheds in Koothattukulam

Table 7-2 : Basic Morphometric parameters of sub watershed in Koothattukulam

BASIC PARAMETERS					
Sub-watershed	Stream Order	Stream Length (km)	Number Of Stream	Area (sq.km)	Perimeter (km)
Pinmatom	3	18.706773	44	9.68	16.21
Mangalathuthazham	4	16.151734	30	8.04	14.65
Chandhathodu	2	3.734312	5	2.75	8.22

Table 7-3 : Derived Morphometric parameters of sub watershed in Koothattukulam

DERIVED PARAMETERS					
Sub-watershed	Drainage Density	Stream Frequency	Circularity Ratio	Mean Bifurcation Ratio	Length of Overland Flow
Pinmatom	**1.15**	**4.55**	**0.46**	**3.17**	**17.33**
Mangalathuthazham	**1.10**	**3.73**	**0.47**	**2.06**	**18.14**
Chandhathodu	**0.45**	**1.82**	**0.51**	**2.00**	**44.02**

7.1.1.1 Pinmatom sub-watershed

Pinmatom sub-watershed is located at the western side of the Municipality. This sub-watershed covers an area of 9.68 sq.km and is the largest one among the three. The basic parameters of the watershed explain that the sub-watershed has a stream number of 44 which include 22 first order stream, 4 second order stream and 1 third order stream. Total perimeter of the watershed is 16.21 km and stream length is 18.71 km.

The derived parameters of Pinmatom sub-watershed show that the mean bifurcation ratio of this sub watershed is 3.17. It has a drainage density of 1.15 and stream frequency of 4.55 which shows a higher value when compared to other two sub-watersheds. The circulatory ratio (0.46) which shows the shape of watershed indicates that Pinmatom sub-watershed has more tendencies towards linear shape. The Length of overland flow of Pinmatom sub-watershed is 17.33 which represent a less area for non-concentrated water flow.

7.1.1.2 Mangalathuthazham sub-watershed

Mangalathuthazham sub-watershed is at the eastern side of Koothattukulam Municipality. It covers an area of 8.04 sq.km and has a perimeter of 14.65 km. The sub-watershed has a steam number of 30 and a stream length of 16.15 km. Among this 17 are 1st order stream, 4 are 2nd order stream, 2 are 3rd order stream and 1 is 4th order stream. Hence considering the stream order Mangalathuthazham is a fourth order watershed.

The mean bifurcation ratio shows a low value of 2.06. Drainage density of Mangalathuthazham sub-watershed is 1.10. Stream frequency is 3.73 which is moderate compare to other two watersheds. Circulatory ratio indicates elongated to oval shape. The Length of overland flow of Mangalathuthazham sub-watershed is 18.14 which represent a less area for non-concentrated water flow.

7.1.1.3 Chandhathodu sub-watershed

Only a small portion of Chandhathodu sub-watershed comes in Koothattukulam Town area. Hence morphometric analysis of this watershed does not give a detailed result. However for understanding the sub-watershed character within the Town an attempt has been made with the available data. Chandhathodu sub-watershed is at the northern side of the Koothattukulam Municipality. Only up to second orders streams are available within the Town limit. This means that this portion is the upper part of the watershed. Chandhathodu sub-watershed covers 2.75 sq.km of the Town area. With 5 streams the sub-watershed region under Koothattukulam Town has a stream length of 3.73 km.

From the derived data the drainage density of the sub-watershed is 0.45 and stream frequency is 1.82. Mean bifurcation ratio is 2. The shape index that is circulatory ratio indicates an oval to circular shape for Chandhathodu watershed. The length of overland flow is very high (44.0) for this region.

7.1.1.4 Inference

From the morphometric analysis made on the three sub watersheds in Koothattukulam, it is identified that Pinmatom sub-watershed region has comparatively more risk of runoff and soil erosion. This is followed by Mangalathuthazham sub-watershed. Chandhathodu watershed shows better infiltration capacity. Hence while considering water and soil conservation measures and structures more priority should be given to Pinmatom sub-watershed region.

7.1.2 Ground water status

To identify the ground water status of Koothattukulam Town water table from 80 sample wells were collected by primary survey. These wells are distributed throughout the

Municipality. Average Ground water level of driest and wettest period is collected from these wells by the method of stratified sampling. A distribution map is prepared from these data with the help of spatial Data interpolation tool of ArcGIS software. Following maps shows the results.

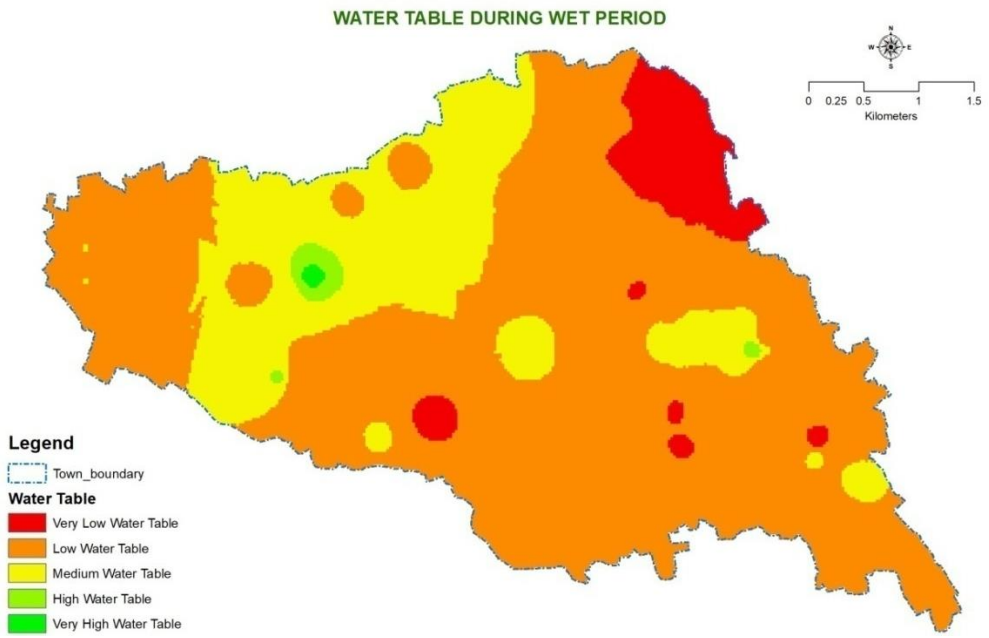


Figure 7-4 : Water table during wet period

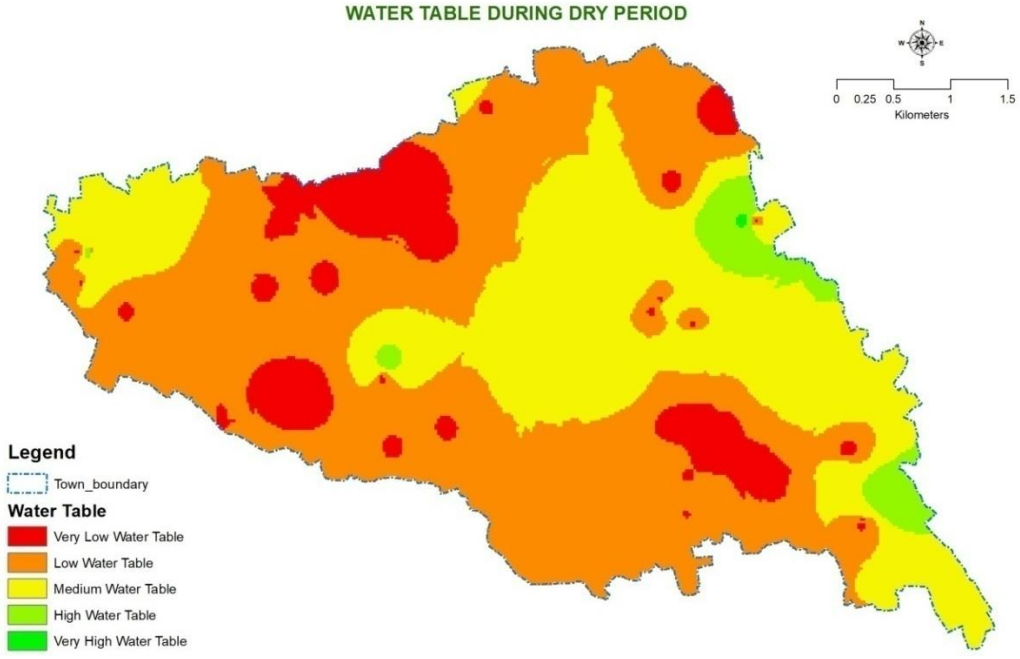


Figure 7-5 : Water table during dry period

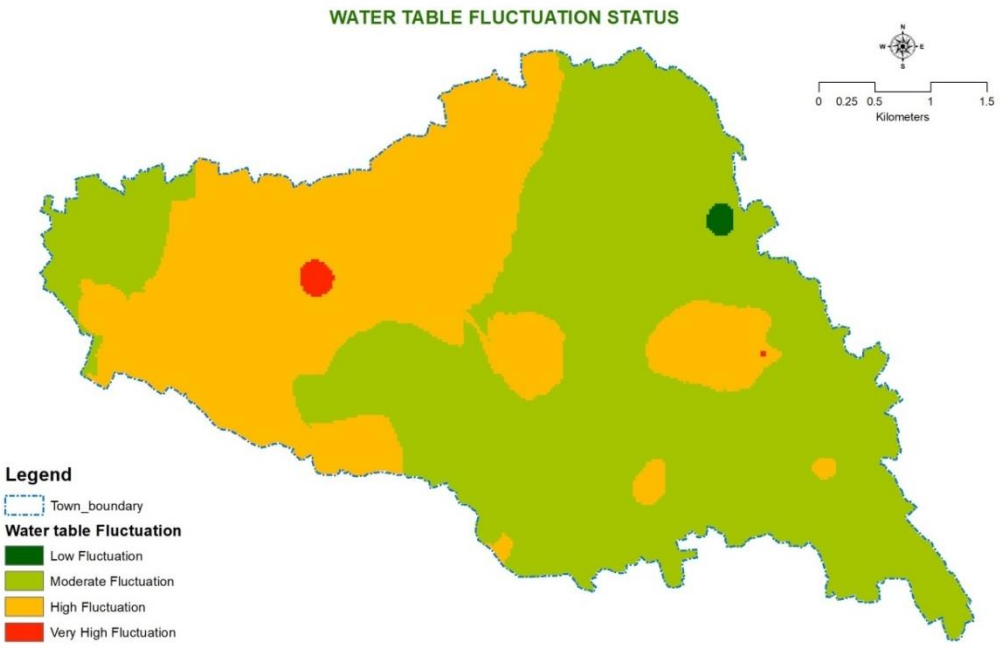


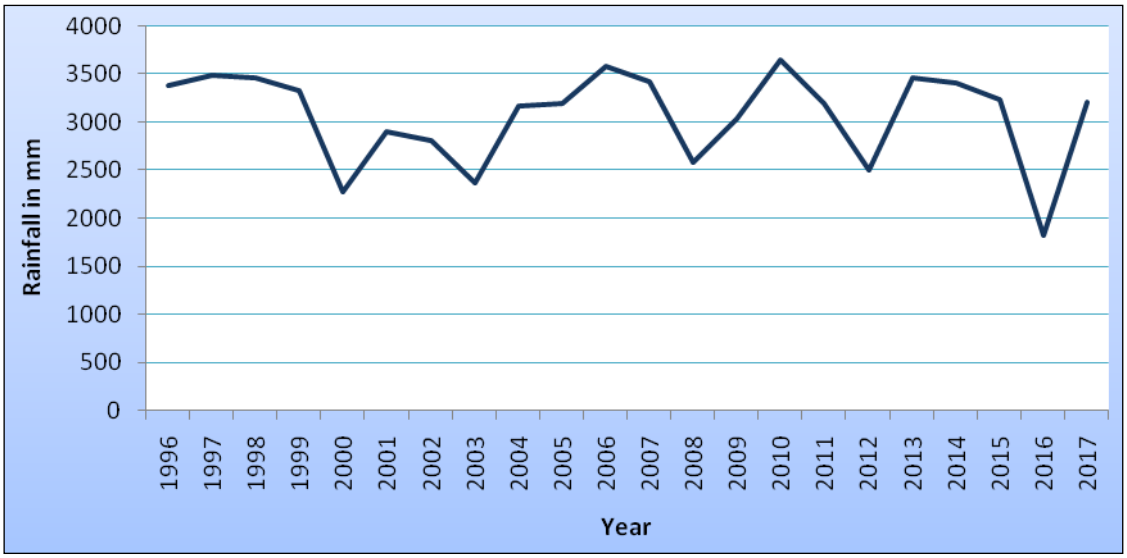
Figure 7-6 : Water table fluctuation status of Koothattukulam Town

The first two maps show the distribution of water table during the wet and dry periods. The water table during wet period ranges from 0m to 9m below ground level (bgl). The shallowest water table is located in central south region of the Municipality and the deepest water table is seen the northeast. However the water table is very high in the eastern and north-eastern side of the Municipality during the dry period. It is noted that even in dry period water level comes up to 1m bgl in north-eastern side. The water table varies from 1m to 14m bgl during dry period.

The Koothattukulam Town shows a high to very high annual fluctuation of water level in the west central region. The eastern side has comparatively low water level fluctuation. This indicates that runoff is comparatively very low in this region. The western side of the Municipality has more fluctuation and hence the runoff is very high and infiltration is very low in this region.

7.1.3 Rainfall Analysis

Rainfall data were obtained from CWRDM Sub Centre, Koothattukulam for the period 1996 to 2017. From the analysis of the data it is seen that the rainfall in Koothattukulam region is highly irregular. From the highest rainfall of 3641mm during 2010 to lowest rainfall of 1821mm during 2016 shows a wide variation in rainfall distribution. This rainfall pattern indicates the risk of uncertainty in depending on rain water in Koothattukulam.



Source: CWRDM Sub Centre, Koothattukulam

Figure 7-7 : Annual Rainfall Variation- Koothattukulam

7.2 EXISTING WATER SUPPLY SYSTEM

The water supply system is under the Kerala Water Authority. UWSS to Koothattukulam is the major water supply system in Town which was commissioned on 2002.

7.2.1 Water Supply Source

Thodupuzha River is the main source of water for the UWSS water supply scheme for Koothattukulam. The intake well and the treatment plant are located in Arakkuzha panchayat which is located 10km north to Koothattukulam. The river is not a part of Municipal area.

7.2.2 Treatment and Transmission Mains

Water is extracted from the river and further it is treated in plants with capacity of 6MLD using rapid sand filters in which 4MLD is given to Koothattukulam Town. Aeration, sedimentation, filtration and chlorination are the treatments done at the treatment plant. The schematic diagram of water supply lines of UWSS to Koothattukulam is shown in figure7.8.

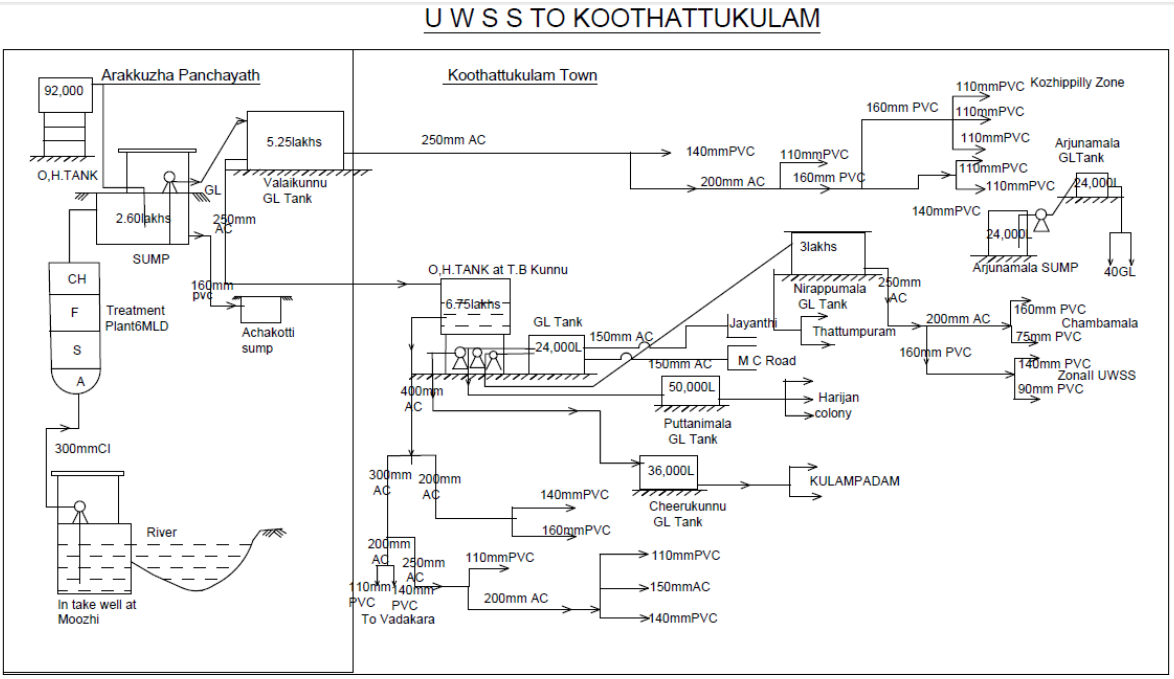


Figure 7-8 : Schematic Diagram of UWSS to Koothattukulam

7.2.3 Water Supply Storage System

The storage system consists of 6 ground level tanks one overhead water tank. Details of these storage facilities as per KWA are shown in table 7.4. Secondary data shows that an average of 20 lakh liters of water is supplied per day from the overhead tank. The location of water tanks and sumps are shown in figure 7.9.

Table 7-4 : Details of GL Tanks, OH Tanks & Sumps under P.H. Section, Koothattukulam

Name of Scheme	OH Tank		GLTank		Sump	
	Location	**Capacity in Liters**	**Location**	**Capacity in Liters**	**Location**	**Capacity in Liters**
UWSS to Koothattukulam	TB Kunnu	675000	Valaikunnu	525000	WTP, Arakuzha	260000
			TB Kunnu	100000	Arjunanmala	24000
			Nirappumala	300000		
			Cherukunnu	36000		
			Arjunanmala	24000		
			Puttanimala	50000		
Total	**1 No**		**6 Nos**		**2 Nos**	

Source : Kerala Water Authority



Over Head water tank



Ground level water tank

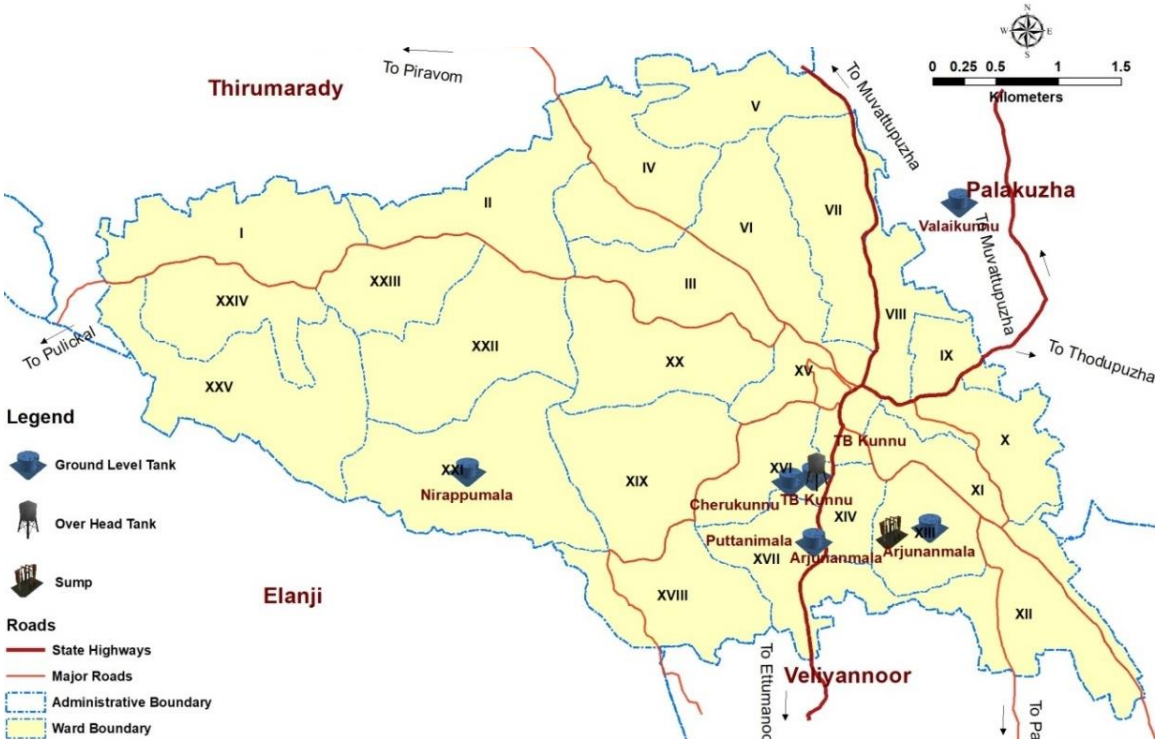


Figure 7-9 : Location of water tanks and sumps in Town

7.2.4 Coverage and Connections

The scheme is actually proposed for Koothattukulam Town, Arakkuzha and Palakkuzha panchayaths, with a beneficiary population of 18000 out of which a population of 14000 belongs of Koothattukulam Town. All wards in Koothattukulam are benefitted through this scheme but the secondary data shows the present status as it is partially covered in the wards. The total number of drinking water connections as per KWA is 1942 in which 1750 are domestic connections and 192 are non domestic connections. Public street taps provided are 310 numbers.

As per figure 7.9 it is seen that the existing water storage facilities are mainly concentrated on the Town core. The eastern region of the Town mainly southern and northern areas are well served by the existing water supply scheme whereas the western region and elevated areas are not fully covered by the existing KWA scheme. The western part of the Town is more vulnerable to water scarcity than the eastern part and hence it is necessary to provide new water supply schemes to those regions facing water scarcity.

7.3 PERFORMANCE INDICATOR

The performance indicator shows that only 39% of the total houses are connected with the existing KWA water supply scheme and 232 lpcd is the available per capita supply of water which is more than the benchmark but the elevated areas faces problems of unavailability of water through the supply lines.

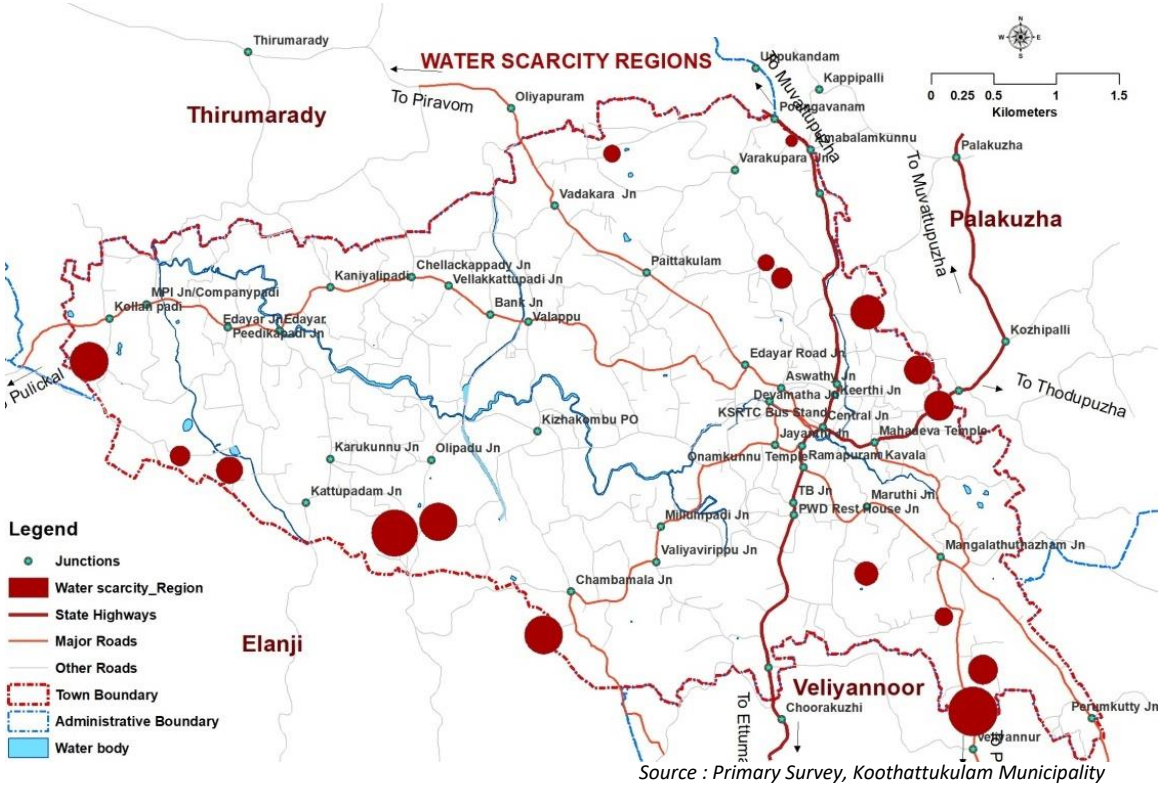
Table 7-5 : Performance Indicator

Sl.No.	Indicator	Value	MoUD Benchmark
1	Coverage of HH water supply connections (1750 HHs connected with water supply network/ 4470 total HHs)	39%	100%
2	Per capita supply of water (4 MLD supply / 17253 population)	232 LPCD	135 LPCD
3	Extent of metering of water connections (1876 metered connection/ 2000 total connections)	93.8%	100%
4	Continuity of Water supply	24hrs in Town wards; alternate days in outer areas	24hrs

7.4 WATER SCARCITY

From the analysis of groundwater, rainfall and the primary information about the historic condition of water status, it is evident that water scarcity is experienced by the Town and the scarcity in this Municipality is mainly because of natural factors and is prevailing for long time period. Human induced changes have lesser impact on water scarcity in this Municipality. The observation is also pointing that the western part of the Town is more vulnerable to water scarcity than the eastern part. Hence the western region should be considered as environmentally more fragile.

As per the socio-economic survey conducted by Town and Country Planning Department, 63.34% of the households reported that there is no scarcity of water, 9.98% reported th at there is scarcity for 1-2 months, 11.97% reported that there is scarcity for 2-3 months, 6.98% reported that there is scarcity for 3-6 months and 7.73% has scarcity for more than 6 months. The scarcity details are shown in figure 7.10.



Source : Primary Survey, Koothattukulam Municipality

Figure 7-10 : Drinking water scarcity areas in Koothattukulam Town as per primary survey

Secondary data details regarding ward wise scarcity of water shows that Wards 8,15,16,17 has 6 hours supply per day, ward 12 has supply of 4 hours per day and all wards except wards 8, 12,15,16,17 have water supply for 6 hours once in two days. The water table fluctuation status of Koothattukulam Town is shown in figure7-11 as per the data obtained from primary survey and inputs from ward counsellors and stakeholders. From this it can be observed that people in almost all wards experiences water scarcity.

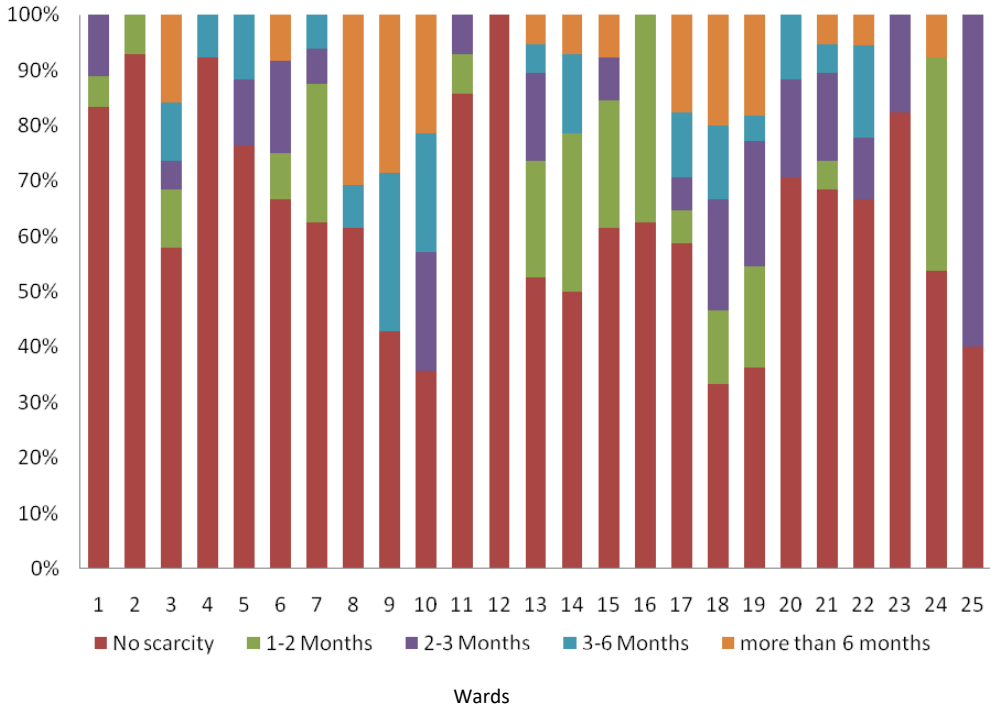


Figure 7-11 : Duration of Scarcity

7.4.1 Duration of Water Supply

Table 7-6 : Duration of water supply in Koothattukulam

Duration of water supply	24 Hr	12-24 hr	6-12 hr	1-6 hr	<1 hr	Once in 2 days or more
Average % for the LSGI	25.16	15.48	0.65	2.58	5.81	50.32

Table 7.6 shows the duration of water supply in Koothattukulam as per socio economic survey. Only 25.16% gets 24 hour water supply and 50.32% of people depending on KWA get water supply once in two days. This is an indication of scarcity of water in the Municipality

7.5 DRINKING WATER SCHEMES- PROPOSED & ON-GOING

The table shows the different drinking water schemes, the wards, and the number of houses benefitted and the status of the schemes in Koothattukulam as per the details from local body. Even though, there are numerous schemes, Koothattukulam still faces water scarcity in some wards.

Table 7-7 : Status of Existing Water Supply Schemes

S.L No.	Name of the scheme	Wards benefitted	No. of houses benefitted	Status
1	Karukunnu Drinking Water Scheme	21	50	Under construction
2	Chellakkappady Drinking Water Scheme	2,22,23	160	Ongoing scheme
3	Paittukulam Vadakara Calicut Erumakkulam (PVCEM) Drinking Water Scheme	3,4,6,7	90	Ongoing scheme
4	Vadakara-Keerukunnu-Kunnumpuram Drinking Water Scheme	4,5	110	Not working
5	Palakunnelthazham Drinking Water Scheme	8	151	Ongoing scheme
6	Chaithanya Nagar Drinking Water Scheme	12,13	60	Ongoing scheme
7	Calicut Drinking Water Scheme	5	30	Under construction
8	Chorakkuzhy Drinking Water Scheme	14,12	-	Proposed
9	Kadambanattuthazham Drinking Water Scheme	18, 19	200	Ongoing scheme
10	Thurappara Drinking Water Scheme	23	30	Ongoing scheme
11	Nedumbara Drinking water Scheme	3	30	Ongoing scheme
12	Keerukunnu SC Drinking water scheme	5	23	Proposed
13	Mini water supply scheme near govt. LPS Mangalathuthazham at Kattamkode	10	10	Proposed

Source : Koothattukulam Municipality

7.6 PROBLEMS AND POTENTIALS

Even though piped water supply covers the whole Town area, water scarcity is experienced in almost all wards especially in higher elevated areas. The average ground water table depth in Koothattukulam is 4.39m. Due to uncertainty on dependence on rain and absence of ground water recharging the ground water table is fast receding. There are no schemes for recycling waste water in the Town. It is imperative to not only initiate new projects and upgrade present infrastructure, but also to promote water conservation through an integrated and a community driven model, comprising of short term and long term measures. Ground water recharging through rain water harvesting, conserving water bodies and controlling groundwater extraction is imperative. Water bodies and aquifers should be conserved. The concepts of 'zero run-off drainage', with retention ponds, sediments traps and balancing ponds should be adopted, with a segregated wastewater disposal.

7.7 INFERENCE

At present, the distribution system of water covers all major habited area in Town, but still there is problem in availability of drinking water. Main source of water for the elevated areas are the existing water supply schemes. Drinking water schemes other than KWA scheme under the Municipality exists in Town which helps to reduce the effect of water scarcity in some areas. The issues will be solved to some extent with the commissioning of the five proposed schemes. Various mandatory measures to properly tap the rainwater and the proper recharging of ground water table need to be initiated, as an important need of the hour. New innovative techniques of water conservation and water recycling are to be developed and implemented through community participation.

8 SANITATION

8.1 DRAINAGE

The topography of Koothattukulam Town is undulating in nature. Uzhavoor thodu which flows in east west direction is the major water body in the region and collecting run-off from the adjacent elevated areas. The existing natural drainage network should be conserved and protected. Huge conversion of paddy and wet lands for residential & commercial purposes and for dry cultivation caused reduction in area for the direct rain water catchment and thereby ground water recharge. Proper drainage system is not present in the Town for storm water drainage and waste water disposal. Only few major roads have side drains. Detailed drainage plan has to be prepared for the Town while conserving the existing drains.

8.2 SEWERAGE SYSTEM

An organised sewerage system is an important aspect to create healthy living conditions. Currently there is no sewerage system or treatment facility for waste water before it is being discharged to open water sources in the Town. There is no piped sewerage system existing in the Town for wastewater treatment or sanitary waste disposal.

8.2.1 Sanitary Waste Disposal

The traditional methods of sanitation are in practice by people like water closets/septic tanks, pit latrines. People largely depend on individual septic tank for disposing sewage. Socio-economic survey reveals that 76.81% depends on septic tank, 22.44% depends on pit latrine and 0.5% depends on others for sanitary waste disposal. 0.25 % of households do not have any sanitation facility and are directly disposed to public drains. The method of sanitary waste disposal is represented in figure 8-1 and the analysis shows that better Sanitation system is available for the houses in the Town. However an organised sewerage system is an important aspect to create healthy living conditions. There is no on going and committed project under sewage disposal by any agency in the Town.

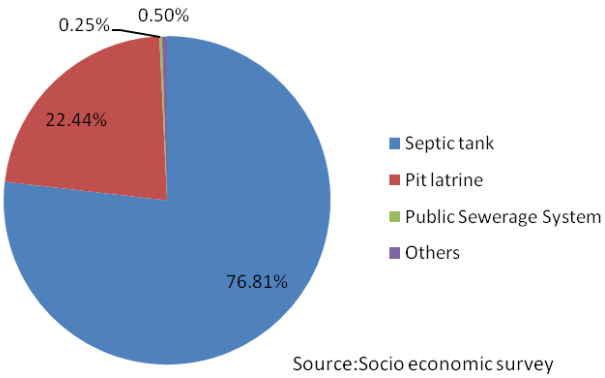


Figure 8-1 : Method of sanitary waste disposal

The Municipality has identified 38 households without toilets across its 25 divisions and covered it under the open defecation-free project of SBU. Koothattukulam is the first open defecation-free (ODF) Municipality in the District under the Swachh Bharat Urban (SBU).

8.2.2 Public Comfort Stations

The availability of Public toilet / comfort station is very less in the Town and at present only 3 Public comfort stations are present. An average of 636 commuters use the comfort station provided at KSRTC Bus stand daily. Since the Town act as a major transit point for vehicular traffic and as the regional service centre, the number of commuters is high. Hence there is an urgent need for providing more public comfort stations at different parts of the Town.

8.2.3 Inference

Proper drainage system has to be developed in the Town for storm water drainage for reducing soil erosion. The Natural drainage system should be conserved. Separate drainage has to be developed for wastewater disposal in the CBD area with adequate treatment facilities before it is discharged to an open source of water. 99.15 % people are having septic tank or pit latrine for sanitary waste disposal. So a septage treatment plant is needed to be developed for the Town for future. More public comfort stations are to be provided at different parts of the Town for the floating population.

8.3 SOLID WASTE DISPOSAL

Solid waste management is emerging as one of the major issues faced by most of the urban areas in India. Rapid urbanisation and changing consumption patterns resulted in increased generation of solid waste in cities.

8.3.1 Generation and Collection

The system of 'disposal at source' is adopted in the Town. It is identified that Solid Waste Management as a thrust area, as it is found to be the root cause for many other problem areas like water logging and mosquito menace (stake holders consultation)in the town. Majority of the people throw waste into open spaces / drains / water bodies. It is found that major portion of solid wastes is generated from the central area of the Town. Solid waste includes domestic and commercial wastes, hospital wastes, e-waste, construction debris etc. According to socio-economic survey, 93.27% of solid wastes are deposited with in compounds of houses, 0.50% is deposited on streets, 0.50% of wastes are deposited on garbage bins, 4.74% of wastes are dumped on open grounds and 1 % of waste is deposited on other areas. The markets do not have any method for the disposal of waste.

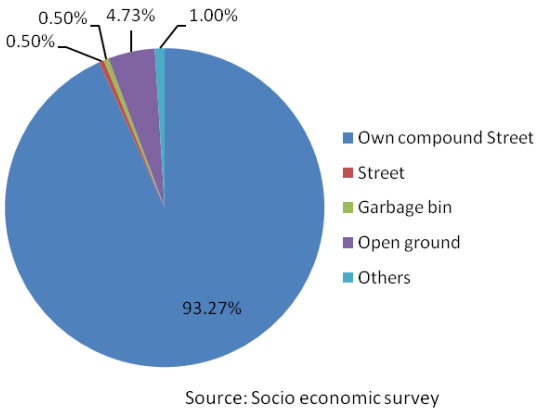


Figure 8-2 : Solid waste disposal methods adopted

The studies conducted by National Environmental Engineering Research Institute (NEERI) in Indian cities have revealed that the quantum of municipal solid waste generation varies from 210gm/capita/day to 350gm/ capita/day and it goes up to 500gm/capita/day in large cities. As per the assessment done by Water Sanitation Programme (WSP) in 2006 the per capita waste generation per day in a municipal Town in Kerala in 2006 is 321 g. Hence the waste generation is assumed as 300gm/capita/day. The total quantity of waste generated based on 2011 population is 5.2MT per day. At present only 1.5 MT of solid waste is collected. Considering the quantity of waste generated from other sources like Hotels & Restaurants, Institutional, Commercial etc the total quantity of waste generated is 8MT.

Health wing of the Municipality collects solid waste which is confined to 5 wards in the Town area which includes ward numbers 6, 7, 8, 15 and 16. All these wards are along the sides of MC Road. The primary sources of solid waste are the houses, commercial establishments, industries, markets, hotels and restaurants, hospitals etc. The waste from collection points are collected by manual loading into fleet of vehicles and finally disposed in an environmentally fragile site located in Town ward. No secondary storage space is available for solid waste collection. Only 6 workers are engaged in collection and disposal. The details of solid waste collection system are shown in table 8-1.

Table 8-1 : Solid waste collection details in Koothattukulam

Sl. No	Source of solid waste (Area/ Ward)	Total quantity of solid waste genera-ted (T)	Total quantity of solid waste collected (T)	Coverage Area/ wards	Collection details			
					Location of Collection points	Workers employed	Frequency of collection	Vehicles used
1	Town Area	1.5	1.5	wards-6,7,8, 15,16	At all shops premises, Residences	6	daily	1

Source : Koothattukulam Municipality

8.3.2 Existing treatment facilities

Disposal of solid waste is done by land filling at Town dumping yard, which is located in ward 15. Separation of wastes into bio-degradable and others are not done as no secondary storage space is available for solid waste collection and the waste is directly disposed. Major portion of solid wastes are generated from the central area of Town. Solid waste includes domestic and commercial wasters, hospital wastes, e-waste and construction debris etc.

All hospital has their own methods for disposing the hospital wastes through IMAGE (Indian Medical Association Goes Eco-friendly). The markets do not have any method for the disposal of waste. Lack of land available for dumping or segregation is the major issue faced by the Town. 55kg of market waste is produced per day.

Considering the total waste generated the collection efficiency of the Municipality is only 18.75% and hence there is an urgent need to invest on an effective waste management system.



Waste dumping at the dumping yard



Thodu near dumping yard

8.3.3 Solid Waste Disposal Project

Municipality has started taking actions for proper solid waste disposal. Details of ongoing and committed projects under solid waste disposal management with agency are as follows:

- Material Recovery Facility (MRF) Centre (Suchitwa Mission) in Ward 15
- Aerobic Composting Unit – 6 Nos. (Suchitwa Mission) in Ward 15
- Bio digester pot – 1000nos. (Suchitwa Mission)

8.4 PROBLEMS

- Existing dumping yard at the Town centre and the leachate percolation from the landfill site is polluting the nearby waterbody (chantathodu) and ground water, hence prevention of contamination and protection of ground water should be the first step to be taken in this sector. To achieve this removal of the waste from the dumping yard needs urgent attention as it also causes a major health risk to the community.
- Only five wards of the Town Area are covered by the Municipality. Considering the total waste generated the collection efficiency is only 18.75%. Considering more decentralized units and thus taking in to account the population of the five wards coming in the Town area, the collection efficiency is only 53%. At present no

treatment of the waste is being done. Even the proposed composting units are not sufficient.

- Dumping of wastes in the public streets in front of trading centres and at different areas of Town
- Poor level of waste collection and no segregation of waste at source
- Separate estimates not available with regard to commercial waste (Compostable, recyclable), Industrial waste (hazardous and non-hazardous), e-waste(recyclable and non-recyclable), Construction debris(reusable as building material)
- Wastes coming to the existing dumping yard is not efficiently separated and processed.
- Different types of wastes are dumped on the grounds, which makes the treatment difficult.
- Unable to treat mixed waste products.
- Unable to collect and process wastes from market, auditoriums, hotels etc.

8.5 POTENTIALS

- Placing of segregated waste baskets in the transport bus stand, civil station, hospitals, markets and other public places for the collection of wastes.
- Installation of viable decentralised composting uinits
- Household segregated bins for organic and inorganic wastes for the Town area
- Special arrangements can be made for the manufacturing of fertilizers by processing the wastes.
- Bio-degradable wastes can be used for making manure and for energy production through new innovative schemes.
- Construction of a waste treatment plant with adequate capacity for treating wastes collected and separated with the help of Kudumbasree units, residents associations and NGOs.
- Arranging windrow compost unit and plastic shredding unit along with the treatment plan

8.6 INFERENCE

The system of 'disposal at source' is adopted in the Town at present, but the changing family structure and land availability for the residents can develop problems in future in this regard. New methods for proper management of solid waste have to be developed for the Town considering the future demands. Decentralized treatment and processing of municipal solid waste have to be developed in Town to reduce the problems in transporting wastes from localities where they have been generated. Awareness creation about the need for source segregation and differential disposal of solid waste is essential.

Kudumbasree workers may be deployed for collecting plastic waste which can be used for recycling purposes. Another area of attention is system for separate collection of e-wastes. Health care institutions in the planning area shall set up requisite biomedical waste treatment facilities like incinerators, autoclaves and microwave systems etc. More aerobic composting units should be provided in Town such that the whole Town area is covered in a decentralised manner with maximum efficiency in waste disposal. Safe recycling facilities for e-waste and construction debris shall be provided and plastic free environment shall be promoted. The objective of solid waste management system for the Town may be to reduce the quantity of solid waste disposed off on land through the principle of Reduce, Reuse and Recycle.

9 ENERGY

9.1 POWER DISTRIBUTION

Electricity generation, transmission and distribution in Koothattukulam is handled by the Kerala State Electricity Board which is the frame agency in this sector in Kerala. Koothattukulam Town mainly falls under Muvattupuzha division and Piravom electrical sub division. 66 KV substation in ward 8 is the major feeder which distributes power to the Town. 2 main transformers are installed in Koothattukulam Town. Though two feeder lines from Piravom substation passes through Koothattukulam Municipality , the feeder located in Edayar distributes the power to the Municipality.

9.2 ELECTRICITY CONSUMPTION

Category wise electricity connection details are given in table 9.1 as per secondary data from KSEB. Mainly there are 2 types of connections, domestic and non-domestic connections. The total numbers of connections are 17,207 and the average monthly consumption is 1620 MKWH in which domestic connections are 13241 with a monthly consumption of 981 MKWH. Under non-domestic connections various categories included are industrial, agricultural, commercial, KWA (Kerala Water Authority), street light (unmetered) and street light (metered). There are 546 street Lights in the Municipal area.

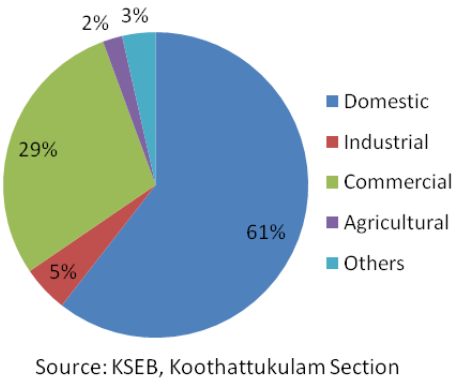
Table 9-1 : Electricity consumption under Koothattukulam section, KSEB

Sl.No.	Category of use	No. of connections	Average Monthly consumption - MKWH
1.	Domestic	13241	981.315
2.	Industrial	206	79.677
3.	Agricultural	826	33.623
4.	Commercial	2850	468.444
5.	Others	84	57.481
Total		**17207**	**1620.54**

Source : KSEB , Koothattukulam Section

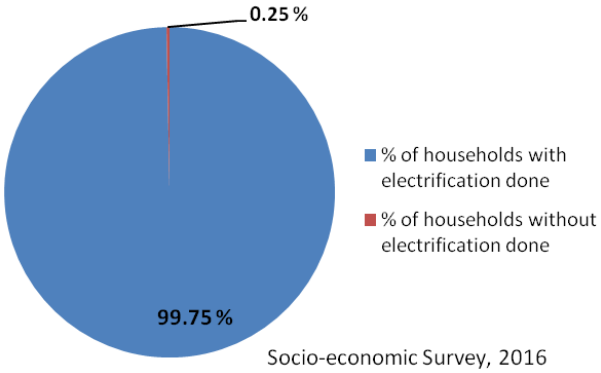
Connections under agricultural sub-section also include connection given for the working of pump houses for irrigation purpose and also connections given to poultry farms, cattle farms etc.

More number of electric connections and more share of electric power consumption are for domestic purpose. Consumption in domestic sector is about 61% of the electricity which is the highest among all the sectors. Consumption for industrial and agriculture purpose is comparatively less than that of commercial purpose. However, consumption wise, respective shares of commercial, industrial and agricultural sectors are 29%, 5% and 2%. Comparison of category wise electricity consumption is shown in figure 9-1.



Source: KSEB, Koothattukulam Section

Figure 9-1 : Category Wise Consumption of Electricity



Socio-economic Survey, 2016

Figure 9-2 : Extent of Electrification

9.3 ELECTRIFICATION DETAILS

According to socio economic survey it is found that 99.75% of houses are electrified and the percentage of un-electrified houses in the Town is 0.25% and there are no houses in the Municipality were electricity is not available within the locality. The details of socio economic survey on extent of electrification in Town is shown in figure 9-2.

9.4 PROBLEMS AND POTENTIAL

9.4.1 Problems

- Street lights are not working properly due to the absence of proper maintenance.
- Non-utilization of non-conventional energy sources

9.4.2 Potentials

- Proposal of KSEB for up-gradation of 66KV substation to 110KV substation
- Extraction of power from non-conventional energy sources.
- Develop innovative ideas for utilisation of renewable energy sources at the local level within community groups or residential associations through community participation

9.5 INFERENCE

The main problems faced in electric power sector are due to drawbacks in the distribution field. Most of the power failure occurs due to the tripping of 11 KV OH lines. Considering existing demand, 66KV substation needs to be upgrade to 110 KV substation and KSEB has already proposed for up-gradation to 110KV substation. New innovative projects for utilization of renewable and non-conventional energy sources should be promoted and implemented in Town with community participation programmes at local level.

10 EDUCATION

Education is an important factor influencing the quality of life of the people and future development of an area. It empowers them with skills and knowledge and helps them to lead their life in a better way and to access best of the employment opportunities available in the market. This in turn will impact the work force participation rate and economy of the area.

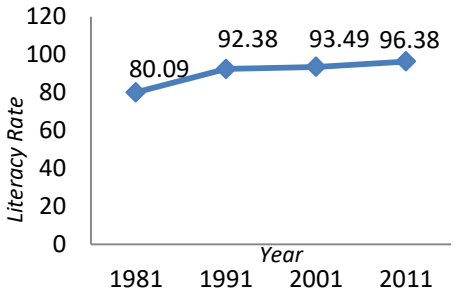
First educational institution in Koothattukulam was started when Travancore Government decided to promote regional languages. In 1912 The Vernacular Malayalam School known as V. M. School was working in church and sangham buildings. When Government U. P. School started in 1914 the V.M. school was merged with it. The former Elementary Hindu mission school was changed as today's Koothattukulam High School. In the beginning these schools were meant for upper cast only. Later these systems were changed and education was opened for everybody in the society and it plays an active role in the social development of people in Koothattukulam. In this chapter, analysis of educational institutions, level of education and the problems faced in educational sector in Koothattukulam Municipality are detailed.

10.1 GENERAL EDUCATION STATUS

The general education status is assessed based on literacy rate, number of educational institutions and educational status. The literacy rate of Koothattukulam Town as per 2011 census is 96.38% which is higher than District rate of 95.89% as well as the state literacy rate of 94%. The phenomenal raise in literacy from 80% in 1981 to 92% in 1991 shows the improvement in the education sector over the years. The literacy rate of the Planning area over past decades is shown in Figure 10-1.

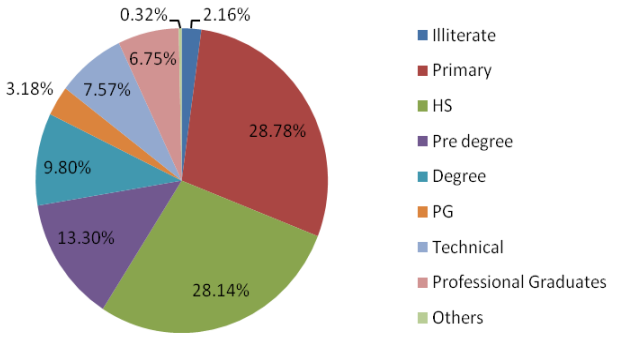
The educational status of the Town is also assessed by the percentage of qualified people. The educational status as obtained from socio economic survey is shown in figure 8.2. From the figure, it can be observed that about 28.78 % of people have only primary education, 28.14 % of people have high school education and 13.30 % of people have pre-degree qualification. The remaining 29.78% possess degree or higher qualification. Only a small percentage of population has gone beyond pre-degree education. The above analysis shows

that Koothattukulam has comparatively high literacy rate but higher education status are comparatively low.



Source : Census 2011

Figure 10-1 : Literacy rate of Koothattukulam



Source : Socio Economic survey - 2016

Figure 10-2 : Educational status

10.2 EXISTING FACILITIES

There are four hierarchies of schools in Town viz. Primary school, Upper Primary school, High school and Higher Secondary school. There are 11 schools in Koothattukulam Town, in which 4 are government run, 4 schools are aided and remaining 3 are unaided or private ownership.

Among the schools, there are 4 Lower primary schools in which 3 are government schools and one is government aided school, 2 Upper Primary schools in which one is government school and other is government aided school and 2 High Schools in which one is government aided school and other is private school. There are 3 Higher Secondary Schools in which only one is government aided school and others are private schools. Among these 11 schools 2 schools provides pre-primary education in which one is government school and other is private school. Out of 11 schools functioning in Koothattukulam 9 schools are under Kerala state syllabus and only 2 schools follow CBSE syllabus. Major share of students are studying in private schools compared to government and government aided schools in all four hierarchies.



Schools in Koothattukulam

10.2.1 Spatial Analysis

Spatial analysis of existing educational facilities within Town shows that the distribution of institutions is not balanced and is not evenly distributed in the Town but Anganavadis are distributed in a balanced manner. The educational institutions are located towards the Town centre along the major roads in Town.

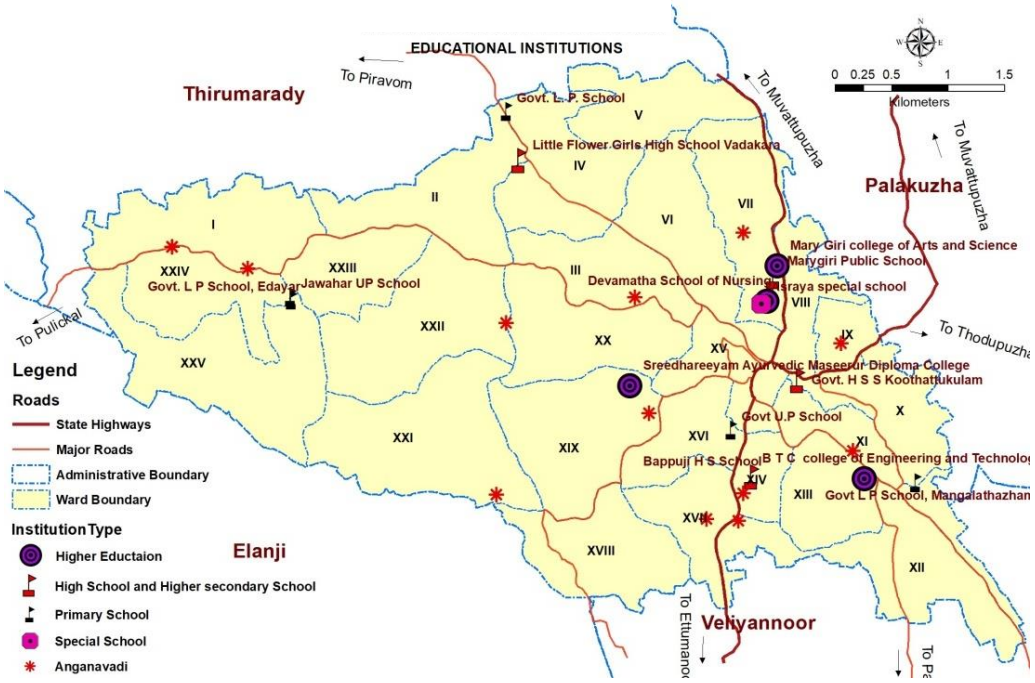


Figure 10-3 : Schools and other Educational institutions in Koothattukulam Town

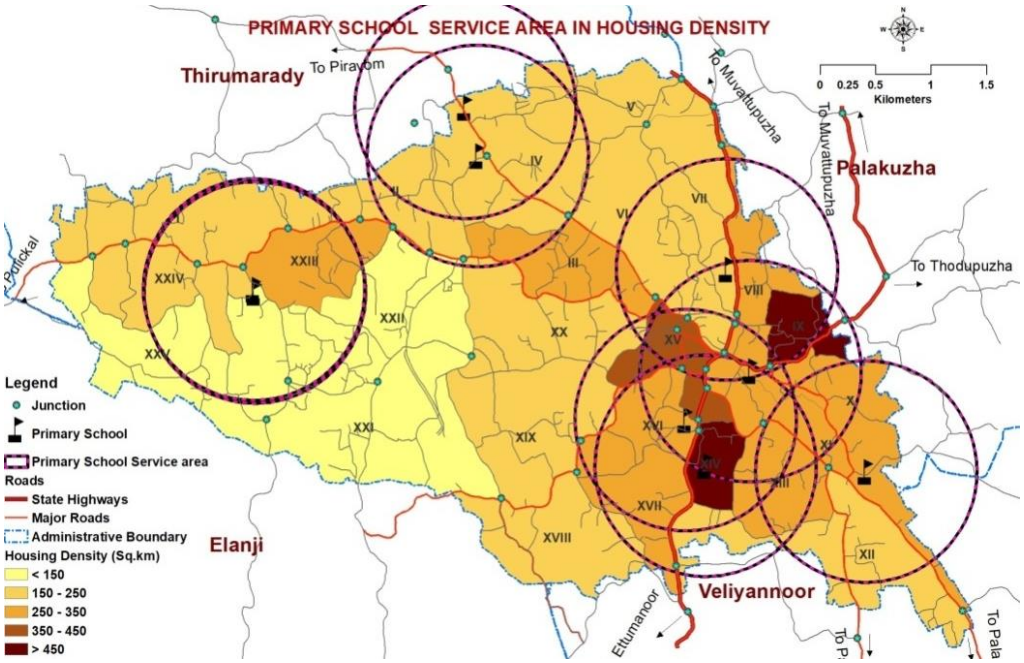


Figure 10-4 : Service area of primary schools in Koothattukulam Town

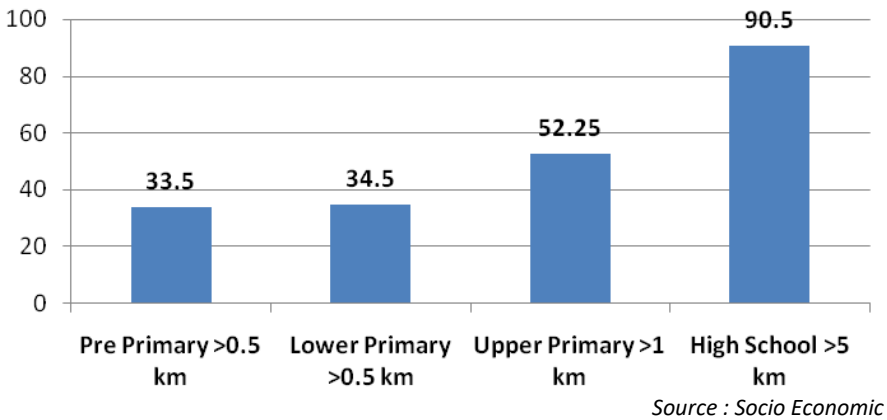
The service area of primary schools in the housing density map of Town is shown in figure 10-4. From figure 10-4 it is evident that wards 18, 19, 20 and 21 are not served by any primary schools. So, proposal for new schools should be located in this area. At present, more schools are concentrated towards the Town core area and others along the main roads where the housing density is more. Even though the service area of primary schools doesn't evenly cover the whole Town area it covers the wards with more housing density, and as per the number of existing educational institutions, it is concluded that the existing infrastructure is adequate for the population in Town.

10.2.2 Infrastructure Facilities

Regarding facilities available at school, the parameters like playground, separate toilets for girls, computer labs, internet facilities, drinking water, road connectivity etc. were considered. Out of eleven schools four schools are lacking playground facility and one school in the local body doesn't have internet and computer lab facility. Basic facilities are available in most of the schools. Other facilities like playground, computer labs etc. are available to a limited number of schools. All schools are well connected with motorable road having a width of 3m or more.

10.2.3 Distance to Educational Facilities

From socio economic survey, 2016 the percentage of students travelling to schools are as given in figure 10-5. Even though there are sufficient numbers of school in the Town, the selection of school may be based on the standard and the syllabus followed in the schools. This may the reason for increase in travelling distance.



Source : Socio Economic Survey 2016

Figure 10-5 : Distance to Educational Facilities

10.2.4 Special School

Asraya special school is the only one special school in Koothattukulam, which started functioning in 2012 in ward 7. It mainly gives emphasis for training the mentally challenged children with the ultimate aim of making them self-motivated to live like any other ordinary citizen in the society. The lowest Class is 1 and the highest class in the school is 8. Currently it has 40 students and 8 staff.

10.3 HIGHER EDUCATION

Marygiri College of Arts and Science, which is an aided college is the only arts and Science College available in Koothattukulam Municipality. The college offers only under graduate (UG) programs in BCA, BBA & B.com with nearly 160 seats. There are no post graduate level courses in this college. Two other private colleges in Koothattukulam are Devamatha school of Nursing which offer General Nursing & Midwifery course and Sreedhareeyam Ayurveda Maseeur Diploma College which offer Diploma in Ayurveda Maseeur (Nurse). Other than these no other higher education institutes in Koothattukulam and people mainly depend on nearby local bodies for higher education.

10.4 TECHNICAL EDUCATION

There is one private engineering college, Baselios Thomas I Catholicose College of Engineering and Technology located at Mangalathuthazham functioning from 2011 in the municipal limit. It offers engineering courses in 5 trades with 300 seats each year. There is no government or private Poly Technique College functioning inside municipal limit and the nearest is in Purappuzha which is 11km away in Idukki District and Kaduthuruthy which is 25km away in Kottayam District. Nearby government ITI is in Arakuzha which is 10 km away from Koothattukulam. The number of higher educational institutions is insufficient in terms ITI and poly technique colleges but ITI & Poly technique colleges are available in the nearby local bodies. There are no medical related colleges in or around Koothattukulam.

10.5 EDUCATIONAL FACILITIES COMPARATIVE STUDY WITH PLANNING STANDARDS

Table 10-1 : Comparison with Planning standards in educational sector

Sl. No.	Category	Planning standards	Remarks
1	High School	1 H.S. for 13000 Population	Satisfied

2	Higher Secondary School	1H.S.S. with 8 divisions for 13000 Population	Satisfied
3	Arts and Science College	1 Arts and Science College for 80000 Population	Satisfied
4	Technical Education	1 professional college for 2,50,000 Population	Satisfied
5	Polytechnic College	1 Polytechnic College for 36000 Population	Not Satisfied
6	ITI	1 ITI/ITC for 35000 Population	Not Satisfied

10.6 INFERENCE

Koothattukulam is having sufficient number of educational facilities up to the higher secondary school level. One Arts and Science College, one Engineering College, one Nursing College and one Ayurveda Diploma College are the institutions for higher studies available in the Municipality.

Less number of students are studying in Government or aided schools compared to unaided schools. Majority of students are following state syllabus. There is enough number of educational institutions in the Town to cater the needs of the resident population as well as of the students from the neighbouring areas. Better infrastructural facilities and educational standards attract more people to the unaided institutions. Implementation of Smart Classrooms in Government Schools shall be considered to attract more students to the Government Schools.

11 HEALTH

Health is another sector where the state of Kerala has achieved remarkable progress which is comparable to that of developed countries. Koothattukulam have allopathic, ayurvedic and homeopathic system of medical facilities. The existing health care facilities are studied in this chapter.

11.1 EXISTING HEALTH CARE FACILITIES

The main healthcare institutions in Koothattukulam are under private ownership. Government hospitals include Community Health Centre, Government Ayurveda hospital and government Homeo hospital. Health facilities include all medical institutions such as hospitals, dispensaries, nursing homes, clinics, maternity and child welfare centres etc. managed by public and private sectors are functioning in Koothattukulam Municipality. The health care units mainly located in central area and peripheral area of the Town, 15 allopathic units, 8 Ayurvedic units, 4 Homeopathic units and 1 veterinary hospital functions in the municipal limit. Its services cover the entire area of Town.



Community Health Centre



Devamatha hospital

Among the allopathic system of medical institution, there are two major hospitals, one under private ownership and another of co-operative. Devamatha hospital is the main hospital with 250 beds and 24 doctors. Hundreds of patients are visiting this hospital for making use of various facilities. This hospital caters to the needs of people of other Panchayaths also. Rajeev Gandhi Co-operative Hospital has 100 beds with 24 hour service and 8 doctors. Community Health Centre is functioning in ward 2 which has 90 beds and 5 doctors. Apart from these, Santhula Charitable Trust Hospital which is a mental hospital also functions in Municipality. Main hospitals under allopathic system are as shown in table 11-1.

Table 11-1 : Hospitals under allopathic system of medicine

Sl. No	Name of Hospital	Number of beds	Number of Doctors
1	Devamatha Hospital	250	24
2	Rajeev Gandhi Co-operative Hospital	100	8
3	Santhula Charitable Trust Hospital [Mental Hospital]	98	4
4	Community Health Centre	90	5
5	Life care medical	-	1
6	Goodwill Corporative Hospital	-	1
7	St.Anns Hospital	-	1

Source : Primary Survey

There are 8 institutions practicing Ayurvedic system of medicine out of which 2 are hospitals and others are clinics. Government ayurvedic hospital is the only one among them which is functioning under government sector with 3 doctors and 30 beds. There is also one ayurvedic hospital under private ownership, Sreedharyam Ayurvedic Hospital, which is famous for eye treatments and of large scale with 32 doctors and 320 beds facility. Others are dispensaries run by private sector.

In homeopathic system of medicine there are 4 institutions, in which one is hospital and rest are all dispensaries run by private. No higher order facilities are available in this system of medicine.



Govt. Homeo Dispensary



Sreedhareeyam Ayurvedic Hospital

11.2 SPATIAL DISTRIBUTION

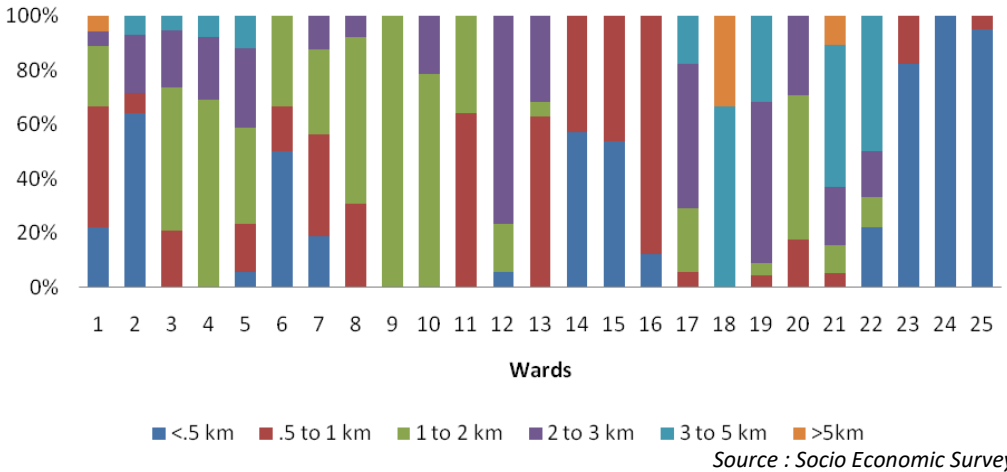
Spatial distribution of major health institutions in the Town are shown in the figure 11-1. The major hospitals are located at the Town core area and the other hospitals are concentrated at the Town core along the major roads.



Figure 11-1 : Spatial distribution of Hospitals

11.2.1 Distance to Facilities

Distance to hospitals/ health facility as per the socio economic survey is shown in figure 11-2. Distances to a Medical facility and hospital have been assessed in the Socio- Economic Survey conducted in 2016. 12.5% of people need to travel more than 5 km to access hospital and 2% of people need to travel more than 5 km to access health facility.



Source : Socio Economic Survey 2016

Figure 11-2 : Distance to Health care facility (Ward wise)

11.3 MAJOR DISEASES

From the secondary data, the major diseases which affected the people were Water Diarrhoea and Chickenpox. Which are 100% cured. As per the Socio Economic Survey conducted in the year 2016 as part of preparation of Master Plan, details regarding major diseases that occurred in the Town during the past five years had been collected. Major diseases occurred and percentage of houses diagnosed with diseases is shown in Figure 11-3. Lifestyle diseases, mosquito borne diseases such as Dengue fever and other epdemic diseases such as chicken pox appeared last year. Chickun Guinea was reported as the major disease of the Town during the last five years.

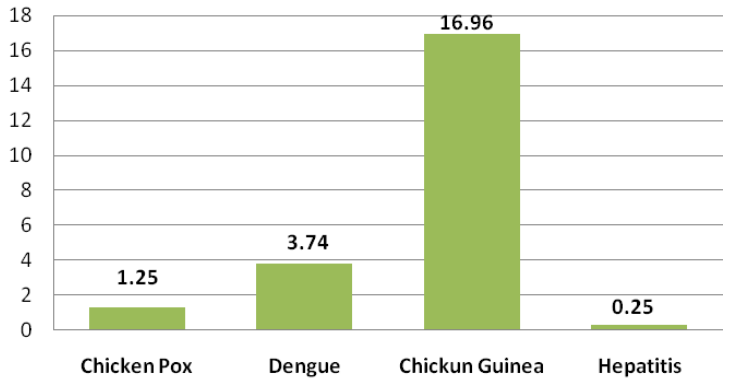


Figure 11-3 : Percentage of houses diagnosed with major diseases, 2016

While analyzing the waste management facilities of major hospitals in the Municipality it is found that all the hospitals have their own project for disposal of waste.

11.4 INFERENCE

Koothattukulam Town has a number of good hospitals to cater the population but lack of multi-speciality hospitals force to depend on nearby local bodies. Private sector plays major role in both Allopathic and Ayurvedic systems of medicine. An established Ayurvedic medicine manufacturing unit and research institute are also functioning in the Town which has history of good quality Ayurvedic treatment. In Homeopathic side private clinics are the common ones. Chickun Guinea was reported as the major disease in the Town during the last five years.

Even though CHC has importance of a District Hospital, the availability of necessary basic requirements with new technologies to provide better health care services to the depended population is unsatisfactory. Municipality faces shortage in health care sector in public

sector. Upgrading CHC in to a Government hospital with new and advanced technologies and facilities will help to reach better health care facilities to the population regardless of their affordability. The infrastructure facilities in dispensaries and other public sector health care centers need to be improved.

12 RECREATIONAL FACILITIES

12.1 PARKS AND OPEN SPACES

There are no major parks, play grounds and stadium in the Town. There is only one children's park located in ward no.7, with an extent of only 22 cent area. There are no organized open spaces or parks for the public to use in the Town and the existing ones are attached to the schools.

The open spaces can include the following three categories, namely:

a. Recreational space

b. Organised green

c. Other common open spaces (such as vacant lands/ open spaces including flood plains, forest cover etc. in plain areas)

As per planning norms considering open spaces, including all the above-mentioned categories, providing an area of 10-12 sq.m. per person may be desirable. For a population of 5000, a Housing Area Park of 0.50 ha area in plain areas and 0.50-1.00 ha in hilly areas, for a population of 15000 a neighbourhood park of area 1.00 ha in plain areas and for a population of 10000 a neighbourhood park of area 1.2 -2 ha in hilly areas is to be provided as per URDPFI standards. But the share of recreation is quite low in Koothattukulam when compared to the planning standards.

From the analysis of the existing land use, it is found that open spaces constitute only 0.01% of the total land use. Barren land constitutes 0.04% and water body constitute about 1.01% of the area. Hence recreational potential may be considered as 1.06% of the total area. 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 construction of new parks and open spaces and stadium in the Town.

12.2 PLAYGROUNDS/ STADIUM

There is no stadium in the Municipal limits. However, there is one open play ground named "municipal ground" extending nearly 1.5 acre and located in ward no.7. Most of the schools are having their own playground facilities. Few plots of various extend are currently used as

playground which could be developed as play grounds with facilities. Ward wise distance to play grounds is shown in fig 12.1. From the figure it is clear that people from twelve wards has to travel more than 5km to reach the playground. URDPFI norms suggests for a Residential unit play area of 5000 sq.m for a population of 5000 and a neighbourhood play area of 1.50 ha for a population of 15000 persons.



Children's park



Proposed stadium

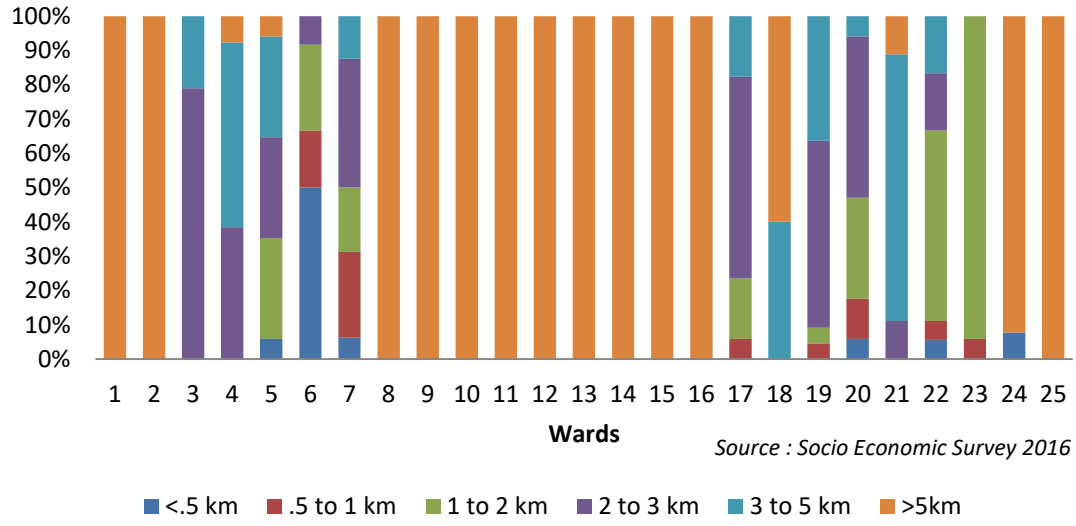


Figure 12-1 : Distance to Playground (Ward wise)

12.3 THEATRES AND AUDITORIUMS

There is only one theatre complex with 2 screens in the municipal limit which has a capacity of 310 seats. There are 8 Auditoriums in Koothattukulam Town. Among them 3 are having an average capacity of 500 or more.

12.4 AVERAGE DISTANCE TO FACILITIES

The average distances for the recreational facilities are obtained from the socio economic survey. For more than 27.25% of population, Cinema theatre is more than 3km away. For playground, 53% has to travel more than 5km. The average distance to playround, as obtained from the socio economic survey is furnished in fig 12-1. It shows that recreational facilities are not available at a reasonable distance for the people of the planning area.

12.5 INFERENCE

Koothattukulam Town is devoid of recreational facilities. Besides, spatial distribution of recreational facilities is not uniform. Residents of many wards do not have any recreational facilities within a walking distance. Municipality lacks open spaces to organize any events of public interest. The share of recreational facilities is quite low in Koothattukulam when compared to the planning standards. Hence there is a need for developing additional recreational areas. All the existing facilities are to be maintained properly.

13 OTHER CIVIC AMENITIES

13.1 TOWN HALL

Eventhough it is a newly formed Municipality, there is a municipal Town hall situated in ward number 8, the capacity is 500 seats. However, there are a handful of auditoriums under private ownership as given in table 13-1.

Table 13-1 : Auditorium/ Halls in Koothattukulam

Sl. No.	Name	Capacity (Seat/sq.ft.)	Location (ward no)
1	Lions Club Hall	900 seat	15
2	SC community hall	800 seat	14
3	V.Chinnas Auditorium	2000 sq.ft	14
4	Arjunan mala cultural central hall	1500 sq.ft	13
5	SNDP hall	150 seat	12
6	Rotary club	100 seat	11
7	CJS memorial hall	2000 sq.ft	7
8	SC cultural hall	1000 sq.ft	1
9	Municipal Town Hall	500 seat	8

Source : Koothattukulam Municipality

13.2 READING ROOMS AND LIBRARY

There are 2 Public Libraries in the municipal area. They are

- CJS memorial library in Ward 7 with an area of 1000 sq.ft
- Ayyankali memorial library at idayar in Ward 1 with an area of 850 sq.ft



CJS memorial library



Town Hall

13.3 CREMATORIA AND BURIAL GROUNDS

There is a municipal crematorium at Valayikkunnu in ward 8 with an area of 28 cent of land. Currently it is rarely used. But in the future it will become a must as the size of landholding per house is drastically reducing.

Table 13-2 : Crematoria and burial grounds in Koothattukulam

Sl.No.	Name	Ward/ Location
1	Muncipal crematorium	8
2	P.R.D.S. Smasanam	16
3	St.steephan church cemetery	17
4	Porambakot smasanam	23
5	Pulaya samudayam	24

Source : Koothattukulam Municipality

13.4 RELIGION, CULTURE

There are about 35 religious institutions spread in the area. Out of which 25 churches of different denominations and 10 temples are there in Koothattukulam Town. The annual festivals in these churches and temples are celebrated during different periods.

13.5 OTHER CIVIC AMENITIES

Other civic amenities and their locations which are essential for well-being of the people of the Town are given in table 13-3.

Table 13-3 : List of other civic amenities in Koothattukulam

Sl.No.	Name	Ward/ Location
Police Station		
1	Police Station	6
Fire Station		
1	Fire and Rescue Station	15
Petrol pumps		
1	HP	6
2	BPCL	8
3	IOC	8
4	Reliance	14
Post Office		
1	Post Office	6
2	Post Office	20
3	Post Office	1

Source : Koothattukulam Municipality

As per the URDFI guidelines, one police station is needed for 90,000 persons and one fire station is sufficient for 2 lakh population. This requirement is satisfied in the Town. There are 4 petrol/ diesel pumps functioning in Town limits. Almost 95% of the houses are using LPG, as per socio economic survey.



Fire and Rescue Station Koothattukulam

13.6 INFERENCE

In terms of civic amenities, Koothattukulam Town is self-sufficed with the necessary civic amenities.

14 HOUSING

Shelter is a basic need. When the need for shelter is not satisfied, it becomes almost impossible for an individual to think of satisfying his/her family aspirations and intellectual needs. Primary responsibility of any Town is to provide its members with a decent and habitable shelter. A standard housing does not mean merely land and building, but includes basic services like water supply, sanitation and access roads.

14.1 EXISTING CONDITION

14.1.1 Residential Areas

As per the land use survey 2016, residential area is distributed in almost all the wards and is mixed up with agriculture. The residential density is more in the central area. At present there are no multi storied residential apartments in the Town. The Town is sparsely populated with residential areas scattered in all parts of the Town. But the density of population is varying. The distribution of residential areas in the Town is shown in figure 14-1.

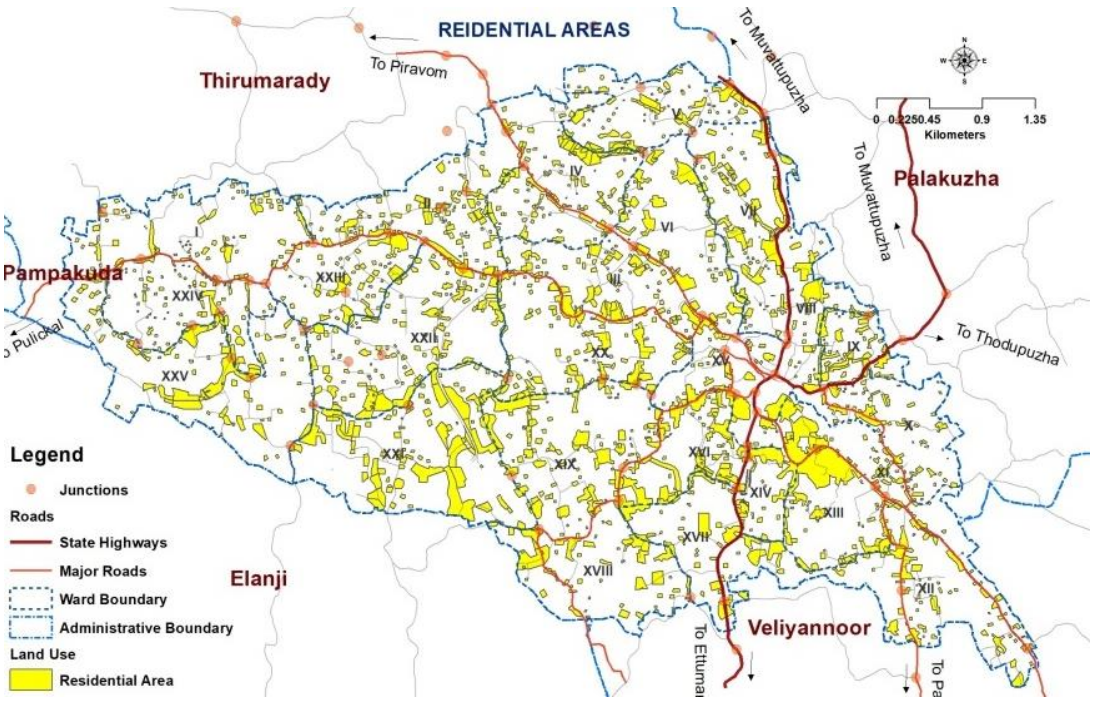


Figure 14-1 : Spatial distribution of residential areas in Koothattukulam Town

The concentration index of residential area is shown in figure 14-2. This shows that there is more residential area concentration along the major roads in the Town with an exception in

ward 21. Residential land use is the second major land use and is mainly concentrated in the 10 wards. These wards are mainly located in the eastern part of M.C.Road and few to the western side of M.C.Road. Generally wards on the western and southern ends of Town have low concentration of residential land use.

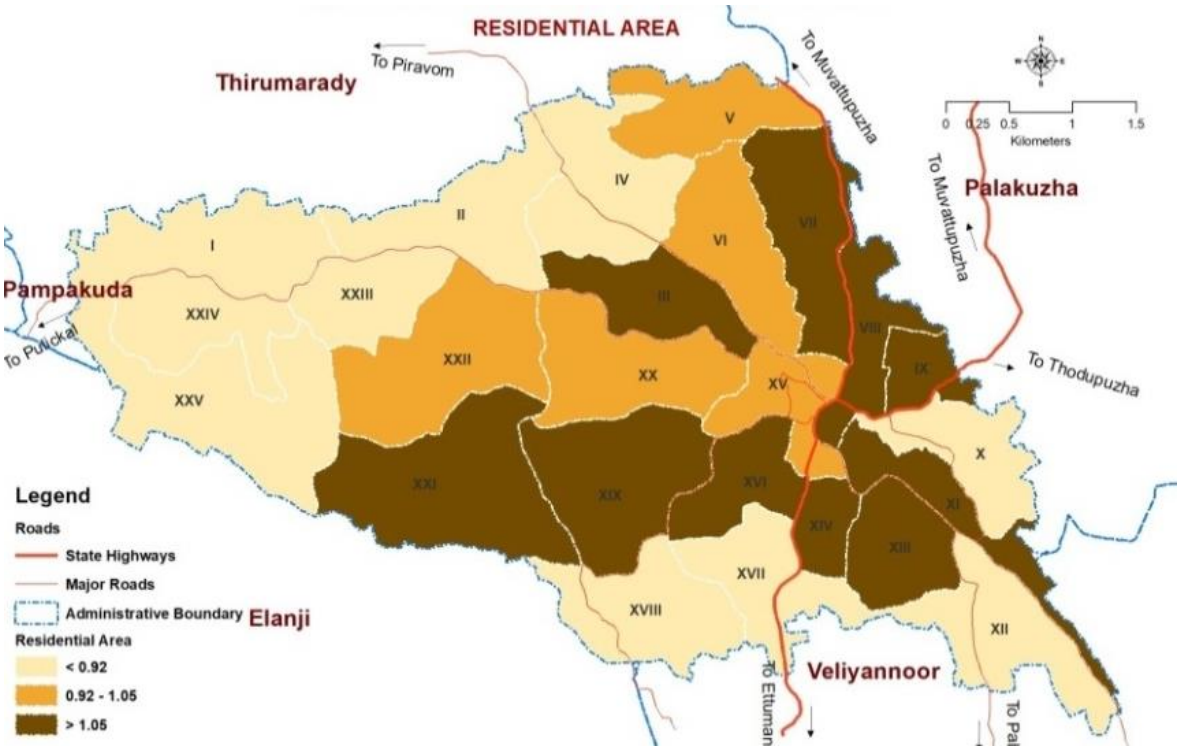


Figure 14-2 : concentration index map of residential areas

14.1.2 Housing Density

A total number of 5054 houses are there in the Town. The ward wise housing density is shown in Figure 14-3. Wards 14 and 9 have highest housing density and it is more along the wards near the major roads in the Town. On considering the number of houses in each ward we can see that the number of houses varies from 188 to 221 in different wards. Ward 8, 13,25,3 and 19 has highest number of houses. Wards 2,9,18 and 20 have least number of houses.

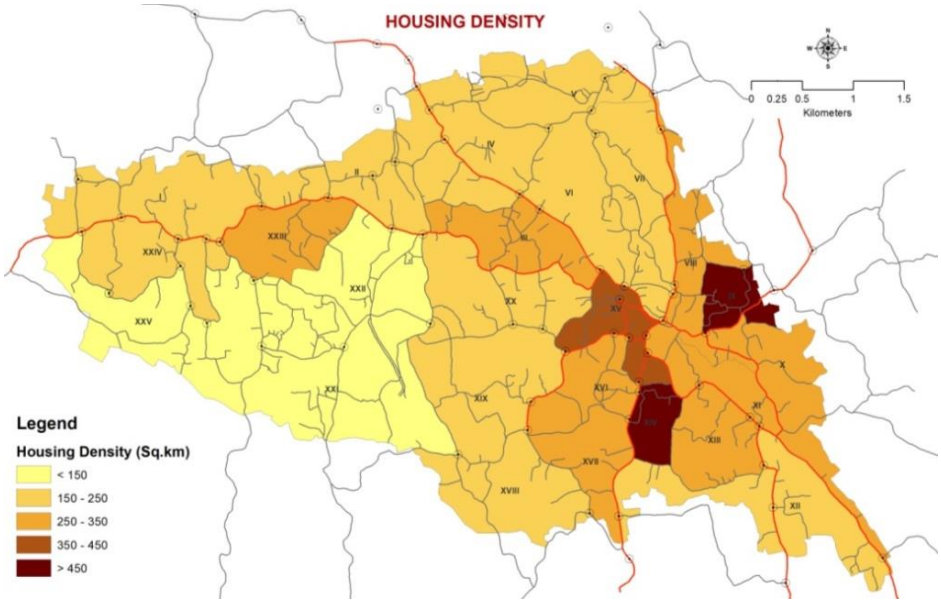
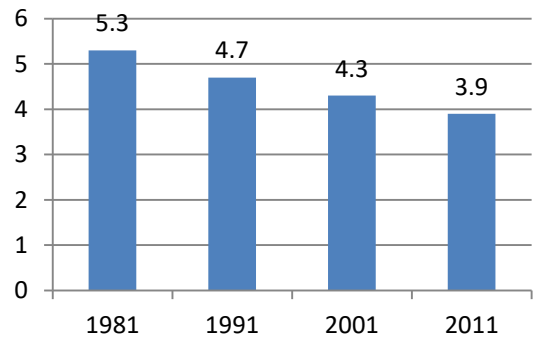


Figure 14-3 : Ward wise housing density

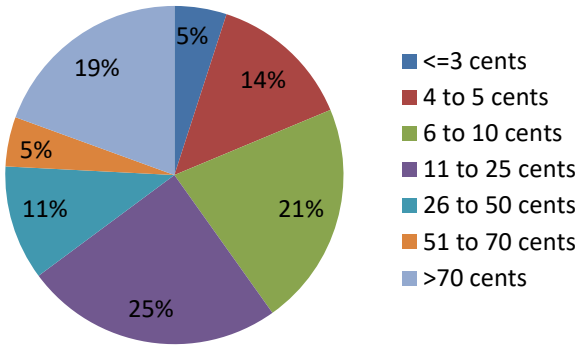
14.1.3 Household Size

As per the census 2011, the number of households in Koothattukulam is 4470 and the population is 17253. The household size of 2011 is calculated as 3.85. The variation in house hold size in the Town from 1981 to 2011 is shown in figure 14-4. This shows that the household size has a decreasing trend which can be observed in State, District and in the taluk also. It indicates the shift towards smaller family sizes in koothattukulam Town.



Source : Census of India 2011

Figure 14-4 : Variations in House hold size from 1981 to 2011



Source : Socio Economic Survey 2016

Figure 14-5 : Percentage variations for each category of plot area

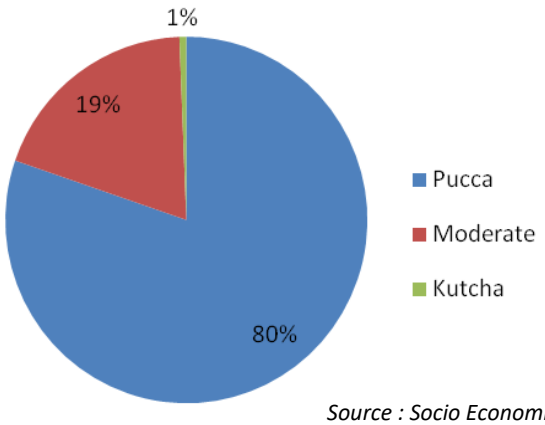
14.1.4 Residential Plots- Plot Size

Details regarding the size of plots and ownership of plots have been collected in the Socio – Economic survey conducted by Regional Town Planning Office, Ernakulam in 2016. The

percentage variation for each category of plot area as per Socio-economic survey (2016) is shown in figure 14-5. It shows that a total of 60% of the category belongs to plot size of 4 to25 cents. The Socio-Economic Survey revealed that majority of households in the Town, i.e. 98.5% have their own land and 0.75%of household have lease land.

14.1.5 Structural Condition of Houses

The percentage of different types of buildings as per secondary data indicates that 80% houses are pucca, 19% moderate and only one percentage kutcha houses are present in the Town. It is represented in Figure 14-6. But the socio-economic survey results on structural condition of houses shows that 70.32% of houses are pucca building, 22.44%of buildings are moderate buildings, 5.99% of buildings are kutcha buildings and 1.25% of buildings are huts.



Source : Socio Economic Survey 2016

Figure 14-6 : Percentage variation of houses based on types of building

The socio economic survey result of different percentage of houses based on the material used for floor shows that only 13.47% of houses used mosaic+marble as floor material. Earth+ordinary tiles+cement as floor material is used by 42.89% and 43.64% houses used other materials for flooring.

The socio economic survey result on different percentages of houses based on types of wall material used for construction shows that 70.07% of houses have brick plastered wall and 23.44% of houses have brick wall which constitutes 93.51% of the total houses surveyed. No houses used grass and coconut leaves for wall material and only 0.25% used plastic as wall material and the rest 4.49% used earth blocks as wall material.

The survey results on the percentage of houses based on type of material used for roof construction shows that no houses used Plastic or Grass or coconut leaves as roof material among the surveyed houses. 74.81% houses have concrete and 25.19% used Tin or Asbestos or Tiles as roofing material.

14.2 HOUSING SHORTAGE

Surveys have been undertaken under various schemes of the Municipality to find the landless and houseless population. As per the Pradhan Manthri Awas Yojana (PMAY) survey, about 567 houseless and landless were identified which is the present total housing shortage in Town. There are 71 landless among them. Dilapidated and substandard houses which need replacement are also included. This shows that the houseless and those live in dilapidated houses constitutes a total number of 496 households. According to the PMAY detailed project report, through the EMS survey held with respect to houseless/landless households about 311 households were identified as on 2015. Details of landless/houseless households as per the EMS survey according to PMAY detailed project report is shown in table 14-1.

Table 14-1 : Details of landless/houseless households as per EMS Survey

From the records of EMS Housing Scheme		Status as on 30/05/2015	
Houseless household	Landless/houseless households	Houseless household	Landless/houseless households
326	66	245	66

Source : PMAY Detailed project report,2017

Efforts have been made to address the issue through various programmes like EMS housing, Janakeeyaasootranam project, but still there is a demand for housing in the Town area.

14.3 HOUSING SCHEMES

14.3.1 EMS scheme

The EMS Housing Scheme envisioned with the objective that there should be no homeless family in the state. EMS total housing scheme launched by Government of Kerala aims at providing house sites to all landless families and houses to all houseless families coming under the BPL category. Details of beneficiaries benefitted through EMS Scheme according to PMAY detailed project report is shown in table 14-2.

Table 14-2 : Details of beneficiaries benefitted through EMS Scheme

Koothattukulam Municipality	Beneficiaries Identified-houseless	Beneficiaries Houseless benefitted	Beneficiaries Landless/ homeless Identified	Beneficiaries Landless/ Homeless benefitted
EMS HOUSING SCHEME	326	81	399	0

Source : PMAY Detailed project report

14.3.2 LIFE Mission

Government of Kerala is undertaking a massive housing campaign to build houses for 2 lakh families without land or housing, which was inaugurated on Kerala Piravi, 1 November 2016. Emphasis will be on financial empowerment and providing means of livelihood. All landless and homeless will be rehabilitated in the next five years.

LIFE Housing Scheme with a mission of homes to all landless or houseless has identified a plot in ward 21, with an extent of one acre seven cents including a road and an Anganawadi. This is shown in figure 14-7. Housing plots extending 4 cents each are already given to 20 families. Flats are proposed in the remaining land and nearly 67 people are identified as beneficiaries.

14.3.3 PMAY Housing for All (HFA) mission

Housing for All (HFA) mission is a central government scheme launched with an objective of addressing the housing requirement of urban poor including slum dwellers through following programme verticals:

- Slum rehabilitation of slum Dwellers with participation of private developers using land as a resource.
- Promotion of affordable housing for weaker section through credit linked subsidy.
- Affordable housing in partnership with public & private sectors.
- Subsidy for beneficiary- led individual house construction.

The detailed project report prepared for Koothattukulam Municipality under Pradhan Mantri Awas Yojana (PMAY) identified 81 families as beneficiaries under Credit linked subsidy scheme and 161 families as beneficiaries under Beneficiary Led house construction. In new house construction beneficiaries 18 SC category, 75 OBC category and 68 general category households are included; among them 114 beneficiaries belong to BPL category. It

was found that among the 161 households 156 were having semi pucca houses while 5 of them were having kutcha house.

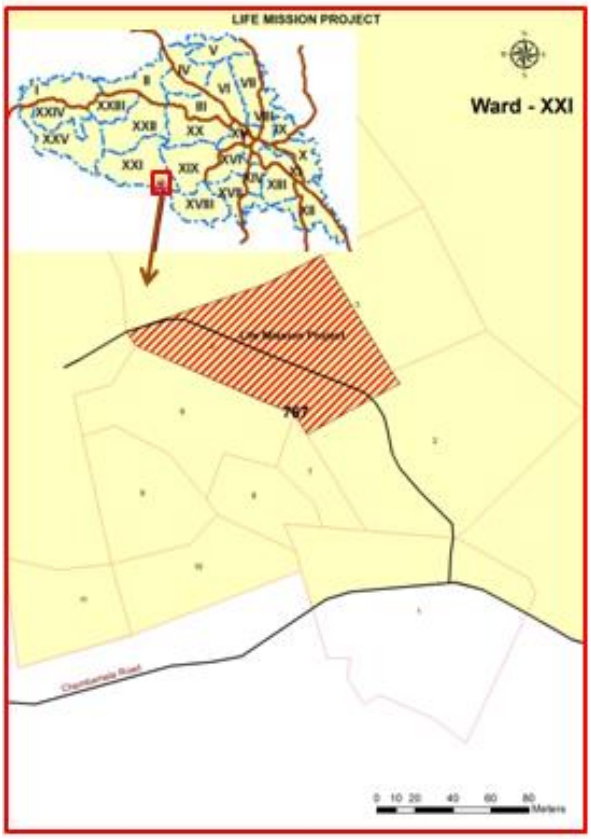


Figure 14-7 : LIFE mission project in Koothattukulam Town

14.4 SUB-STANDARD HOUSING/ SLUMS

There is no government notified slum area in the Town but 14 sub standard housing colonies are present. Sub-standard housing colonies are housing agglomerations with no or insufficient basic facilities. The details of substandard housings are given in Table 14-3. Their locations are given in figure 14-8.



Puttanimala colony



Harijan Colony



Lakshamveedu colony

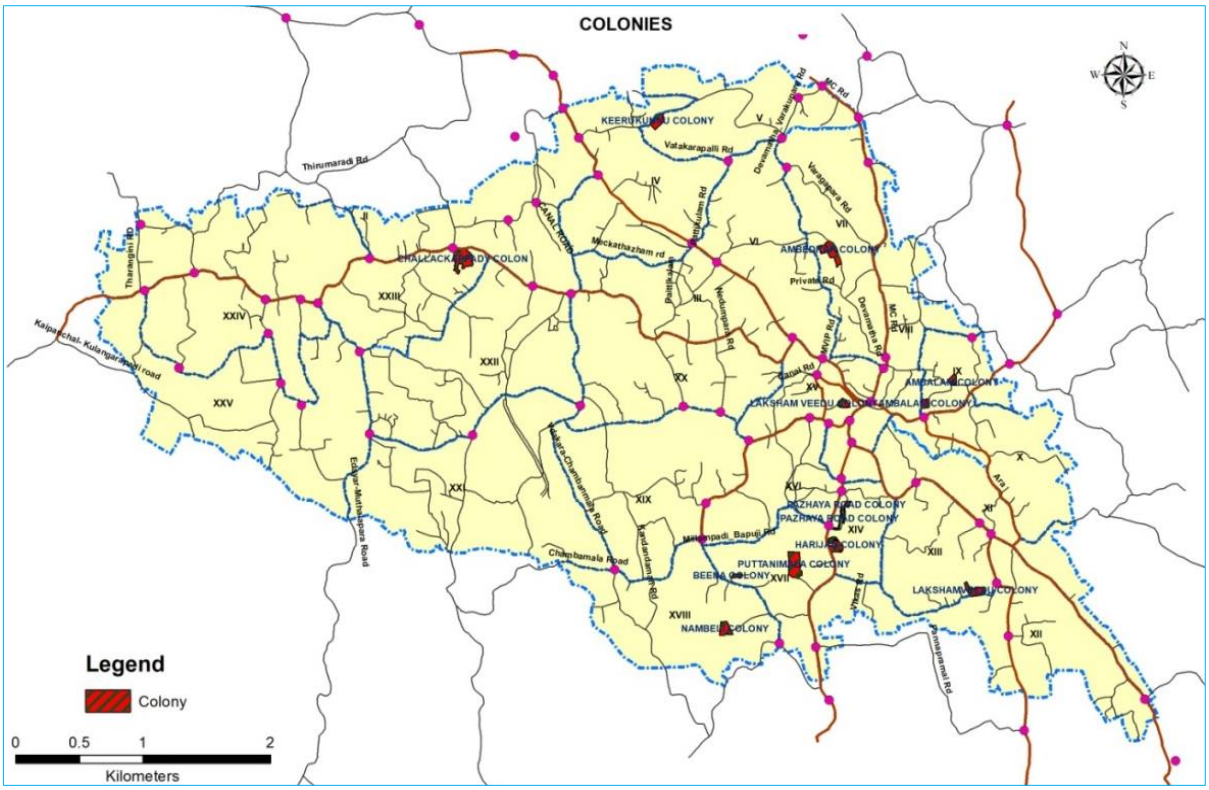


Figure 14-8 : Spatial distribution of colonies in Koothattukulam Town

Table 14-3 : Details of Housing colonies in Koothattukulam Town

Sl No	Name of Colony/Slum	No of Houses
1	Harijan Colony	42
2	AmbalamBhagam Colony	11
3	Nambely Colony	32
4	EdayarLakshamveedu Colony	24
5	ChellackapadyLakshamveedu Colony	40
6	Puttanimala Colony	31
7	Beena Colony	10
8	MangalathuThazhamLakshamveedu Colony	20
9	Venkulam Colony	7
10	OnamkunnuLakshamveedu Colony	16
11	Pazhaya road Colony	30
12	Keerukunnu Colony	23
13	Ambeker Colony	31
14	I.M Varkey Colony	5

Source : Koothattukulam Municipality

14.4.1 Grading of Sub-Standard Housing

The basic facilities of each sub-standard housing area are noted during the survey and a weightage is fixed based on the infrastructure facilities such as access of road, population

density, SC/ST population, drainage facility, number of street light etc. The majority of people in substandard housing areas are backward classes and below poverty line. The indication of backwardness, their minimum standard and weightage assigned are listed in table 14-4. The area with weightage of 40 or above would be treated as slum.

Table 14-4 : Grading of colonies in the Town

Sl No	Name of Colony/Slum	Weightage								Combined Weightage
		Sanitation facilities	Drainage	Access Road	Water Supply	Street Light	Density	SC Population	Housing Condition	
1	**Harijan Colony**	0	10	5	4	1	2	9	2	**33**
2	**AmbalamBhagam Colony**	0	10	5	0	1	4	0	2	**22**
3	**Nambely Colony**	0	10	6	0	1	7	2	1	**27**
4	**EdayarLakshamveedu Colony**	0	10	7	4	1	8	5	1	**36**
5	**ChellackapadyLakshamveedu Colony**	0	10	5	4	2	5	1	2	**29**
6	**Puttanimala Colony**	0	10	5	3	1	20	4	3	**46**
7	**Beena Colony**	0	10	6	1	0	7	5	1	**30**
8	**MangalathuThazhamLakshamveedu Colony**	0	10	7	1	1	10	2	2	**33**
9	**Venkulam Colony**	0	10	7	1	1	4	1	0	**24**
10	**OnamkunnuLakshamveedu Colony**	0	10	6	1	1	6	2	1	**27**
11	**Pazhaya road Colony**	0	10	3	1	1	11	3	3	**32**
12	**Keerukunnu Colony**	0	10	7	5	3	4	4	2	**35**
13	**Ambeker Colony**	0	10	5	0	2	7	7	1	**32**
14	**I.M Varkey Colony**	0	10	3	4	1	5	0	0	**23**

GRADE D:

Colonies with combined weightage of 40 or above are categorized as Grade D which can be considered as Pucca slums. There is only one colony identified as grade D in Koothattukulam which is **Puttanimala Colony**.

GRADE C:

Colonies with combined weightage ranging from 30 and 39 are categorized as grade C colonies. These colonies are in slightly improved state compared to grade D colonies.

However severe problems on basic infrastructure, relatively high density and social backwardness exist in these colonies. The colonies identified under Grade C are:

- Harijan Colony
- EdayarLakshamveedu Colony
- Beena Colony
- MangalathuThazhamLakshamveedu Colony
- Pazhaya road Colony
- Keerukunnu Colony
- Ambeker Colony

GRADE B:

Colonies with combined weightage varying from 20 – 29 are categorized as Grade B colonies. The major problem is overcrowding of people. The colonies identified to be in grade B category are as follows.

- AmbalamBhagam Colony
- Nambely Colony
- ChellackapadyLakshamveedu Colony
- Venkulam Colony
- OnamkunnuLakshamveedu Colony
- I.M Varkey Colony

GRADE A:

Grade A colonies are in a comparatively well developed state. Most of the basic infrastructures are available in such areas. With less financial support these colonies could be developed as normal housing area. But there is no Grade-A colony in the Town area.

14.5 INFERENCE

Spatial distribution of residential areas shows that it is scattered in the Town area with more concentration toward the major road sides towards the central Town. The socio economic survey details shows that 98% of the people lives in their own land and the structural condition of the houses are good with more than 90% people live in pucca/ moderate houses but 7.24% lives in kutcha/huts.

There is no government notified slum area in the Town even though the substandard housing areas in terms of housing colonies are present. Housing shortage and presence of substandard housing colonies are main problem in the Town. The situation of substandard housing colonies shows need for immediate attention to improve the status of basic facilities in them especially in Puttanimala Colony which is the only Grade D colony in the Town. Grade C colonies are to be considered as the second priority areas. The status of infrastructure in Grade B colonies is comparatively good. Government has initiated different schemes to solve the problem of housing shortage in the Town.

15 SPECIAL CONCERN AREAS

15.1 SC POPULATION

According to 2011 census SC population of Koothattukulam Town is 1029, which is about 5.97% of the total population of the Town. The comparison of SC population with nearby LSGIs in Ernakulam District in the year 1981 to 2011 is shown in figure 15-1. The SC population in the Town is in the middle on comparison with the nearby LSGIs and shows a slight decreasing growth trend like the other LSGIs.

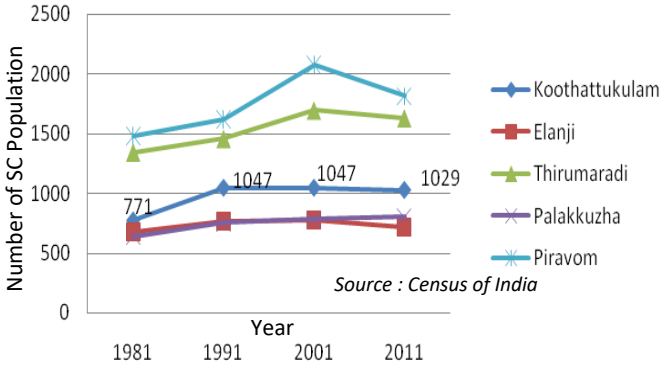


Figure 15-1 :Comparison of SC population with nearby LSGIs

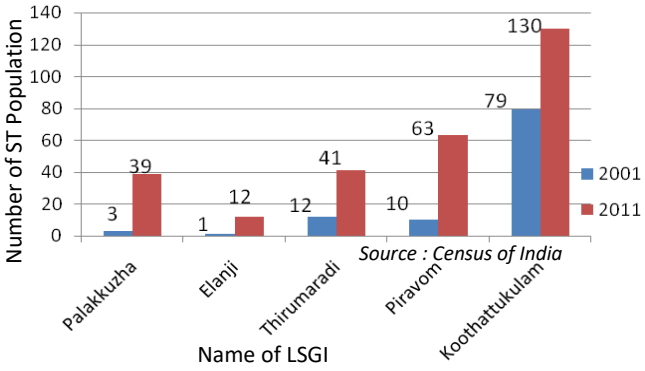


Figure 15-2 :Comparison of ST population with near LSGIs

As per secondary data from the local body, the SC population In Koothattukulam is distributed in all the wards and is more in wards 1, 4, 5, 9 and 17. The secondary data shows that there are 250 SC families with a total number of 999 persons present in the Town, out of which 436 are male and 563 are female population.

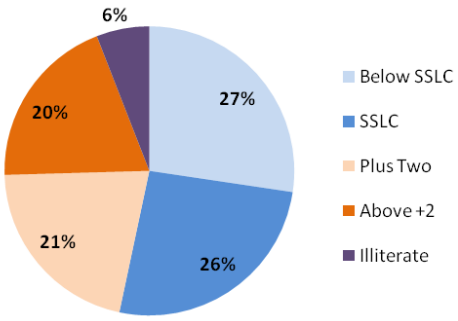
15.2 ST POPULATION

As per 2011 census, ST population in the Town is 130, which is about 0.75% of the total population of the Town. Comparison of ST population in the year 2001 and 2011 with nearby LSGIs is shown in figure 15-2. From the figure it is observed that the ST population is more in Koothattukulam Town on comparing with the nearby LSGIs and it shows an increasing trend like other LSGIs.

The secondary data shows that there are 34 ST families with a total number of 112 persons present in wards 3, 6, 7 and 12 of Koothattukulam Town, out of which 59 are male and 53 are female population.

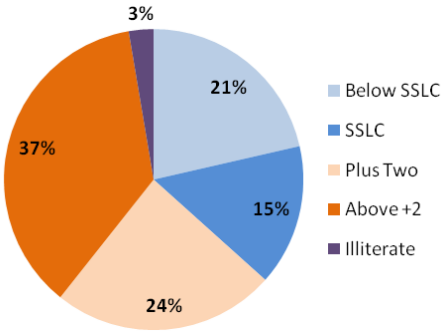
15.3 LITERACY

As per secondary data, out of 947 persons 6% of SC population and out of 112 persons 3% ST population are illiterates. The educational qualification of SC and ST population as per secondary data in Town is shown in figure 15-3 and 15-4. Figure shows that only 67% SC population and 76% of ST population have educational qualification of SSLC and above.



Source : SC Dept.

Figure 15-3 : Educational qualification of SC population



Source : ST Dept.

Figure 15-4 : Educational qualification of ST population

15.4 OCCUPATION

Occupational status of SC families in Koothattukulam Town is shown in table 15-1. From this secondary data we can see that only 65 of them are employed in the given categories. 40 persons are working in Permanent -Government sector, 10 persons are working in Permanent- private sector and 5 of them are having self employment agriculture sector.

Table 15-1 : Occupational status of SC Families

Sl. No.	Occupation	Male	Female	Total
1	Permanent -Government	35	5	40
2	Permanent -Private sector	_	10	10
3	Temporary -Government	_	5	5
4	Temporary -Private sector	_	2	2
5	Self employment -Agriculture Sector	_	5	5
6	Other Self employment	_	_	_
7	Labourer -Other than agriculture Sector	_	3	3
8	Labourer -agriculture allied Sector	_	_	_
9	Labourer -Construction field	_	_	_
Total Employment		35	30	65

Source : SC Dept.

Occupational status of ST families is shown in table 15-2. This secondary data on occupation shows that out of 155 persons, 80 of them are unemployed, 40 persons have Government

job, 20 persons are non agricultural labourers, 10 are having permanent job in private sector and 5 are engaged in the collection of medicinal herbs.

Table 15-2 : Occupational status of ST Families

Sl. No	Main work	Person	
		Number	%
1	Collection of medicinal herbs	5	3.23
2	Agricultural Labours	_	_
3	Non agricultural Labours	20	12.9
4	Government / semi Government job	40	25.81
5	Permanent job in private sector	10	6.45
6	Permanent job in forest areas	_	_
7	Others	_	_
8	Unemployed	80	51.61
Total		155	100

Source : ST Dept.

15.5 OTHER SOCIAL ASPECTS

SC population can be seen in all the sub slandered housing colonies in the Town except 2 colonies (Ambalam Bhagam Colony and I.M Varkey Colony) and only housing colony with ST population is Ambekar Colony. As per the secondary data, one ST family in Arjunanmala colony is landless. Harijan colony has more number of SC population (150 persons) and the other colonies with more number of SC population are Edayar Lakshamveedu Colony, Keerukunnu Colony and Puttanimala Colony. 100 households with a population of 387 persons inhabits in these colonies. The other problems include lack of basic amenities and infrastructure in SC colonies and poor educational attainments of the deprived sections especially those belong to SC community.

The demographic structure of the state shows the larger share of female population and the increasing share of old age population. According to 2011 census details, Koothattukulam Town has a sex ratio of 1058 with a female work participation rate of 31.54%. It shows the need for empowering women by providing social security and support in economic activities. From the age sex pyramid, the share of children and old aged can be calculated. The share of 0- 6 age group is 7.6% and the total share of 0 – 15 age group is 14.3% which shows the need for special consideration for children during the planning process. The share

of persons aged 60 and above (old age population) is 21.7%. The increasing share of old age population in the demographic structure shows the need for immediate attention for seniors in every Development Plans by providing necessary supporting infrastructure facilities in housing and transportation for their active involvement in economic activities to live a happy and healthy life.

At present, there is one working woman's hostel and two old age homes are present in Town. Working women hostel known as 'Janani Working women hostel' started on 1/1/2018 situated in Kerala state service pensioners building located at ward 8 of the Town has a total accommodation strength of 18 women. One old age home is located at ward 2 with an area of 2 acre known as 'Gilead Orphanage and Retreat Centre' under the ownership of Orthodox Sabha with government sanction to accommodate maximum 35 persons. Another old age home is located at ward 8 with an area of 1.5 acre known as 'Karuna Bhavan' under the ownership of Snehagiri convent with a capacity to accommodate maximum 50 persons.

15.6 INFERENCE

Koothattukulam Town shows an increase in number of SC/ST population but unemployment is a major problem faced by these weaker sections. So projects for providing employment opportunities for ensuring their economic development are to be made. The concentration of SC families in the housing colonies and landless families among these weaker sections shows the need for support and consideration for them during the planning process.

The changing demographic structure of the Town shows the need for planning for old age population and projects have to be developed for the welfare of all the weaker sections of society including women, children, old age and SC/ST population. New initiatives for ensuring social security for all the weaker sections of the society should be developed to bring them to the mainstream. Women, children and old age people need special consideration in the new Development Plans.

16 ENVIRONMENT

The environment of a city is a critical determinant of the health of its inhabitants and consequently, urban productivity, but Urbanization leads to many environmental problems of varying extent and it varies from Town to Town. Proper Planning and awareness to public is needed to keep the urban environment safe for its inhabitants. The environmentally sensitive areas and the various environmental issues faced by the Town are explained in this chapter.

16.1 SENSITIVE / FRAGILE AREAS

Sensitive /fragile area in the Town includes water bodies, sacred groves and paddy or low lying lands. Uzhavoor thodu and other water bodies, kizhakombu kavu and paddy fields are the main environmental sensitive areas in Koothattukulam Town.

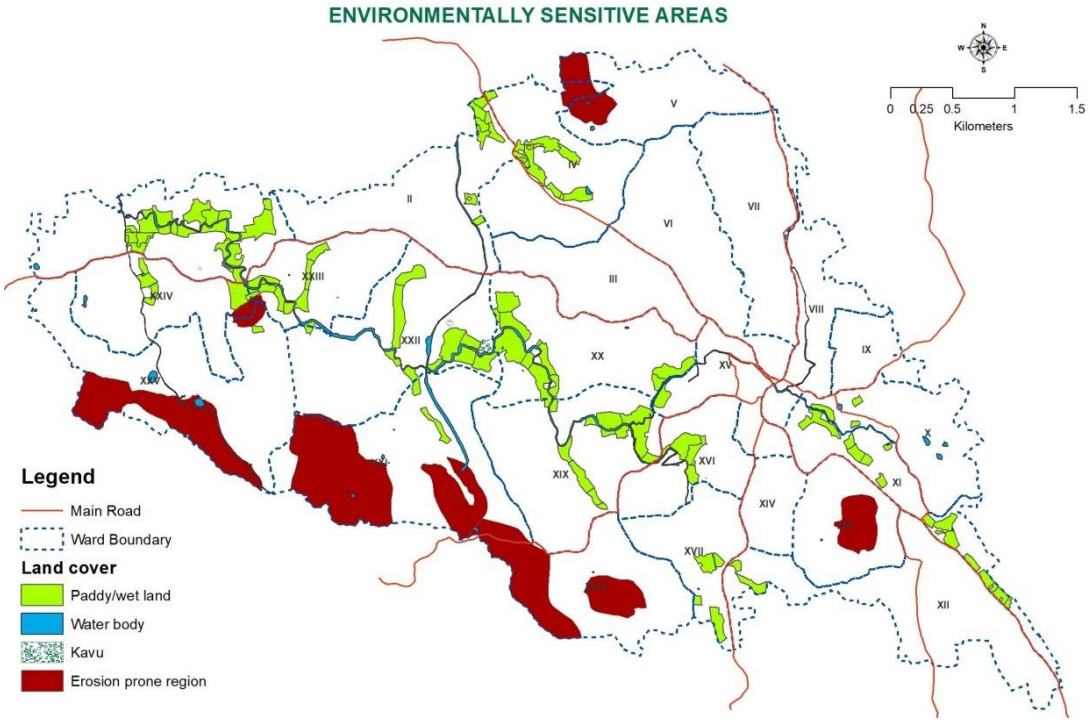


Figure 16-1 : Environmental sensitive areas in Koothattukulam Town

16.1.1 Water Bodies

Uzhavoor thode, Valiya thode, Cheriya thode, Chantha thode and canals of Moovattupuzha irrigation project passing through the Town are the main water bodies and the main sources of irrigation in the Town. Other water bodies like ponds are also present in the Town. Existing water bodies, paddy fields and sacred groves (kavu) are shown in figure 16-1.

Flood 2018: In view of August 2018 flood disaster occurred across the Kerala State, the Regional Town Planning Office has studied the impact of flooding on the land use in the district. As per the impact analysis of mega flood – 2018 in Ernakulam district, it is seen that out of 14 urban local bodies in the district, 13 local bodies were affected with 2018 flooding except Koothattukulam town. The following map shows the local bodies in the district affected with the 2018 flood:

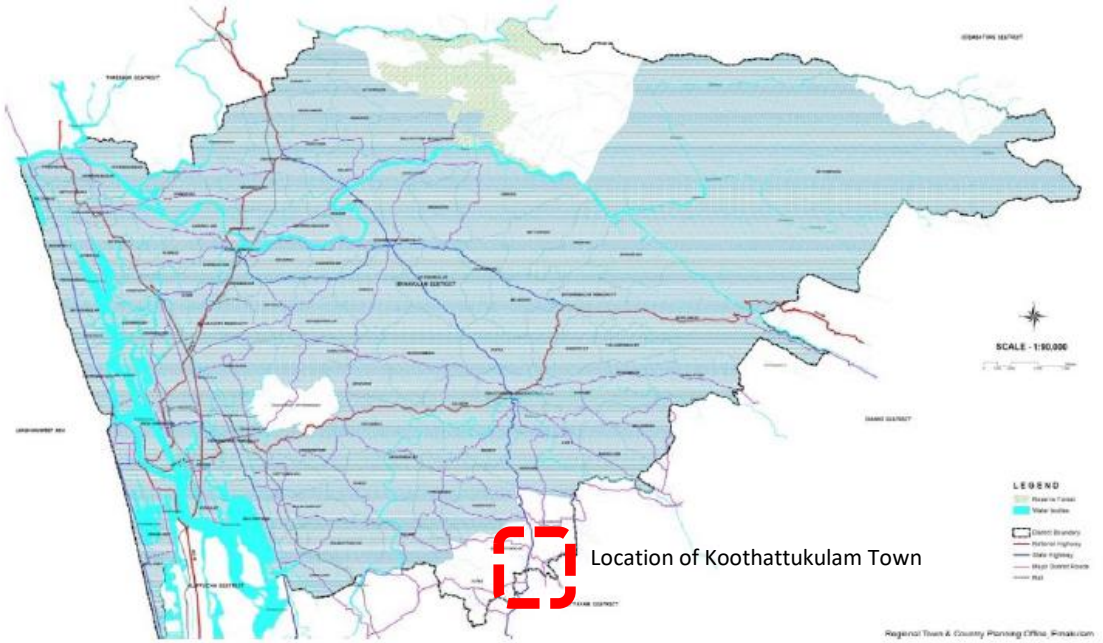


Figure 16-2 : Local bodies in the District affected with the 2018 flood



Pond



Ramanchira Thodu



Kizhakombu Kavu

16.1.2 Sacred Groves/ Kavu

In Koothattukulam there is one major kavu of area 1.2 acre known as Kizhakkombu Kavu, and other small kavu related to Hindu temples are present. In this evergreen sacred grove, big old trees and various types of medicinal herbs are seen. Considering the environmental aspects these sacred grooves may be protected as it is.

16.1.3 Paddy field

As per the land use survey 2016, only 129.36 hectares land, which is 5.5 % of the total area is wet land and 60 ha paddy cultivation is present. But as per "Koothattukulam gramapanchayath vikasana report, 1996" the total paddy land was 325ha in which 201 ha paddy cultivation was present, and 102ha was unused agriculture lands. This shows a reduction of 60.19% in total paddy land use and 70.14% reduction in paddy cultivation. This is primarily due to due to conversion of paddy lands for growing up more economical crops such as rubber and other garden crops.




Paddy lands in Koothattukulam

Paddy fields play a vital role in the ecological balance of the area. In addition to its agriculture importance it also acts as a collection basin of rain water and recharges the ground water resources. So these low lying areas have to be conserved for ground water recharge.

16.1.4 Erosion prone regions

Erosion prone regions in Town according to land capability studies by soil survey department come under other environmentally fragile zones. Land Capability is the grouping of one or more individual soil mapping units having similar potentials and continuing limitations or hazards. Sharma H.S (1972), defines, "land capability classification as a field investigation of soil properties, slope, degree of soil erosion and changing Land-use patterns which form the basis for future planning of soil and water conservation". Based on these factors the capability of a region is divided into different units, sub classes and classes.

Class VI group of capability of land have very high restriction of erosion and slope. These regions in Koothattukulam Town are shown in figure 16-1. Due to steep slope characteristics, this area is suitable for crops with minimum tillage and is best suitable for forest and grass land. This zone is considered as environmentally fragile zone. Hence large scale construction should be limited. Some areas of the south-western boundary of Koothattukulam Town come under this zone.

16.2 ENVIRONMENTAL ISSUES

16.2.1 Solid waste disposal

The issues of solid waste disposal are present in Koothattukulam Town. The problems related to solid waste management like lack of segregation of waste at source due to unavailability of secondary storage space for solid waste collection, no treatment to the waste generated and the direct dumping of waste in the available land, etc are present. Major portion of solid wastes are generated from the central area of Town. Lack of land available for dumping or segregation is the major issue in this regard faced by the Town. Also inadequate drainage system and insufficient number of drains is a problem in the drainage system in Town.

16.2.2 Water Pollution

Water pollution is the contamination of water bodies (e.g. lakes, rivers, oceans, aquifers and groundwater). Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds. The leachate coming from the dumped market waste in the Chantha thodu is the main source of pollution here. Also, the Uzhavoor thodu is facing pollution and the main pollutant identified is market waste.

16.2.3 Air and Noise Pollution

The increase in motor vehicular traffic in Town has contributed to air and noise pollution which in turn has an adverse effect on the health of its inhabitants. The emissions from vehicles are the main cause of air pollution in urban area. In central area of the Town there is air pollution in limited extent due to traffic congestion. The important source of noise pollution is motor vehicles which is experienced during day and night in major roads.

16.2.4 Soil erosion

The undulating terrain with hills and low lying land in between the hill and certain area with steep slope need special attention. The soil survey report based on cadastral level mapping published by Soil Survey Department, Kerala during 2011 classified soils of Koothattukulam into five soil series based on its characteristics. They are Kothamangalam, Mulamthuruthy, Irapuram, Odakkali and Perumbavoor. The soil erosion details in Town are shown in table 16-1. Odakkali series are prone to moderate to severe soil erosion due to its physiographic position and need urgent soil conservation measures to increase soil productivity and to reduce soil loss. The vegetation and green cover of these soil erosive areas are to be protected and other preventive measures are to be taken to prevent soil erosion.

Table 16-1 : Soil erosion details in Koothattukulam Town

Soil series	Total area (ha)	Erosion class		
		Slight	Moderate	Severe
Odakkali	1039	--	988	51
Perumbavoor	603	161	442	--
Irapuram	249	18	231	--
Mulamthuruthy	257	257	--	--
Kothamangalam	112	112	--	--
Total	2260	548	1661	51

Source : Soil Survey Dept.

16.3 INFERENCE

Since Koothattukulam is a growing Town its environmental issues need to be addressed at this stage itself and planned growth of the Town has to be ensured for its inhabitants with consideration to its environment. In the planning area priority has to be given for protection of environmentally sensitive areas like water bodies, paddy fields and sacred groves. Soil conservation measures to reduce soil erosion and new waste management solutions needs to be developed for the Town.

17 DISASTER MANAGEMENT

The primary goal of the Disaster Management is to reduce the likelihood that the Muncipality 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. 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.

The Ernakulum city currently holds a Disaster Management Plan prepared in the year 2015 by Kerala Disaster Management Authority. However events like the flood of 2018 and unpredictable climatic events have occurred over the recent years.

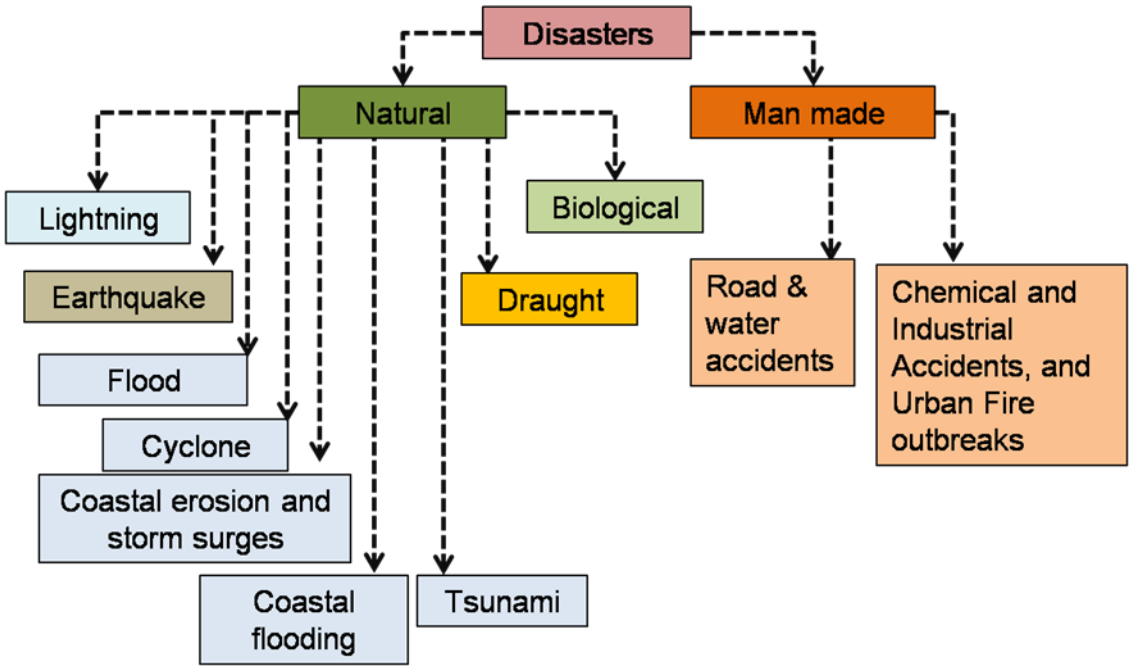


Figure 17-1 : Types of Disaster

Table 17-1 : Hazard Seasonality mapping of the district, Source: District Disaster Management Plan, 2015 Ernakulam and KSDMA data

Disaster	J	F	M	A	M	J	J	A	S	O	N	D
Earthquake												
Drought												
Wildfire												
Lightning												
Flood												
Cyclone												
Coastal erosion and storm surges												
Tsunami												
Landslide												
Epidemics												
Road/water related accidents												

Table 17-2 : Profile of Disasters in Koothattukulam

Earth quake	Land slide	Coastal Related	Floods	Lightning	Drought	Cyclone	Epidemics
Nil	**Nil**	**Nil**	Inundated areas in Broad flat bottom valleys (Paddy fields) Koothattukulam, Idayar, Kizhakombu, Vadakara	Moderate	Moderate draught	Nil	Common Vector related diseases. , However less compared city region

Source: District Disaster Management report 2015 for Ernakulam, Draught situation Analysis report by KSDMA 2017

The monsoon season ticks 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. Occurance of earthquake and tsunami is majorly geological related and is expected at any time of the year.

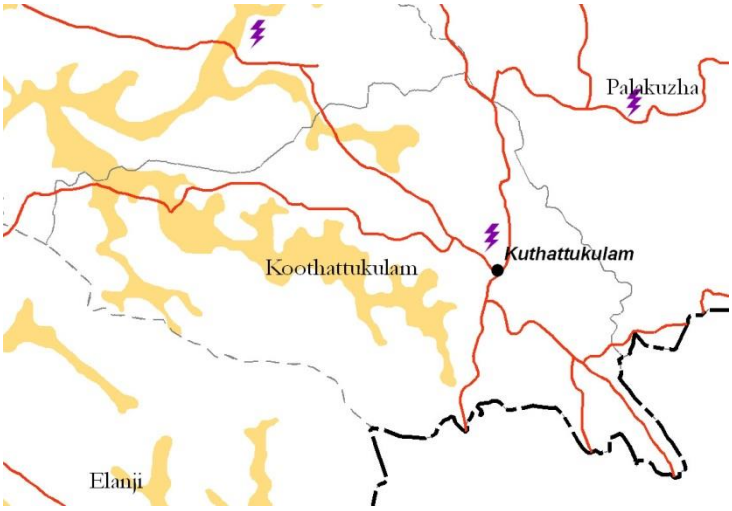


Figure 17-2 : Bitmap of Koothattukulam from Multi Hazard map of Ernakulam district, Source: Cochin Corporation

17.1 Earthquake

Kerala has been placed in **zone III,** where the maximum expected **intensity is 5.6 M.** Ernakulam district which falls under the low lying terrain has high probability of occurrence of earthquake which is anticipated due to the rising building construction activities in the area.[1]Kerala has experienced occasional mild tremors since historical times. However pockets of higher ground acceleration have been identified in central Kerala. In this region higher levels of earthquake hazard are expected calling for the introduction of better building practices. In Kerala, several deep seated faults exist, the notable among them are Periyar fault, Idamalayar fault, **Muvattupuzha fault**, Bhavali fault and Kuthuparamba fault. Besides there are many more minor faults and fractures that can generate minor tremors as a result of crustal readjustment.

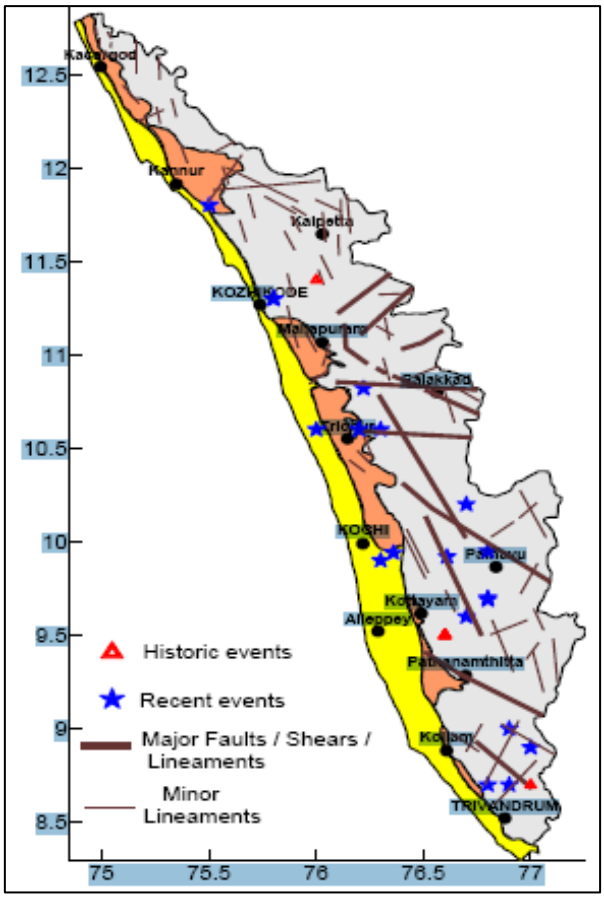


Figure 17-3 : Location of historic and recent earthquakes in Kerala, Source: Kerala State Disaster Management Plan Profile

[1] Disaster Management Plan Ernakulum district - KSDMA

17.2 Landslides

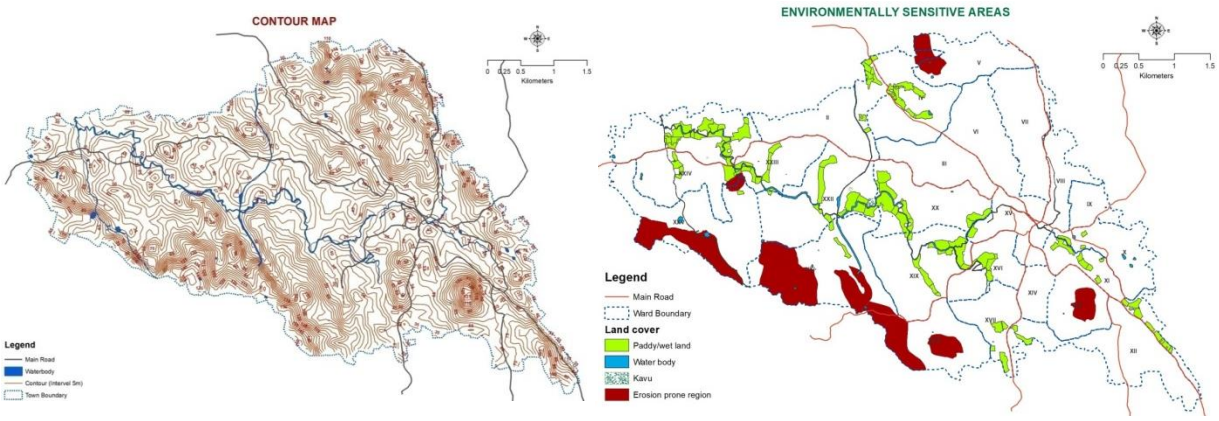


Figure 17-4 : Contour map and environmentally sensitive areas in Town of the Town

On analysing the contour map and the environmental sensitivity map it can be deciphered that the steep slopes combined with the presence of 'Perumbavoor and Odakkali' types of soil can lead to erosion and on disturbance mild landslides in the South west region of the Muncipality, especially during torrential rains. However the disaster management plan 2015 have not yet recorded it as a major threat.

17.3 Flood

The central canal (Chanda Thodu) and its surrounding areas are found to be prone to inundation as per the multi hazard zonation map above. As the area surrounding the canal is scattered with wetlands and paddy fields it can act as a green sponge in taking in excess water. However any change in its land use, reclamation etc can lead to future flood issues in the central area. Further conservation measures for this green sponge to take in the flood waters can help the town from future floods. Koothattukulam, Idayar, Kizhakombu and Vadakara are also earmarked as flood prone areas.

Flood 2018: Ernakulam district receives an average annual rainfall of 3289 mm. As per IMD data, the district received 2477.8 mm of rainfall from 1 June 2018 to 19 August 2018 in contrast to an expected 1680.4 mm of rainfall. This was 47% excess to the normal. As mentioned in earlier in the Chapter : Environment , based on the study conducted by Regional Town planning Office , out of the 14 urban local bodies in the district 13 local bodies were affected with 2018 flooding except Koothattukulam town. This may be due to the absence of any major water body affecting the town area and good slope conditions to

aid the natural drainage flow. The presence of paddy wetlands along the spinal canal can help in accommodating the excess water.

17.4 Lightning

Occurrence of causalities during monsoon season is common within the district and therefore can be considered as thunder and lightning prone district of the state. 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 central town and northern parts are found to be vulnerable.

17.5 Draught

The district disaster management report 2015 classifies Koothattukulam into **No draught** class, However the more recent draught situation analysis study conducted by KSDMA classifies Koothattukulam into **Moderate draught** classification. This shift might be due to the rainfall pattern that has become more unpredictable and the unprecedented use of ground water which has increased over time along with reduction in vegetative ground cover and rapid urbanisation. As per the analysis a rainfall departure of -41.98 is observed in Perumbavoor which is the closest station.

Table 17-3 : Rainfall data analysis of different locations in the District

STATION NAME	SUM	NORMAL	DEP
Aluva(ALU)	1293.8	2603.1	-50.30
Ernakulam South(ERS)	1468.55	2603.1	-43.58
C.I.A.L. Kochi(CIAL)	1293.05	2603.1	-50.33
NAS Kochi(KCHI AP)	1200.45	2603.1	-53.88
Paravur(PVR)	4.5	2603.1	-99.83
Perumbavur(PBR)	1510.225	2603.1	-41.98
Piravom(PRV)	2359.5	2603.1	-9.36

Groundwater departure map prepared by KSDMA shows a low to moderate departure in the GW level in the Koothakulam area.

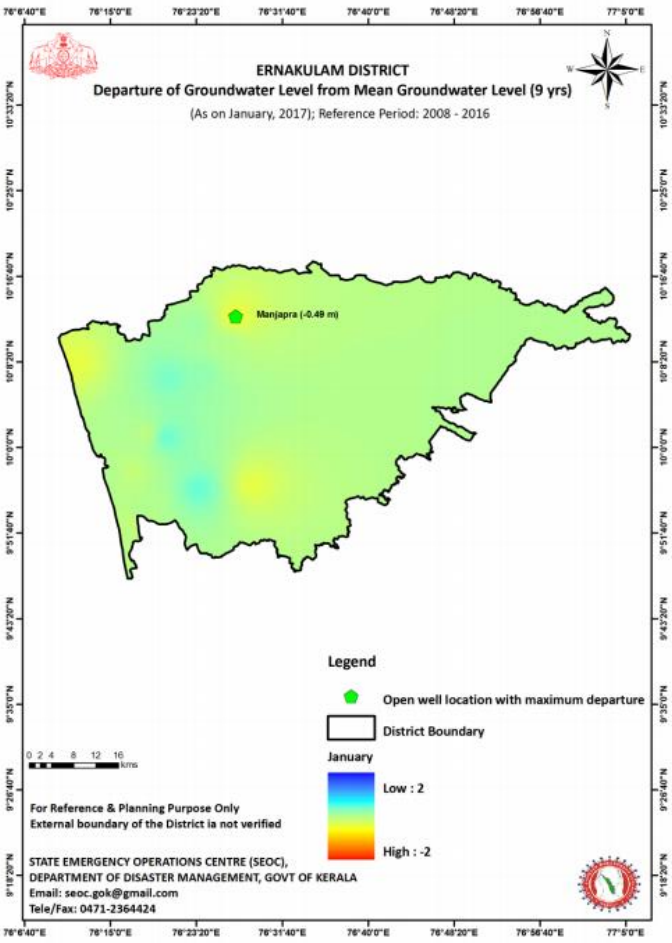


Figure 17-5 : GWL departure from MGWL for last 9 years , KSDMA 2017

17.6 Biological

Although not as frequent as in the city region, stagnant waters in the town can lead to vector born diseases. Profused breeding of mosquitoes in drains and canals due to stagnation of water at various points and faulty gradient also cause this. Further, accumulation of silt and garbage invariably blocks the drains. Extreme and scattered rainfall events which are common now lead to outbreaks of vector diseases. The district disaster management plan 2015 for Ernakulam has not considered the probability of an epidemic outbreak and the possibilities of containment as the occurance of a global pandemic of biblical proportion is a new occurrence. 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 is high and therefore adopting early planning measures to arrest the outbreak and defining of containment zones needs to be considered.

17.7 Chemical Industrial and Fire outbreaks

MPI (Meat Products of India) is the only major industry here. There is no industry in Town, which could be pointed out as a cause for chemical and industrial disaster. The valley area can stagnate air pollutants as the easterlies are not strong here therefore not making it an ideal location for polluting industries 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. There also no major festival and major crowd events that might lead to stampedes or other related disasters as per disaster management report for Ernakulam 2015.

17.8 Response measures

List of schools in Koothattukulam that are shortlisted for emergency relief as per the disaster management report for Ernakulam 2015 are sown in the table below.

Table 17-4 : List of schools, which are shortlisted for emergency relief in Koothattukulam

Name of School	Location
Bappuji EMHS, Koothattukulam	Koothattukulam P.O., 686662
Infant Jesus EMHS, Koothattukulam (HS)	Koothattukulam P.O, 686662
High School, Koothattukulam	Koothattukulam P.O., 686662

In the wake of the flood 2018 and Ockhi cyclone, As per section 22(2)(f) of Disaster Management act 2005 it was decided to develop a handbook for public in order to obtain all disaster related information, codes and details in order to brace better called as the **Orange book of Disaster Management by KSDMA**. A framework of incident response system integrating various departments comprises the core of the book. It has been revised after 2019 floods.

As per the disaster management report 2015 for Ernakulam The disaster response phase involves emergency relief measures taken in anticipation of, during and immediately in the aftermath of a disaster event to ensure that the effects of the disaster are minimized. The stakeholders involved are as following:

The key activities in the disaster response phase is activating **The Incidence Command System** for the district which is an organized system of government departments and other agencies that are to be worked under a structured pattern for response and recovery with other bodies into **'Emergency Support Functions'** like Communication, Search and Rescue, Law and Order, Emergency medical Care, Public Works (debris / road clearance, equipment support), Logistics (Water, Electricity and Transportation) and Coordination (warning, evacuation, relief, shelter, damage assessment, NGO / volunteers Coordination, Public Information / Help lines) as per their nature and type of assistance they can provide in a crisis situation. **The State and District Emergency Operation Centres** would facilitate the State Disaster Management Authority / Department of Revenue and Disaster Management and District Disaster Management Authority / District Collectors in Coordination, Operation Management, Information Collection and Documentation, Public Information and Resource Management in this phase.

The District Collector / District Disaster Management Authority

- Activate all the institutional arrangements for disaster response
- Evacuation, search, rescue and relief activities
- Recommend declaration of an event as disaster, if required, to the State Government
- Coordinate with State Disaster Management Authority / Department of Revenue and Disaster Management for additional resource

Local Authorities

- local authorities including corporations, municipalities and district, block and grama panchayaths would work in close coordination with relevant government departments and district disaster management authorities

Non governmental Organisations and community groups

- The Village Disaster Management Plans shall be activated by Village Disaster Management Committee and the Task Forces such as Early Warning Team, Evacuation, Search and Rescue Team, First Aid Team and Water and Sanitation Team shall be activated

Private sector

- On –Site Disaster Management Plans developed, Mock Drills and capacity building in the pre –disaster phase, they may co-operate with relevant agencies in the conduct of emergency relief.
- Supply of emergency search and rescue items, drinking water, hardware items like generators, pumps, industrial equipment etc. along with deployment of volunteers

For the **evacuation search and rescue** the District Collector guided by relevant Disaster Management Plans and supported by government departments particularly Police and Fire and Rescue Services, Department of Health, local authorities and Community Task Forces, would be responsible for evacuation, search and rescue. The relevant government departments should give priority to ensure sufficient **food and water supply**, sanitation mechanisms and temporary shelters to the affected population. The multipurpose community centres shall be converted to temporary shelters to accommodate

the displaced population. Next, the district administration and local authorities would work in close coordination with relevant Government departments to **restore the basic infrastructure and essential services** to normal operating condition. It is necessary that **law and order** is maintained properly and security to the affected population and aid workers is provided to ensure uninterrupted relief operations. The **immediate relief** packages should be need based and customized to the specifics of the disaster and affected community and adhered to the minimum standards set for relief distribution. The state government shall explore additional sources of funding from central government agencies, if budgetary allocations of the state government for relief activities and funds available under Calamity Relief Fund and National Calamity Contingency Fund are inadequate to meet the requirements. In order to ensure optimum utilization of limited resources in the most efficient manner and to avoid duplication and over stretching, preliminary assessments should be carried out by the government departments and local authorities. All of this is shortly followed by Reconstruction, Rehabilitation &Recovery measures.

The disaster management plan of Ernakulam district 2015 lacks a futuristic framework which is a dire need in the wake of several extreme rainfall and flood events that has happened in city recently. The plan also needs updation in terms of measures to be taken in case of a pandemic spread. Overall the the document needs to be a ready resource for all types of disaster events as Ernakulam has come out to be one of the most vulnerable districts in the world in terms of disaster events in the wake of climate change.

17.9 Way Forward

Aspect	Issues	Way forward
Earthquake	Kerala has been placed in **zone III,** where the maximum expected **intensity is 5.6 M**	Filling up of marsh lands and backwaters can be hazardous to be controlled **Micro seismic map** for understanding the vulnerability with technical assistance.
Flooding	• Urbanisation and sprawl into the flood plains	Preparation of an **integrated unified storm water drainage map** which offers a blueprint of

	• Loss of wetlands, marshlands and reclamation of water bodies • Unpredictable rain patterns • Silted and garbage laden canals	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 spinal canal 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 floodwaters would create a hazard.
Biological threats	• Pandemics /epidemics-containment of spread. • Known vector diseases	Dedicated areas/ makeshift areas for treatment, isolation and quarantine are less and therefore needs to be identified within each ward as assets which could used in emergencies. A fool proof **strategic plan for future pandemic spread** can be developed for the municipality.
Chemical, industrial and fire disasters	Valley areas can stagnate pollutants and flows of easteries are less.	Avoiding hazardous industries in future which could lead to air and water pollution, Chemical, industrial and fire disasters.
Draught	• Variations in Rainfall pattern and extreme rainfall events, along with depreciation. • Ground water depreciation	Rainwater harvesting and subsequent ground water replenishment through quarries and other water bodies. Rejuvenation of ponds and wetlands. Guidelines for water conservation and training at ward level in water conservation.
Climate change	• Change in temperature and precipitation can change	An updation of District Disaster Management plan 2015, to handle further disasters like

	local human and natural ecologies • Fluctuation in rainfalls can lead to loss of fertile lands , drinking water depreciation, vector born diseases, economic setbacks etc.	cyclones, extreme rainfall events, landslides, floods and pandemics which are of recent occurrence by the DDMA is advised. 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 corporation area training volunteers in emergency responses like first aids, search and rescue , emergency camps etc. **Early warning systems plan** within the muncipality 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 Muncipality which could be adopted else where.

17.10 Inference

Out of the 14 local bodies in Ernakulam district Koothattukulam alone stood resistant to flood hazards in 2018 due to its unique geographical and robust drainage conditions. However any future anthropogenic interventions disturbing the central canal and the paddy fields around it can lead to future flood conditions within the town. The South west region of the local body is steep and prone to erosion which requires this region to be conserved from punitive developmental activities. Other disasters like draught, lightning etc. although not dominant are to be looked out for through conservation of existing ponds & wetlands and installation of lightning arresters.

18 DEVELOPMENT ADMINISTRATION AND FINANCE

18.1 DEVELOPMENT ADMINISTRATION

18.1.1 The Elected Council

The elected council consists of 25 members one from each ward in the Town through election by the people of respective wards, among the 25 elected members 13 are women members. The Chairperson who is the head of the council has been elected from the elected members of the council. The Vice-chairperson, to assist the chairperson and also to discharge the duties of chairperson in his absence, is also elected by the members of the municipal council. There are six standing committees, i.e., for finance, public works, development, health, education and welfare to assist the municipal council in respective fields. Each Standing committee consists of four members except finance committee where there are five members. The vice-chairperson is the chairman of the finance standing committee and the members of the council will elect the chairpersons of other standing committees.

18.1.2 Administrative Structure of the Municipality

The Municipal Secretary is the executive head of the Municipality and he is supported by the following six sections of staff.

i. General Administration section
ii. Revenue section
iii. Engineering section
iv. Public health section and
v. Peoples planning section
vi. Accounts and Auditing.

18.1.3 General Administration section

The General Administration section is headed by the Junior Superintendent and consists of three sub-divisions i.e. Establishment, Accounts and other General matters.

18.1.4 Revenue Section

Revenue section is headed by the Revenue Officer. The section deals with the revenue of the Municipality.

18.1.5 Engineering section

The Engineering section is headed by Municipal Engineer in the cadre of Assistant Executive Engineer and is assisted by Assistant Engineer and Public works overseers. This section is responsible for the project planning, execution and maintenance of basic services and other infrastructure within the Town. This section looks after the implementation of the Development Plans and other Town Planning schemes, approval of building plan and lay out plans, detection of unauthorized construction, eviction of encroachments etc.

18.1.6 Public Health section

This section is headed by the public health officer Grade I. This section attends works like collection and disposal of solid wastes, cleaning of drains and work related to public health, mother and child care, C.D.S works etc.

18.1.7 People's Planning section

This section co-ordinates the plan formation under decentralized planning process. Annual plans and five year plans for the Municipality are being prepared under decentralized planning process.

18.1.8 Functions of the Municipal Council

Koothattukulam Municipality is the major agency implementing development works in Koothattukulam. The development works under the responsibility of Municipal Council include, the construction of Municipal roads and their maintenance, Public health - Primary health centre, Community health centre, Solid waste disposal, Construction of public market and their maintenance, Public cremation ground and its construction procedures, Open spaces, parks and their construction works, Providing infrastructure in slums, Protection of common ponds, The maintenance of the institutions transferred to the Municipal Council such as Schools, Hospitals and other institutions.

18.2 MUNICIPAL FINANCE

According to the Local Self-Government Department (LSGD) data, Koothattukulam was ranked first among the municipalities in the state, utilising 99.73 per cent of the Plan fund. As it is a newly formed Municipality, the annual finance statement is only available from 2014. However 3 years data has been analyzed. In order to review the status of municipal finances, the actual income and expenditure data has been collected and further regrouped and recast for the period Financial Year (FY) 2015-16 to 2016-17. Accordingly, the analysis has been carried to understand the revenue and capital account status and overall closing balance for the review period. Following are the key highlights of the financial assessment.

Table 18-1: Income & Expenditure of Koothattukulam (2015-17)

Particulars	2015-16	2016-17
Total Revenue	5,88,08,518	7,16,41,713
Total Expenditure	5,94,66,162	6,82,76,599
Surplus / Deficit	-6,57,644	33,65,114

Source : AFS 2015-16, Koothattukulam Municipality

18.2.1 Current Status of Municipal Finance

18.2.1.1 Revenue Account- Revenue Income

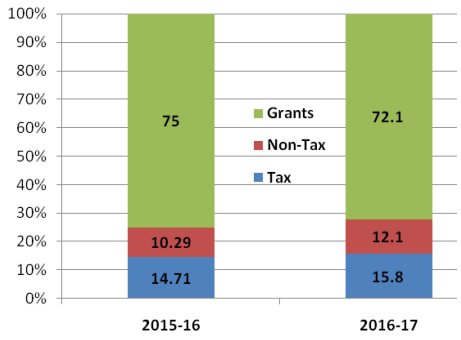
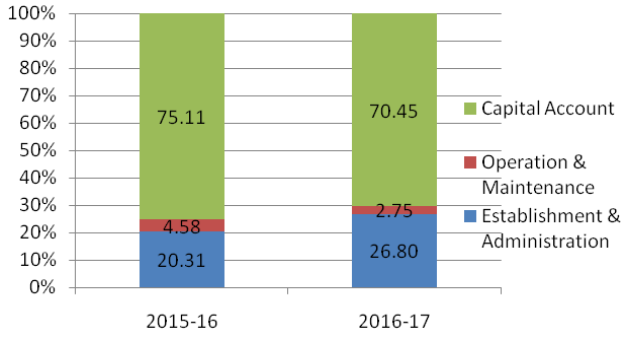


Figure 18-1 : Revenue Income Composition



Source : AFS 2015-16, Koothattukulam Municipality

Figure 18-2 : Revenue Expenditure Composition

Revenue Income consists of own Sources of revenue and revenue grants and contributions. Further, Own Sources of revenue comprises of tax revenues and non-tax Revenues. Following figures presents the trends in revenue income at Koothattukulam Municipality. Contribution of each of the sources i.e. Tax Revenue, Non-Tax Revenue and Revenue Grant has been depicted the figure 18-1. This figure indicates the over dependency on revenue

grants and it would be a threat for Koothattukulam in near future as it is mainly dependent on grants. Tax and non-tax revenues are contributing only 25% of total revenue income and show a small increased contribution towards the total income over the years.

Table 18-2 : Revenue Income of Koothattukulam (2015-17)

Sl. No.	Particulars	2015-16	2016-17
1	Tax	86,50,225	1,13,31,135
2	Non Tax	60,51,310	86,62,212
3	Grants	4,41,06,983	5,16,48,366
4	Total Revenue	5,88,08,518	7,16,41,713

Source : AFS 2015-16, Koothattukulam Municipality

18.2.1.2 **Revenue Expenditure**

Like the receipts, the expenditure of the Municipality is also classified into three accounts revenue account, capital account and debts account. The expenditure under revenue account includes the expenditure for administration and tax collection, public works, Town planning, education, water supply and drainage, public health, street light, maintenance of municipal properties, Grant for maintenance of transferred assets etc. The expenditure under capital account includes expenditure for management, public works, education, water supply and drainage, public health, street lighting, endowments, deposits, poverty eradication programmes, expenditure for the programmes implemented through the departments transferred to the Municipality, programmes under decentralized planning etc. Following figures presents the trends in expenditure at Koothattukulam Municipality.

Table 18-3 : Revenue Expenditure of Koothattukulam (2015-17)

Sl. No.	Particulars	2015-16	2016-17
1	Establishment & Administration	1,20,78,660	1,82,99,873
2	Operation & Maintenance	27,24,731	18,74,602
3	Capital Account	4,46,62,771	4,81,02,124
4	Total Expenditure	5,94,66,162	6,82,76,599

Source : AFS 2015-16, Koothattukulam Municipality

Revenue expenditure towards each heads i.e. Establishment & Administration, Operation & Maintenance, Capital Account and Interest has been depicted the figure 18-2. Comparing the Own source of revenue income to revenue expenditure, expenditure is exceeding and this shows the need to tap more sources or improve the existing system of collection.

18.3 GOVERNANCE


Municipality Office

Currently the municipal office is functioning in the Town hall building which is having limitations in functioning and is proposed to shift to new building which is to be constructed near transport terminal.

18.3.1 Other Departments

Kerala Water Authority is dealing the distribution of drinking water in Municipal area. Office of the Assistant Engineer is functioning at Koothattukulam. The Electricity distribution system is maintained by the Kerala State Electricity Board. KSEB Assistant Engineer in Electrical Section Koothattukulam functioning at Koothattukulam is in charge of distribution of Electricity. The Kerala State Public Works Department (Roads) is in charge of construction and maintenance of roads other than those roads owned by the Municipal Council. The Kerala State Public Works Department (Buildings) is constructing major buildings.

18.4 INFERENCE

The Local Self Governments has major role in providing various services, infrastructure facilities and civic amenities to the people. But the present institutional capacity is inadequate to provide better services to the people. Municipality has to identify new sources for resource mobilization. As a newly formed Municipality, Koothattukulam should focus on balancing the finance and survive on own source of revenue which helps in reducing accumulation of debts.

19 SUMMARY AND FINDINGS

19.1 ROLE OF TOWN AS PER DUR

Koothattukulam is classified as fourth order settlement which is classified under service area of Piravom Municipality, a third order settlement in the District. Even though Koothattukulam is fourth order it has a scope of development along with Piravom, as nearby local bodies are all fifth order and depends on these urban centres.

In the regional context of the District, Koothattukulam is a fourth order settlement and Central junction in Koothattukulam is classified as 3rd order node and Mangalathuthazham junction is classified as a fourth order node in the District. Central junction in Koothattukulam is proposed as a second order node in DUR.

In the District level analysis Primary agriculture (Plantation) is identified as the activity of the Town. The economy of the region is agriculture oriented and primary sector activity is the character of the region. The functional character of the Koothattukulam Town is rural based on land use and average plot size within the settlement. Based on land use concentration and functional character, the activity pattern of Koothattukulam Town and nearby local bodies are found to be primary activity which is mainly agriculture. Agricultural workers and cultivators are the predominant workers in these areas. There is concentration of agricultural or plantation land use in such areas and also the plot sizes and major land uses indicate the nature of activity as primary.

19.2 GENERAL FINDINGS

- Koothattukulam Town has an area of 23.18 sq.km with 25 wards having a total population of 17253, is a boundary local body in the south east side of Ernakulam District which comes under the midland region.
- The area is formed by many hills of height above 100m from the mean sea level and two valleys in-between. Arjuna Hill (Arjunanmala) is the largest hill (130m above sea level) and divides the region into two valleys.
- The two valleys in the central portion have its gradient from east to west. Valley on the southern side is the largest one and it extends up to Uzhavoor in Kottayam District.

- Out of the 13 agricultural zones of Kerala, Koothattukulam possess the central mid zone geographical features.
- Relief of Koothattukulam Town extends from 0 to 160 m. Higher relief is seen horizontally on top and bottom side of the Municipality. The centre region has comparatively low relief with elevation ranging from 0 to 40 m. Highest elevation is observed in the south-west side of Municipality. Higher elevation is also observed in north region.

19.3 POPULATION

- The population of Koothattukulam Town as per 2011 census is 17253. This is only 0.53% of the total District population of Ernakulam. Koothattukulam has the lowest population while comparing with other Towns in the District.
- Population growth rate of Koothattukulam has shown a trend of continuous decrease since 1981 to 2011. Total population in the Town is declining for the last one decade with a negative population growth rate of 2.43%.
- Most of the nearby LSGs of Koothattukulam Town also shows negative growth rate. Hence it may be assumed that the growth of population of the Koothattukulam follows a general pattern of declining growth rate.
- The reason for negative growth rate is presumed as the reduction in the job opportunities in plantation sectors, mainly in rubber plantation. Another reason is the absence of economic activities attracting the workforce. These two factors lead to outmigration and negative growth rate of population.
- The population density of Koothattukulam Town is 744 persons per sqkm, which is low compared to other Towns in the District. The sex ratio of Koothattukulam is 1058 as per 2011 census.
- The literacy rate of the Town is 96.38% which is comparatively higher than the District and state. Literacy rate among women is found to be high, which is an indication of women empowerment in the Town.
- From the analysis it is observed that the WPR in Koothattukulam is 41%, with a major share of other category of workers including the persons engaged in rubber plantations.
- Analysing the occupational structure, it is seen that share of main workers is high which will aid the overall development. The share of marginal workers is comparatively low.

- There is a decline in the share of primary sector employees (cultivators and agricultural labourers), which constitute only 20% of the total workers. The percentage of household industrial workers is less and follows a consistent form.
- The shares of cultivators, agricultural labourers and house hold industrial workers are declining, the share of other workers are increasing at very high pace from 46% in 1981 to 77% in 2011. This major shift in employment pattern shows a lack of interest towards the primary agriculture sectors, due to the reduced output from those sectors.

19.4 LAND USE

- More than 70% of the total geographical area is used for agricultural activities and 18% is used for residential activities.
- The commercial area of the Town is concentrated in the core of the Town and along the side of major road corridors such as M.C.Road and Koothattukulam – Piravom road.
- Residences are concentrated mainly in the eastern part of M.C.Road and few to the western side of M.C.Road. Generally wards on the western and southern end have low concentration of residential land use.
- Major portion of the agriculture land is coming under dry cultivation and share of paddy field is very nominal.
- Overall agriculture is concentrated towards the western and southern part of the Town away from the Town core area.
- Parks, play grounds, open spaces and other recreational spaces in the Town is very less and it is far below the suggested URDPFI standard requirements.

19.5 ECONOMIC ASPECTS

19.5.1 Industry

Meat Products of India is the one and only large scale industry in this Town. In addition to MPI, there are four small scale industries like Sreedareeyam ayurvedic medicines and research Centre, which is a famous ayurvedic and herbal, and 39 micro level industries functioning in Koothattukulam. At present it is seen that Industries have a little role in the economic development of the region.

Koothattukulam has potentials for development of small scale agro based industries utilizing the agricultural produces and raw materials. Even though majority of land are undulating, land is available in Koothattukulam, but other infrastructure facilities such as building, power and transportation facilities are not sufficient. There is a scope, associated with MPI such as cattle feed factory, bone meal unit and farming can be promoted. Small scale industries such as food processing and eco green units can offer a prime contribution to the economic development of Municipality.

19.5.2 Trade & Commerce

Trade and commerce is one of the major economic activities of Koothattukulam from years back. There are two markets in Koothattukulam Town one is a general market and another is a cattle market. Even if there are markets, they lack adequate infrastructure facilities. Proper waste management system, basic amenities, parking areas, truck loading facilities etc. are essential for the smooth functioning of a market. So the existing markets shall be expanded and modified as hi-tech markets by providing all the basic infrastructural requirements. Cattle Market in Town is famous for cattle trade in Kerala. So there is scope to develop it as a market Town by expanding existing markets by providing all the basic infrastructural facilities.The major commercial centres in Town are concentrated along the major road corridor and at the Town centre. Even if informal activities exist in Koothattukulam Town in a very small scale, Street vending zones should be identified for rehabilitation of street vendors.

19.5.3 Tourism

The potentials to develop ayurvedic treatment centre by utilizing the existing benefits and providing more facilities, will fetch more tourists as there are people coming to Kerala for rejuvenation and treatment through ayurveda. The supporting infrastructure facilities such as roads, parking spaces, quality products, etc. need to be improved to improve this sector. Even though tourism is not an established economic sector in Koothattukulam, there is a scope to improve healthcare tourism sector in Town.

19.5.4 Agriculture

Agriculture and allied activities has a major role in the economy of the Town. Rubber, Coconut, Pineapple, Paddy, Banana are the major crops being cultivated. Dry agriculture land dominates in the Town over wet agriculture and agriculture area is distributed in almost all parts of the Town. Rubber is one of the major cash crops in the Town, which is cultivated in almost all the wards.

There is less paddy cultivation in Town and a reduction in paddy cultivation due to a shift towards cultivation of garden land crops; but, paddy fields need to be maintained due to its environmental importance and benefits like ground water recharge, natural drainage for flood water, etc. Statistics shows that there is a reduction in agriculture in the Town. Measures to ensure availability of proper Irrigation facilities by improving the existing facilities, ensuring more agricultural labours, etc to all areas can increase the total productivity in agricultural sector.

The soil series and crop suitability study of the Town shows that, In the Valley regions where soil is more fertile and water availability is more, wet land crops like paddy, banana and tapioca should be given first priority. Vegetables can also be cultivated in a seasonal basis in this region. In the side-slopes the soils support dry crops like Rubber, coconut, and Arecanut. Other than these crops nutmeg, pineapple, pepper, cocoa and coffee are also suitable for this soil. In the hill submits and steep slopes teak and rubber plantation are good option. Forest trees and fodder grass are also suits this regions.

19.5.5 Animal Husbandry

Cow, buffaloes, hen, dog, goat, pig etc. are the main livestocks in Koothattukulam Town. There is no authorized slaughter house in Town. Six dairy farms and three Milk co-operative societies are present in Town. The Increasing feed cost results in cattle rearing a non profitable activity for small scale unorganized farmers. Conversion of agricultural land and reduced plot size reduced the availability of fodder. Moreover production expenses do not go with market prices in the sector of milk production.

Animal husbandry sector has more potential in the regions like Koothattukulam in Ernakulam District. Presence of veterinary hospital / clinics and availability of six milk societies increases the potential for animal husbandry. MPI plays a very important role in promoting animal husbandry sector in Koothattukulam.

19.5.6 Fisheries

Inland fishing is the only fishing activity that can be practiced within Town due to the absence of coastline. No commercial production of fish exists at present within the Town. There is a potential of inland fishing due to the presence of several ponds within the Town. It will also help to empower the rural economy of the area.

19.6 TRAFFIC AND TRANSPORTATION

Road transport is the only mode of transport available in Koothattukulam. Koothattukulam is well connected to different parts of the states through road transport. Other modes of transport such as waterway and railway infrastructure is absent in Koothattukulam region. The nearest railway station is Piravom road. Lack of sufficient public transport connectivity between Koothattukulam and Piravom Road station is an intricacy for the people of Koothattukulam.

State Highway 1, widely known as main central road (MC Road) traversing from Thiruvananthapuram to Angamaly passes through Koothattukulam and is the most important road in Koothattukulam. New State Highway-40 from Alappuzha to Madurai also passes through Koothattukulam Town. State Highway-42 from Kumarakom to Cumbummettu passes through outskirts of Koothattukulam Town area. Apart from the state Highways, several MDRs and ODRs also serve the transport needs of the people.

The road inventory shows that majority of roads are with inadequate right of way and carriage way width. The local road network system is needed to be improved. Some roads in Town core area are exceeding its capacity; and congestion exists at the Town centre. The configuration of the road network system of Koothattukulam exhibits radial pattern. The road system has many inadequacies such as poor road geometry, insufficient carriageway width and ROW, nonstandard alignment, poor surface condition, lack of demarcated parking spaces, lack of pedestrian friendly facilities etc.

19.7 WATER SUPPLY

At present, the distribution system of water covers all major habited area in Town, but still there is problem in availability of drinking water. Elevated areas of the Municipality face acute water scarcity. Main source of water for the elevated areas are the existing water supply schemes.

Koothattukulam Town is a part of three sub-watersheds. They are Pinmatom, Mangalathuthazham and Chandhathodu. The ground water status study of Town shows that the shallowest water table is located in central south region of the Municipality and the deepest water table is seen the northeast. The water table varies from 1m to 14m bgl during dry period. The Koothattukulam Town shows a high to very high annual fluctuation of water level in the west central region.

The study of annual rainfall data, from the highest rainfall of 3641mm during 2010 to lowest rainfall of 1821mm during 2016 shows a wide variation in rainfall distribution. This rainfall pattern indicates the risk of uncertainty in depending rain in Koothattukulam.

From the analysis of groundwater, rainfall and the primary information about the historic condition of water status, it is evident that water scarcity in this Municipality is mainly because of natural factors and is prevailing for long time period. Human induced changes have lesser impact on water scarcity in this Municipality. The observation is also pointing that the western part of the Town is more vulnerable to water scarcity than the eastern part. Hence the western region should be considered as environmentally more friable.

Drinking water schemes other than KWA scheme under the Municipality exists in Town which helps to reduce the effect water scarcity in some areas. The issues will be solved to some extent with the commissioning of the five proposed schemes. Various mandatory measures to properly tap the rainwater and the proper recharging of ground water table need to be initiated, as an important need of the hour. New innovative techniques of water conservation and water recycling are to be developed and implemented through community participation.

19.8 SANITATION

Existing natural drainage system needs to be conserved and strengthened. Proper drainage system has to be developed in the Town for storm water drainage for reducing soil erosion. Separate drainage has to be developed for wastewater disposal in the CBD area with adequate treatment facilities before it is discharged to an open source of water. There is a better Sanitation system available for the houses in the Town, 99.15 % people are having septic tank or pit latrine for sanitary waste disposal. So a septage treatment plant is needed to be developed for the Town for future. More public comfort stations are to be provided at different parts of the Town for the floating population.

19.9 SOLID WASTE DISPOSAL

Health wing of the Municipality perform collection of solid waste which is confined to 5 wards in the Town area which are along the sides of MC Road. The total quantity of waste generated based on 2011 population is 5.2MT per day. At present only 1.5 MT of solid waste is collected. Considering the quantity of waste generated from other sources like Hotels & Restaurants, Institutional, Commercial etc the total quantity of waste generated is 8MT. Considering the total waste generated, the collection efficiency is only 18.75%.

Separation of wastes into bio-degradable and others are not done and the waste is directly disposed. At present no treatment of the waste is being done. Disposal of solid waste is done by land filling at Town dumping yard, which is located in ward 15. Major portion of solid wastes are generated from the central area of Town. Solid waste includes domestic and commercial wastes, hospital wastes, e-waste and construction debris etc.

Existing dumping yard at the Town centre and the leachate percolating from the landfill site are polluting the nearby waterbody (chantathodu), hence protection of ground water from contamination should be the first step to be taken in this sector. To achieve this removal of the waste from the dumping yard needs urgent attention as it is a major health risk to the community.

The system of ‘disposal at source’ is adopted in the Town at present, but the changing family structure and land availability for the residents can develop problems in future in this regard. New methods for proper management of solid waste have to be developed for the

Town considering the future demands. Decentralized treatment and processing of municipal solid waste should be developed in Town to reduce the problems in transporting wastes from localities where they have been generated. Awareness creation about the need for source segregation and differential disposal of solid waste is essential.

Kudumbasree workers may be deployed for collecting plastic waste which can be used for recycling purposes. Another area of attention is system for separate collection of e-wastes. More aerobic composting units should be provided in Town such that the whole Town area is covered in a decentralised manner with maximum efficiency in waste disposal. Safe recycling facilities for e-waste and construction debris shall be provided and plastic free environment shall be promoted. The objective of solid waste management system for the Town may be to reduce the quantity of solid waste disposed off on land through the principle of Reduce, Reuse and Recycle.

19.10 ENERGY

Electricity generation, transmission and distribution in Koothattukulam are handled by the Kerala State Electricity Board in which Koothattukulam Town mainly falls under Muvattupuzha division and Piravom electrical sub division.

The main problems faced in electric power sector are due to drawbacks in the distribution field. Most of the power failure occurs due to the tripping of 11 KV OH lines. Considering existing demand, 66KV substation needs to be upgraded to 110 KV substation and KSEB has already given proposals for this upgradation. New innovative projects for utilization of renewable and non-conventional energy sources should be promoted and implemented in Town with community participation programmes at local level.

19.11 EDUCATION

The literacy rate of Koothattukulam Town as per 2011 census is 96.38% which is higher than District and state. There is a rise in literacy from 80% in 1981 to 92% in 1991 showing the improvement in the education sector over the years. Koothattukulam is having sufficient number of educational facilities up to the higher secondary school level, but there exists a gap at present in the spatial distribution of primary schools. Wards 18, 19, 20 and 21 are not served by any primary schools. Less number of students studying in Government or

aided schools compared to unaided schools. Majority of students are following state syllabus.

There is enough number of educational institutions present in the Town to cater the needs of the resident population as well as of the students from the neighbouring areas. Better infrastructural facilities and educational standards attract more people to the unaided institutions. One Arts and Science College, one Engineering College, one Nursing College and one Ayurveda Diploma College are the institutions for higher studies available in the Municipality. Though the number of higher educational institutions is insufficient in terms ITI and poly technic colleges, when the nearby local bodies are also taken into account, the present higher educational facilities cater to the requirements of Koothattukulam.

19.12 HEALTH

Koothattukulam Town has a number of good hospitals to cater the population but lack of multi-speciality hospitals force people to depend on nearby local bodies. Private sector plays major role in both Allopathic and Ayurvedic systems of medicine. An established Ayurvedic medicine manufacturing unit and research institute are also functioning in the Town which has history of good quality Ayurvedic treatment. In Homeopathic side private clinics are the common ones. Chickun Guinea was reported as the major disease in the Town in the last five years.

Even though CHC has importance of a District Hospital, the availability of necessary basic requirements with new technologies to provide better health care services to the dependent population is unsatisfactory. Municipality faces shortage in health care sector in public sector. Upgrading CHC to a Government hospital with new and advanced technologies and facilities will help to reach better health care facilities to the population regardless of their affordability. The infrastructure facilities in dispensaries and other public sector health care centers need to be improved.

19.13 RECREATION

There are no major parks, play grounds and stadium in the Town. There is only one children's park, one open play ground and one theatre complex present in Town. There are

no organized open spaces or parks for the public to use in the Town and the existing ones are attached to the schools.

It can be said that Koothattukulam Town is devoid of recreational facilities. Besides, spatial distribution of existing recreational facilities is not uniform. Residents of many wards do not have any recreational facilities in a walking distance. Municipality lacks open spaces to organize any events of public interest. The share of recreational facilities is quite low in Koothattukulam when compared to the planning standards. Hence there is a need for developing additional recreational areas. All the existing facilities are to be maintained properly.

19.14 OTHER CIVIC AMENITIES

Eventhough it is a newly formed Municipality, there is one municipal Town hall and 8 auditoriums present in Town. In terms of civic amenities, Koothattukulam Town is self-sufficed with the necessary civic amenities. But new public comfort stations are to be developed for the floating population in Town.

19.15 HOUSING

Spatial distribution of residential areas shows that it is scattered in the Town area with more concentration toward the major road sides towards the central Town. The socio economic survey details shows that 98% of the people lives in their own land and the structural condition of the houses are good with more than 90% people live in pucca/ moderate houses but 7.24% lives in kutcha/huts.

There is no government notified slum area in the Town even though the substandard housing areas in terms of housing colonies are present. Housing shortage and presence of substandard housing colonies are the main problems in the Town. The situation of substandard housing colonies shows need for immediate attention to improve the status of basic facilities in them especially in Puttanimala Colony which is the only Grade D colony in the Town. Grade C colonies are to be considered as the second priority areas. The status of infrastructure in Grade B colonies is comparatively good. Government has initiated different schemes to solve the problem of housing shortage in the Town.

19.16 SPECIAL CONCERN AREAS

Koothattukulam Town shows an increase in number of SC/ST population but unemployment is a major problem faced by these weaker sections. So projects for providing employment opportunities for ensuring their economic development are to be made. The concentration of SC families in the housing colonies and landless families among these weaker sections shows the need for support and consideration for them during the planning process.

The changing demographic structure of the Town shows the need for planning for old age population and projects have to be developed for the welfare of all the weaker sections of society including women, children, old age and SC/ST population. New initiatives for ensuring social security for all the weaker sections of the society should be developed to bring them to the mainstream. Women, children and old age people need special consideration in the new development plans.

19.17 ENVIRONMENT

Sensitive /fragile area in the Town includes water bodies, sacred groves, paddy or low lying lands and others. Uzhavoor thodu and other natural drains, ponds and other water bodies, paddy fields, Kizhakombu kavu, etc. are the main environmental sensitive areas in Koothattukulam Town. Erosion prone regions in Town according to land capability studies by soil survey department come under other environmentally fragile zones.

Since Koothattukulam is a growing Town its environmental issues need to be addressed at this stage itself and planned growth of the Town has to be ensured for its inhabitants with consideration to its environment. In the planning area priority has to be given for protection of environmentally sensitive areas like water bodies, paddy fields and sacred groves. It is needed to develop different soil conservation measures to reduce soil erosion and new waste management solutions are to be developed for the Town.

19.18 DISASTER MANAGEMENT

Out of the 14 local bodies in Ernakulam district Koothattukulam alone stood resistant to flood hazards in 2018 due to its unique geographical and robust drainage conditions. However any future anthropogenic interventions disturbing the central canal and the paddy fields around it can lead to future flood conditions within the town. The South west region

of the local body is steep and prone to erosion which requires this region to be conserved from punitive developmental activities. Other disasters like draught, lightning etc. although not dominant are to be looked out for through conservation of existing ponds & wetlands and installation of lightning arresters.

19.19 DEVELOPMENT ADMINISTRATION AND FINANCE

The Local Self Governments has major role in providing various services, infrastructure facilities and civic amenities to the people. But the present institutional capacity is inadequate to provide better services to the people. Municipality has to identify new sources for resource mobilization. As a newly formed Municipality, the Town should focus on balancing the finance and survive on own source of revenue which helps in reducing accumulation of debts.

According to the Local Self-Government Department (LSGD) data, Koothattukulam was ranked first among the municipalities in the state, utilising 99.73 per cent of the Plan fund during the year 2017-18.

20 GOALS AND OBJECTIVES

20.1 DEVELOPMENT APPROACH

As per District urbanisation report, the central junction in Koothattukulam is proposed as 2nd order node in the south east 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. As per DUR, Koothattukulam Town is proposed as fourth order settlement in the region with its surrounding panchayaths as fifth order settlements. It implies that Koothattukulam has to act as a sub-regional centre at the south east 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 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, so as to create a Town which has direct access to high quality road infrastructure links to nearby service areas. It will be useful for providing facilities supporting agriculture, animal husbandry and allied activities like markets, cold storage, agriculture promotional activities which fulfil as city centre.

Medium level industries such as Meat Products of India and Sreedhareeyam Ayurvedic medicine manufacturing unit impart a presence of industrial activities in the region. Sreedhareeyam Ayurvedic Hospital, which is famous for ayurvedic eye treatment has a potential for health tourism which will in turn develop the economy of the Town as they also give a thrust to activities like herbal farm, home stays, commercial complexes etc in the Municipality and other infrastructure development in the region.

Spatial distribution of higher education facilities in education sector of the region shows that existing facilities of the Municipality suffices in the region. In general Koothattukulam is a major commercial centre of the region and provides higher order facilities in transportation, ayurvedic medicine, animal husbandry and agriculture sector.

20.2 DEVELOPMENT VISION

"To develop Koothattukulam as a clean, 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 "

The vision has been built on the three pillars of development which are economic growth, quality of life and environmental sustainability. 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 which needs to be addressed as the prime challenges towards attaining a sustainable development model.

20.3 DEVELOPMENT GOALS

The development goals for Koothattukulam Town are formulated based on the findings and conclusions derived from the sectoral analysis, local level analysis and spatial analysis. The following are the major goals:

1. To develop Koothattukulam Town as sub regional centre at the south east region in the District with adequate infrastructure facilities.
2. To use the topography of the lands to the greatest advantage in providing suitable densities of development and prevent the provision of large scale structures at environmentally unsuitable locations.
3. To strengthen the economic base of the area.
4. To develop as an environment friendly Town by conservation of environmentally sensitive areas.
5. To enhance quality of life of citizens at all levels, and to ensure the equitable distribution of facilities accessible for persons at all localities of the Municipality.

20.4 DEVELOPMENT OBJECTIVES

The utilization of potentials and resources creates new economic base for Koothattukulam. This will improve the quality of life of the people. Development based on available

potentials and resources are the action towards achieving the development goal. The development objectives for Koothattukulam Town are summarized below.

In connection with the first goal to develop Koothattukulam Town as sub regional centre at the south east region in the District with adequate infrastructure facilities, the objectives set are

a. Increase regional accessibility by developing the regional road network connecting the influence areas and improve the traffic and transportation facilities of central area of the Town to ensure the free flow of traffic.
b. To provide adequate physical infrastructure such as water supply, power, drainage, solid waste and sewage disposal facilities.
c. To provide adequate recreational facilities for the people with an integrated system of Parks, open spaces and stadium.

Second goal is to use the topography of the lands to the greatest advantage in providing suitable densities of development and to prevent the development of large scale structures at environmentally unsuitable locations, the objectives set are

a. To protect environmentally fragile areas
b. To protect the fertile soil area from non-agriculture use

Regarding the third goal to strengthen the economic base of the area by promoting commercial activities and industries, and the objective set to achieve this goal are

a. To provide adequate health tourism infrastructure
b. To develop small scale industries such as Rubber processing and food processing
c. To promote primary sector and animal husbandry activities wherever possible.
d. To promote integrated farming activities in the Municipality.

To develop Koothattukulam as an environment friendly Town by conservation of environmentally sensitive areas is the fourth goal and the objectives set to achieve this goal are

a. To conserve environmentally sensitive and water potential areas.
b. To adopt water and soil conservation measures.

c. To prevent pollution, deterioration and conserve natural network of water bodies like canals, thodu, ponds, etc., other environmentally sensitive areas like kavu, paddy and wet land areas.

d. To develop waste water treatment facilities at places where it is directly discharged to an open source of water.

To enhance quality of life of citizens at all levels, and to ensure the equitable distribution of development and facilities accessible for persons at all localities is the final goal and the objectives to achieve this goal are

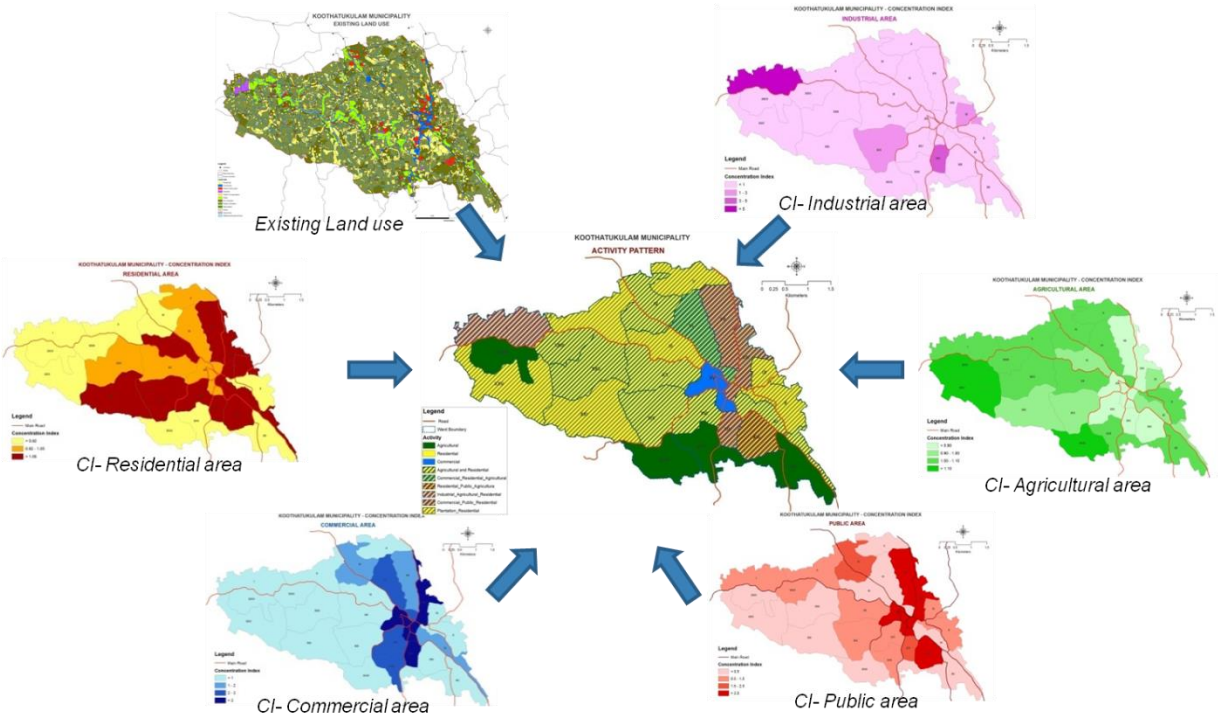
a. To facilitate affordable housing
b. To provide adequate number of community or individual water supply connections to cater to the needs of urban poor
c. To provide adequate community bins/collection bins
d. To Provide adequate number of comfort stations at Town centre, public places and markets

21 DEVELOPMENT CONCEPT

Main features and characters considered for formulating a development concept for the Town are spatial distribution of activities, population distribution, relief profile of the Town, Eco sensitive land uses, connectivity within the Town and towards the influence areas and major nodes.

21.1 SPATIAL DISTRIBUTION OF ACTIVITIES

Spatial distribution of activities is obtained by interpolating the concentration index and land use pattern by ranking. Agriculture activity dominates in the outer wards and urban activity in the eastern part of the Municipality. Corridor development of urban activity is expanding along the M.C. road. Public dominated mixed activity is in wards 7, 8 & 14. Agriculture activity is predominant in the periphery especially in the elevated areas. Pure residential activity is not found in any of the wards however residential agriculture mix is found in remaining wards.



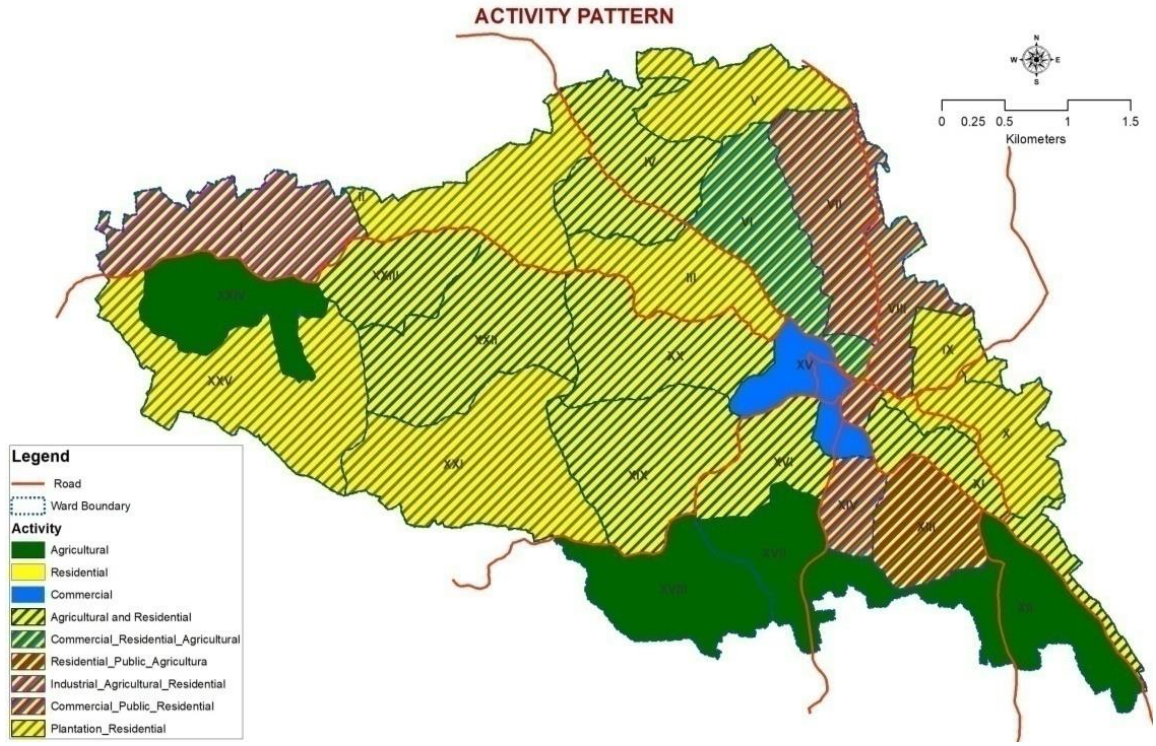


Figure 21-1 : Activity pattern of wards in Koothattukulam Town

Activity pattern can be summarised as below

Urban activities are seen mainly along the major roads of the Town. Corridor form development of urban activity is seen along the M.C. road and is seen expanding towards north and south of the M.C Road. Town centre is confined on the east side of the Town where the state highways meet. Public 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 Town. Agriculture activity dominates in the outer wards ie, along the periphery and especially along the elevated areas. Pure residential activity is not found in any of the wards however residential mix agriculture is seen in the remaining wards.

21.2 POPULATION DISTRIBUTION

Spatial distribution of population is in such a way that the densification of the area round immediate surroundings of CBD Area, area adjacent to CBD, along the State highways and major District roads. Agriculture dominated area have less population density.

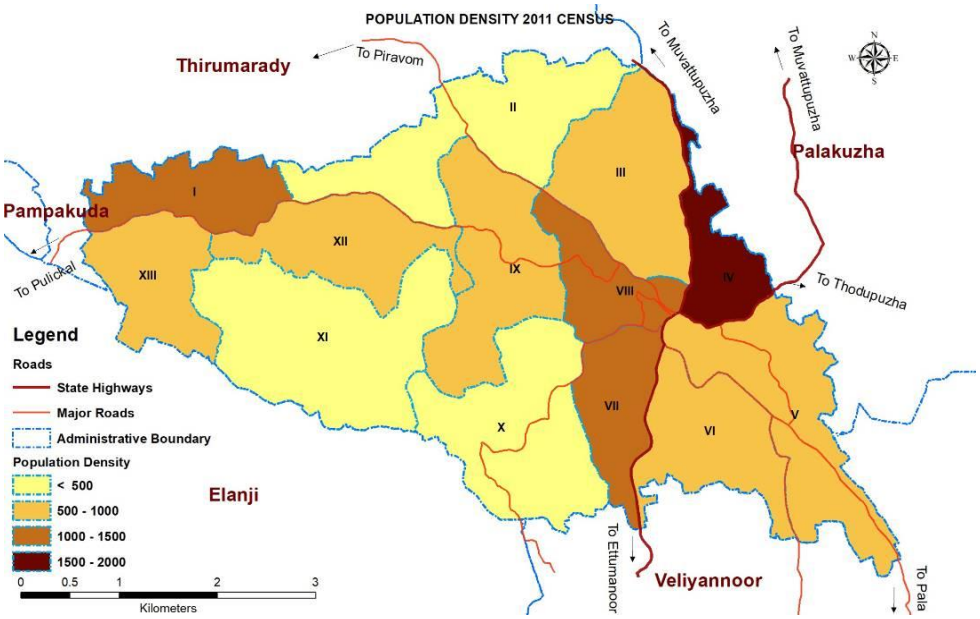


Figure 21-2 : Population density distribution

21.3 GEOGRAPHICAL PROFILE OF TOWN

The contour profile of the Town shows that south, south east and north east sides of the Town boundary are elevated portions with steep slopes. The central portion is the lowest portion where mainly wet lands and water body exist. The elevated portions are mainly occupied by rubber cultivation and are prone to soil erosion which could be retained only for agriculture purposes.

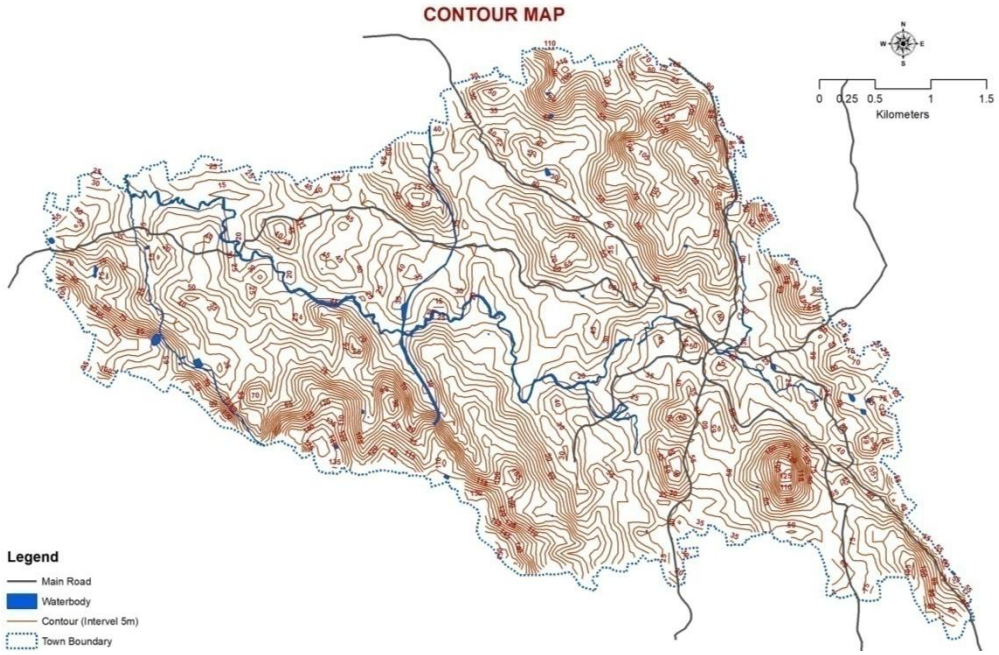


Figure 21-3 : Contour map of Koothattukulam Town

21.4 ECO SENSITIVE AREAS

The Paddy fields and water bodies are taken into account considering its environment importance. The extent of paddy field is found at the geographically central areas in east west direction in a discontinued pattern. The water from the elevated areas finally reaches these existing paddy/wetlands which helps in ground water recharging and hence these are to be protected. All environmentally sensitive regions including water bodies, paddy/ wetland, sacred groves, steep slopping and soil erosion prone areas, etc. are excluded from future development potential zones to prevent its conversion to other land uses.

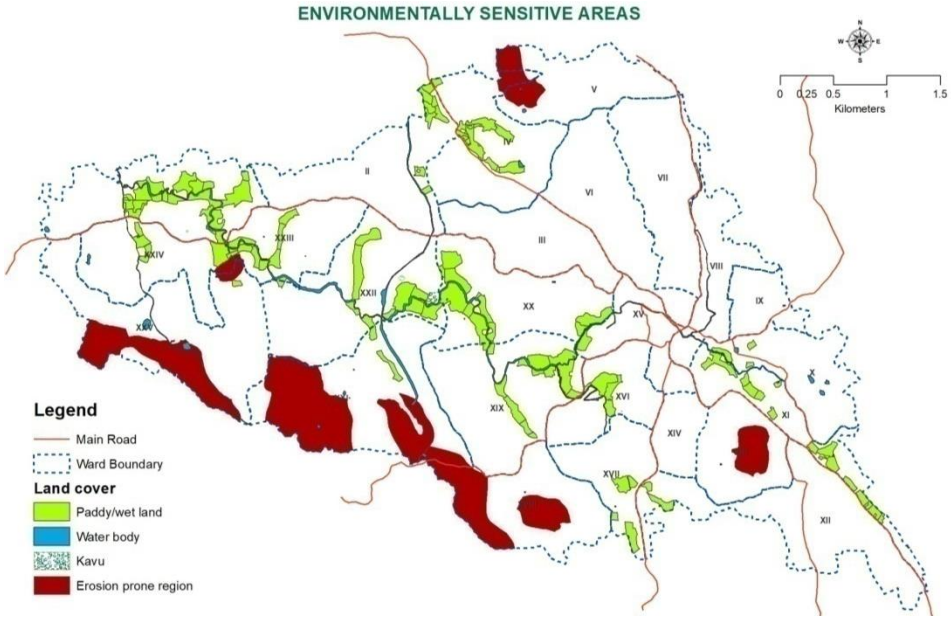


Figure 21-4 : Eco sensitive areas of Koothattukulam Town

21.5 MAJOR ROADS AND NODES

Major nodes of the Town are identified based on the hierarchy of roads intersecting and existence of commercial land use. Based on the DUR the central junction is proposed as 2nd order and Mangalathuthazham junction is classified as 4th order node in the District. The most important commercial nodes identified at Town level are Central Junction, T.B Junction, Aswathy Junction, Ramapuram kavala, Keerthi Jn, Parisudham oil Junction, Bappuji Junction, Substation Junction and Mangalathuthazham Junction. The existing nodes are on the major road corridors with the Central junction as first order node, Aswathy jn and Ramapuram kavala as second order nodes and the remaining nodes as third order nodes.

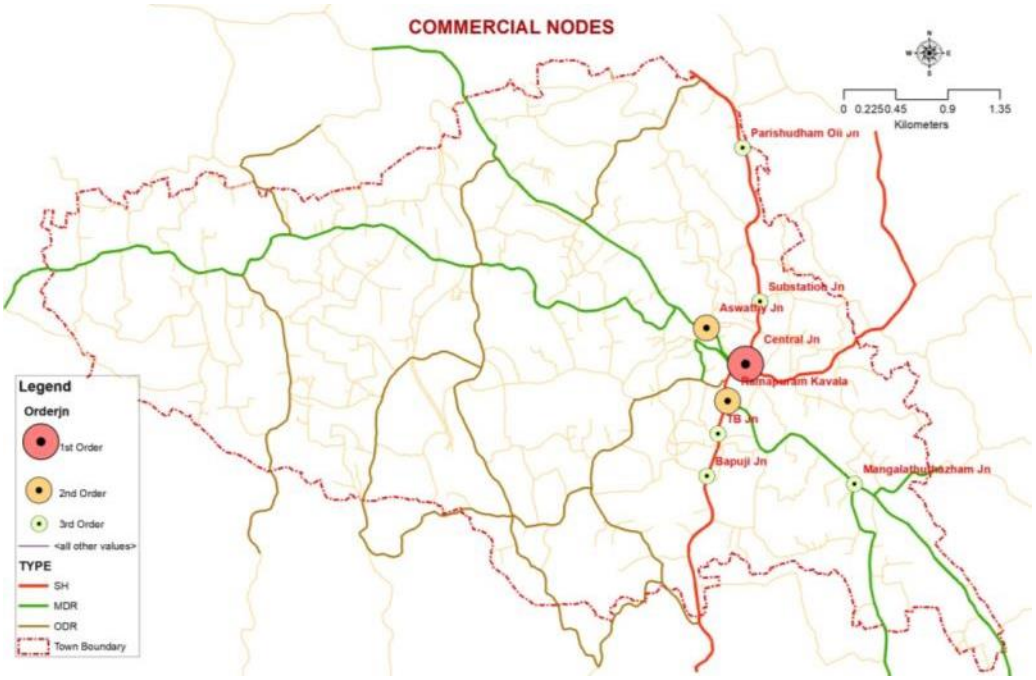


Figure 21-5 : Hierarchy of roads and nodes in Koothattukulam Town

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

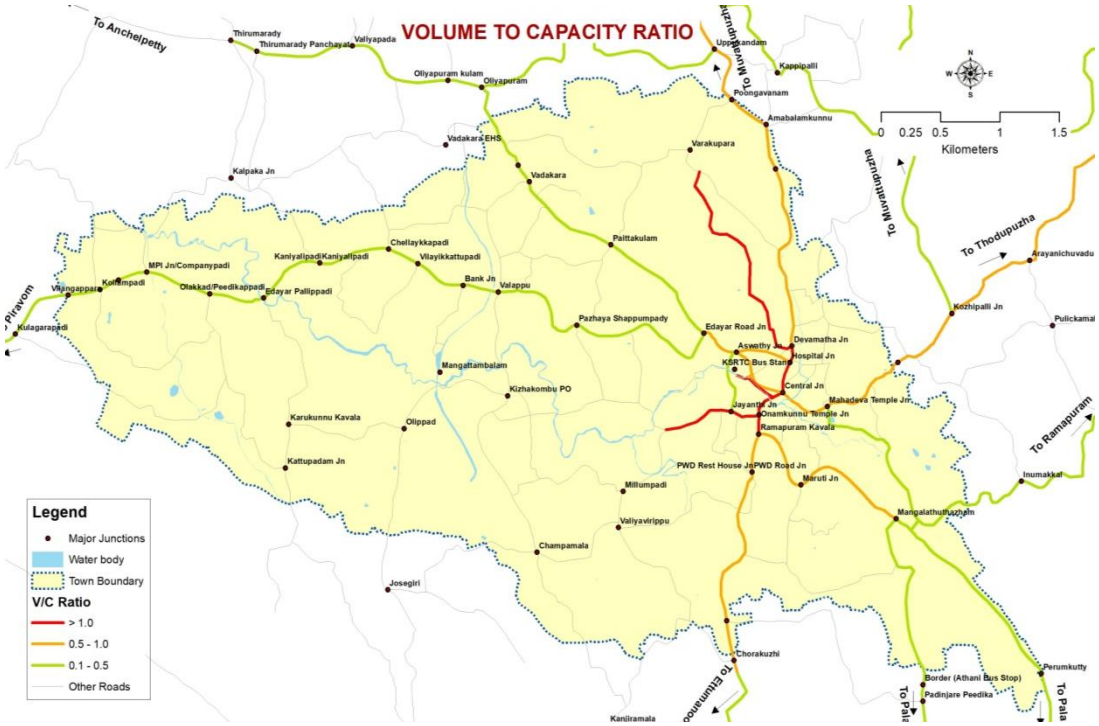


Figure 21-6 : Volume capacity ratio of major roads

21.6 FUNCTIONAL CHARACTER

Functional character of wards was obtained from toolkit output, analysing nature of residence, workers classification and also the land use concentration index pattern. Only ward number 5 has urban character with presence of commercial, residential and public land uses. The wards to the north and south of this ward have semi urban character which is mainly with residential and public land uses. Rural character is shown by wards in periphery which are mainly agriculture areas where both wet as well as dry agriculture is practiced. Other wards are observed as semi-rural which are in a transition from rural to semi urban but are mainly with residential and agriculture land uses.

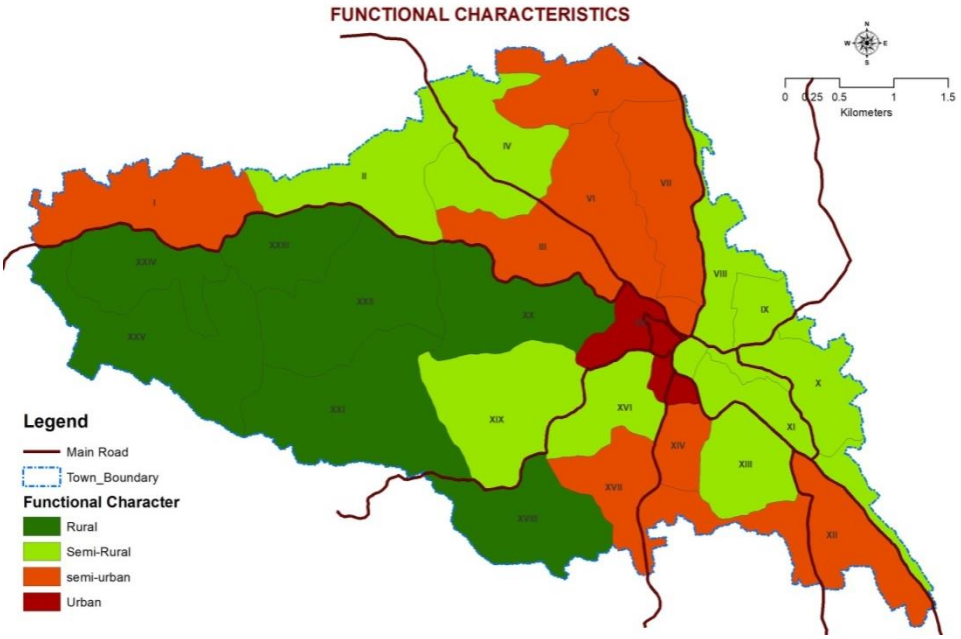
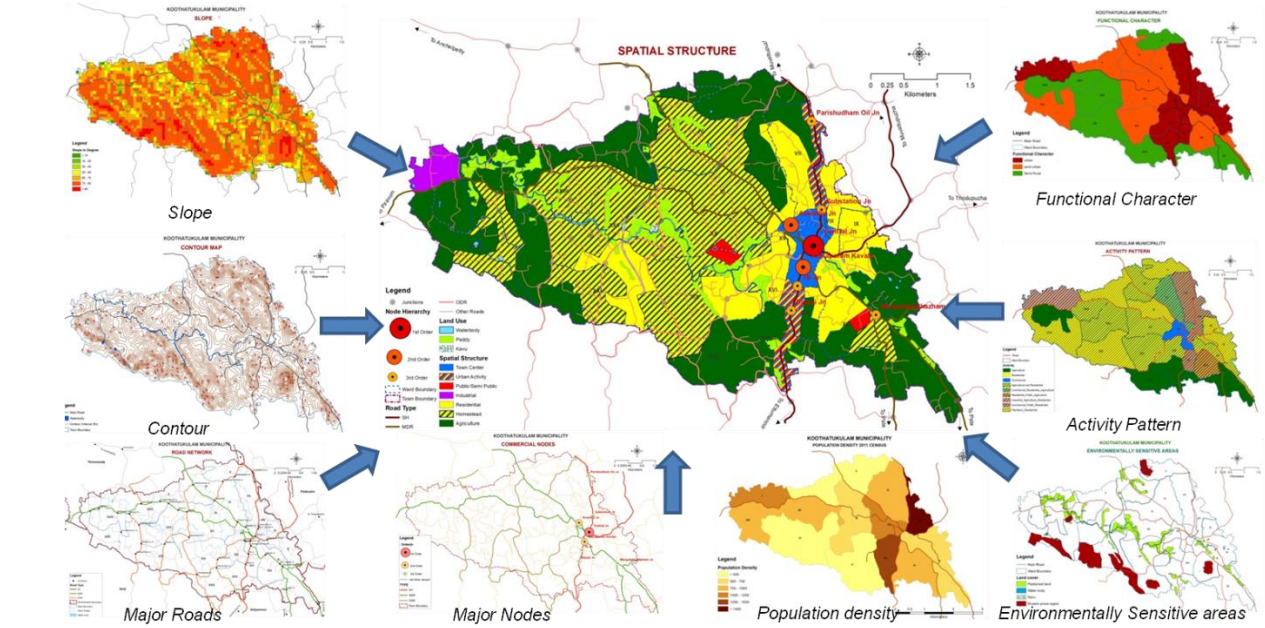


Figure 21-7 : Functional Character of wards

21.7 EXISTING SPATIAL STRUCTURE

The existing spatial structure of the Town is observed as shown in figure by considering major roads, nodes, activity pattern and eco sensitive areas like paddy/wetlands and water bodies. Town 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.



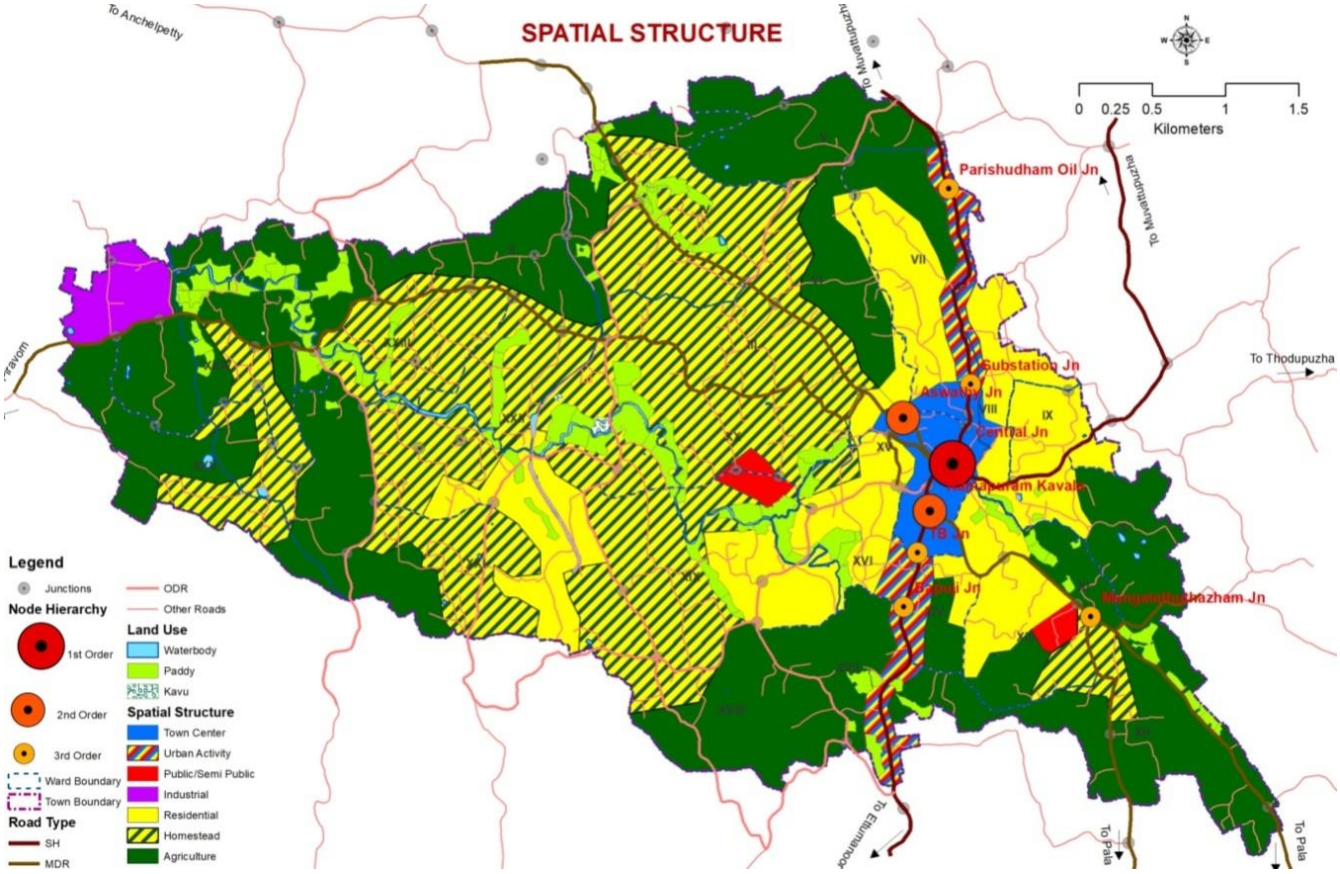


Figure 21-8 : Existing Spatial Structure of the Town

As per the existing spatial structure of the Town, urban activities are along the major road corridor of the Town and Town centre is confined on the east side of the Town where the state highways meet. 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 Town.

The Spatial Structure can be summarized as below which consists of

- Road Pattern
  - Radial Roads
  - Link roads
  - Local roads
- Activity Pattern
  - Multiple Activity Area
  - Mixed Residential Area
  - Agriculture & Allied Activity Area
- Existing Hierarchy of Nodes
  - Ist order : Central Junction, Onamkunnu temple Junction &Keerthi Junction
  - IIndorder : Aswathy Junction &RamapuramJuction
  - IIIrdorder : Parisudham oil Junction, T.B Junction, Bappuji Junction, Substation Junction, Mangalathuthazham Junction
- Environmentally Sensitive Areas
  - Streams, Pond
  - Paddy, Wetland
  - Kavu
  - Erosion Prone Areas

21.8 LAND SUITABILITY

A multicriteria decision making system is used for the purpose of identifying land suitability in Koothattukulam Municipality. Multicriteria decision making is the method of identifying, prioritizing, ordering and providing weightage to different factors which directly or indirectly influence the phenomenon or the process. From the information available three steps are used for decision making. They are

- Determine the relevant factors
- Provide ranks and weightages to these factors
- Process the numerical values and identify the suitability

Methodology

The land suitability of Koothattukulam Municipality is made on the basis of five factors. These include the slope, land use, roads, nodes and population density. Based on the influence and importance these factors are ranked from 1 to 4. 1st rank is given to Slope, 2nd rank for land use, 3rd rank for road and node and 4th rank for population density. Based on the ranks they are given weightage values. For first rank weightage value given is 4, for second rank weightage value is 3, for third rank weightage value is 2 and for forth rank weightage value is 1. This weightage is multiplied with the suitability value (given to different groups inside the influencing factor) and a total weightage is calculated.

Table 21-1 : Ranking and weightage of selected factors

Factors	Rank	Weightage
Slope	1	4
Land Use	2	3
Roads and nodes	3	2
Population Density	4	1

Slope

For multicriteria decision making of land suitability of Koothattukulam Municipality 1st rank is given for slope. Here slope of Koothattukulam Municipality has been grouped into 3 classes based on the steepness. A suitability value is provided to each slope class and is multiplied with the weightage value (4). The major slope classes are - slope less than 10% (weightage 12), Slope between 10% and 25% (weightage 8) and slope above 25% (weightage 4).

Table 21-2 : Ranking and weightage for slope factor

Slope	Suitability Value	Weightage	Total Weightage
Less than 10%	3 (Highly Suitable)	4	12
Between 10% and 25%	2 (Suitable)	4	8
Slope above 25%	1 (Less Suitable)	4	4

Land Use

Here land use of the Municipality has been grouped into different categories and given different priority orders and thereby several cases are analysed. Then the best

categorisation for development suitability case is selected in which the land use is categorised into two and given suitability values. Paddy land and water body are considered as environmentally sensitive areas. Hence these areas are not taken for consideration.

Table 21-3 : Ranking and weightage for land use factor

Land Use	Suitability Value	Weightage	Total Weightage
Non agricultural area	2 (Highly Suitable)	3	6
Agricultural area	1 (Less Suitable)	3	3

Roads and Nodes

Land area near to the major roads and junctions are considered as highly suitable for development. Hence, land area which comes within the buffer of 500m has been given high suitability (weightage 6), area which comes within 1000m buffer has been given moderate suitability (weightage 4) and beyond that has been given less suitability (weightage 2).

Table 21-4 : Ranking and weightage for major roads and nodes factor

Road and Node Buffer	Suitability Value	Weightage	Total Weightage
Within 500m	3 (Highly Suitable)	2	6
Between 500m and 1000m	2 (Suitable)	2	4
Above 1000m	1 (Less Suitable)	2	2

Population Density

Population density is a major factor affecting any developmental activity. Land suitability for new projects is not recommendable in high density area due to socio-economic reason. Hence suitability of land is inversely proportional to population density ie higher the density lower will be the land suitability. Based on the available data the population density of Koothattukulam Municipality has been classified into three, namely density less than 800persons/Sq.km (weightage 3), density between 800 and 1250 persons/Sq.km (weightage 2) and density more than 1250 persons/sq.km (weightage 1).

Table 21-5 : Ranking and weightage for population factor

Population Density (per sq.km)	Suitability Value	Weightage	Total Weightage
<800	3 (Highly Suitable)	1	3
800 to 1250	2 (Suitable)	1	2
>1250	1 (Less Suitable)	1	1

Land Suitability Map

The preparation of map is done using the GIS software. From the above data, area coming under each category has been identified and mapped separately. Through the intersection method in the over lay analysis all these maps are compiled and a new map output has been derived. This output map provided various combinations of all the four factors. The sum total of weightages coming under each combination is calculated and is sorted in descending order. The higher value represents higher suitability and lower value represents lower suitability. These values are categoriesed and groped as less suitable, moderately suitable, suitable and highly suitable. Environmentally sensitive regions like wet lands, water bodies, sacred groves and rock out crops are directly grouped under less suitable or not suitable land.

From the map it is observed that the east central region and north-western region are the best suitable land for development. Land suitability is very low in the south-western region due to the presence of steep slopes and out crops. In general 70% of the land in Koothattukulam Municipality has high or very high land suitability.

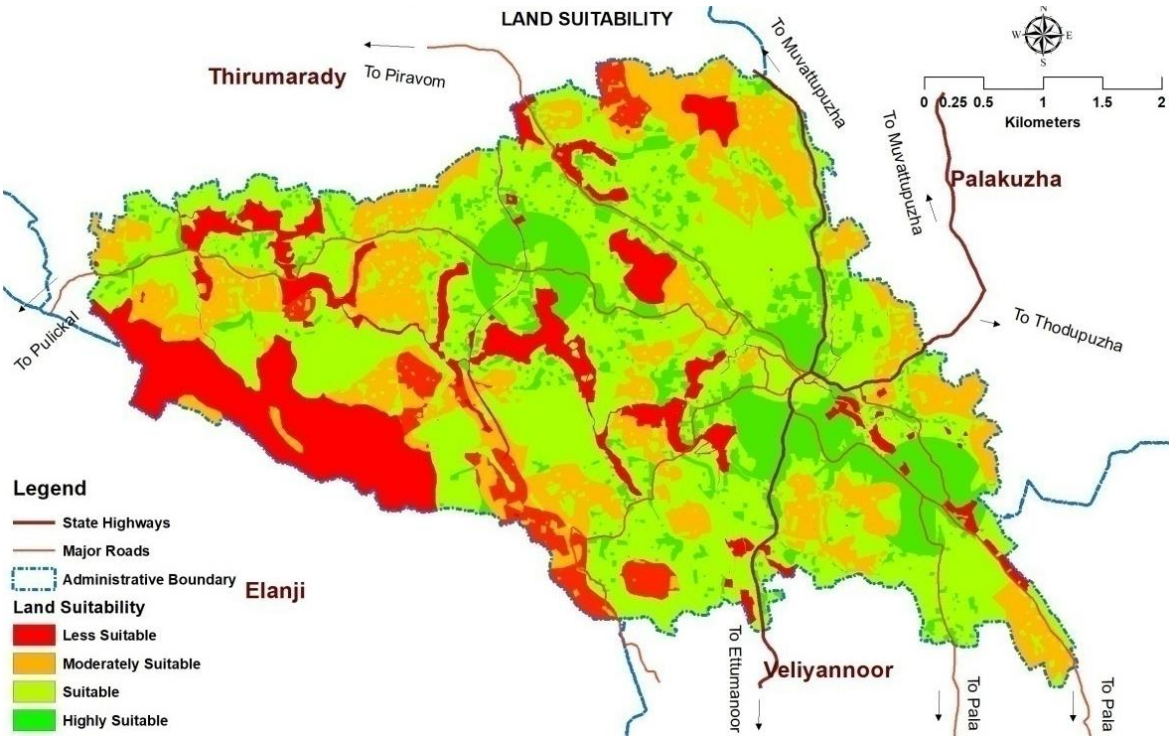


Figure 21-9 : Land Suitability map based on analysis

The existing land use, terrain and the presence of MC road makes the East central region of the Town suitable for high intense activities like Commercial, Public & Semi-Public, transportation and residential mix uses. The north western region where comparatively flatter terrain exists is suitable for moderately intense activities. The remaining region is only suitable for dry agricultural plantations because of undulating & steep terrain. This region is also erosion prone areas and hence Intensive developments are not possible in this region.

No development permissible zones such as Geological Conservation Zone and eco sensitive zones are located in non-suitable areas of final suitability map. Hence the suitability map identifies most suitable areas for development. Therefore this final suitability map provides a useful guide for land use zoning.

21.9 CONCEPT OF FUTURE DEVELOPMENT

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

Land suitability analysis was performed for identifying potential development areas in the Town considering the geographical constrains and the future development concept for different sectors like industrial, commercial, recreational, agricultural and transportation. The factors are summarised and coordinated to arrive at a future development concept for the Town.

21.9.1 Concept for Commercial Area Development

Existing commercial activities are seen along the sides of MC road. The existing commercial area in the Town core region is retained and considered as central business District (CBD) of the Town 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. East central region and north-western region are the best suitable land for development. The Town centre is to be further developed on all directions so that it

becomes a Town centre for the service area. One major node is proposed at the intersections of the radial and ring roads thereby decentralising commercial node.

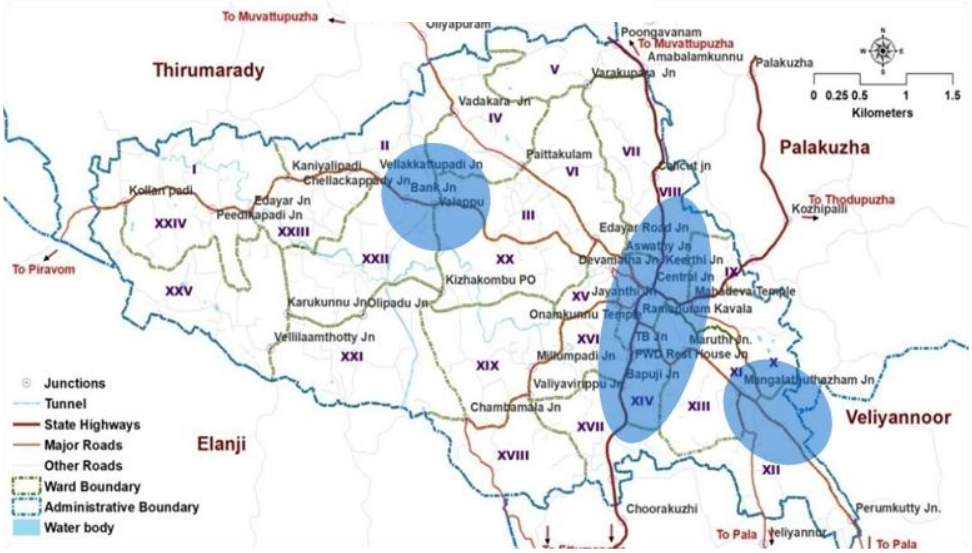


Figure 21-10 : Concept for Commercial Area Development

Existing commercial activities are seen mainly along the sides of MC road. The existing commercial nodes such as Central Junction, Onamkunnu Jn, Keerti Jn, Aswathy Junction, Ramapuram Jn, Babuji Jn and TB Junction will merge and act as Town centre. Managalathuthazham Junction (proposed as 3rd order node in DUR) and Valappu Junction will act as sub-centre for the service area.



Figure 21-11 : Concept for Industrial Development

21.9.2 Concept for Industrial Development

The objective of strengthening the economic base of Town shall be achieved through agro-based industrial development. Proper connectivity and availability of raw materials will catalyse the industrial development. The land use could be proposed as industrial promotional zone to cater mixed landuse development in the region with non polluting industries.

21.9.3 Concept on Recreation

Since there is a lack of recreation space in the Town, prioritization is to create open spaces which create the ability to help manage future growth and development in large undeveloped areas. The main proposals are creation of parks at neighbourhood level and recreational spaces such as stadium, beautification of canal and ponds with provision of walkways**.** Two local parks near Valappu Jn and Bappuji Jn, play ground, recreational open space, etc are proposed.

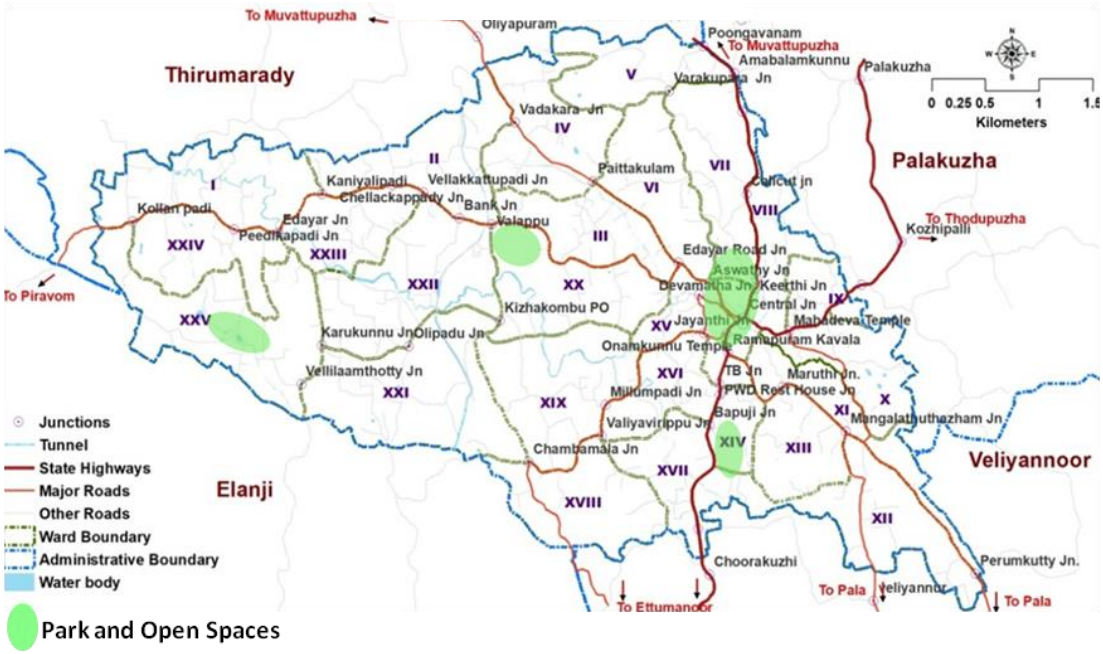


Figure 21-12 : Concept on Recreation

21.9.4 Concept on Dry Cultivation

Koothattukulam has the majority land under dry agriculture; however, the Town continues to lose agricultural land to development. The protection of agricultural resources is the top priority and this support provides the Town with the opportunity to continue to preserve

farmland on a significant scale. The dry cultivation land is classified into two; dry cultivation cum residential and dry cultivation alone. The later is mainly soil erosion prone area where large scale constructions are not possible. Developments are to be restricted in this area.

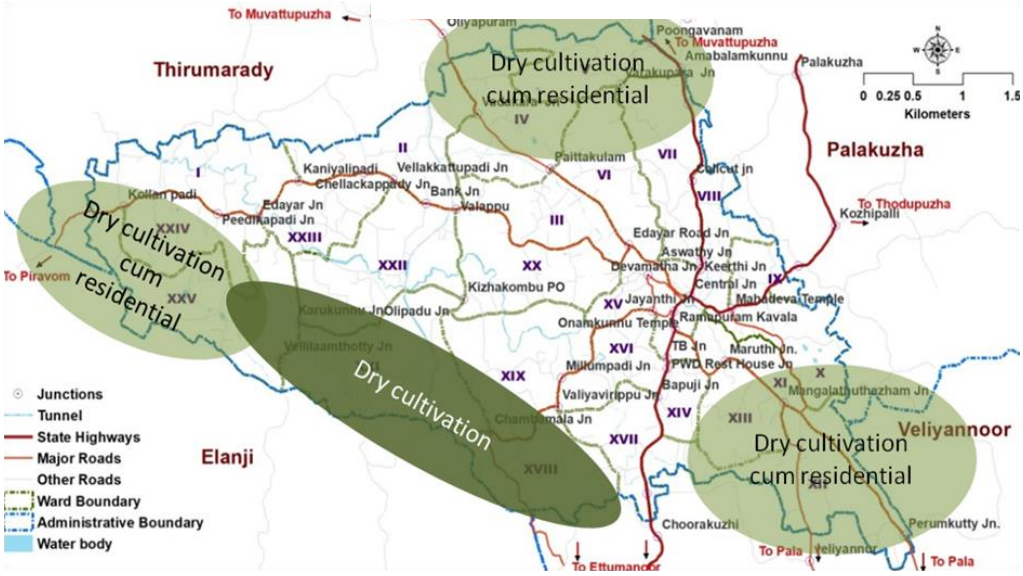


Figure 21-13 : Concept on Dry Cultivation

21.9.5 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. Suitability map is considered for land use zoning of future development

21.9.6 Concept for Transportation Development

The existing radial pattern of road network can be utilised and strengthened with inner and outer ring roads together with link roads. As part of decongestion of city centre a bypass for MC Road needs to be developed. The inner ring road, radial roads and bypass will help to deconjest the core areas and strengthening of link roads and local roads will improve the inner connectivity of Town. For improving regional connectivity outer ring road, north south and east west corridors are to be developed. The outer ring can also improve the inner Town connectivity at the peripheral regions of Town.

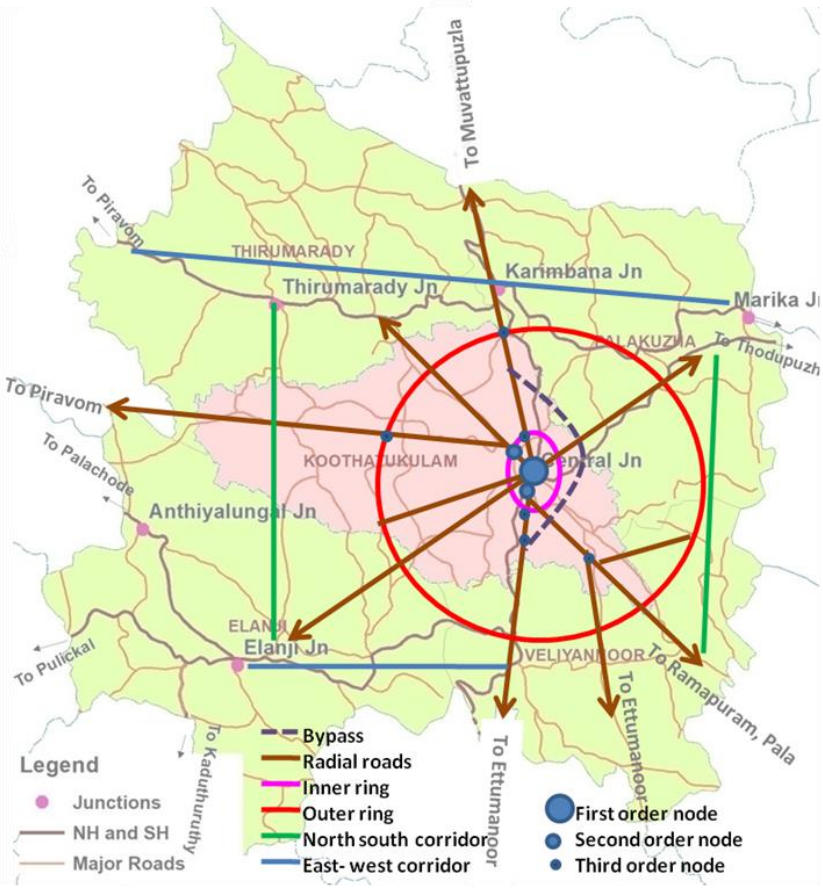


Figure 21-14 : Concept For Transportation Development

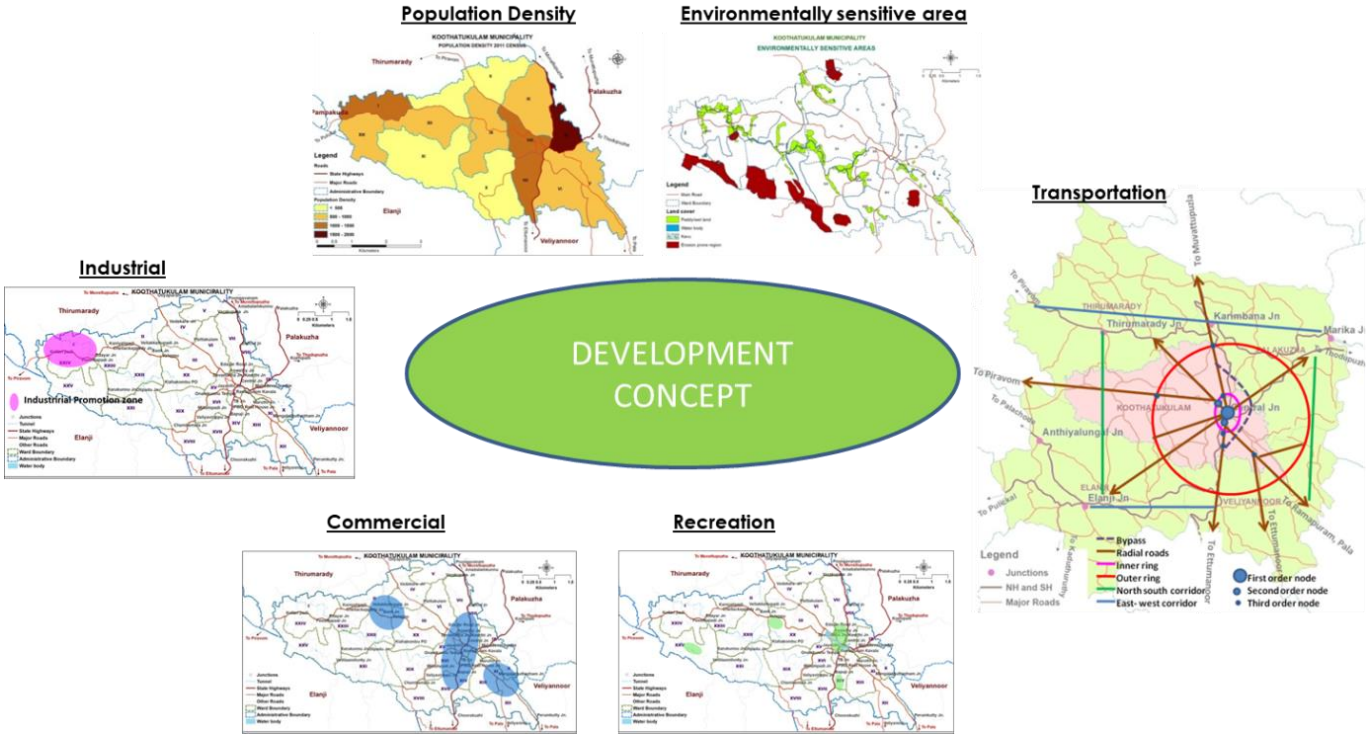


Figure 21-15 : Development concept formulation

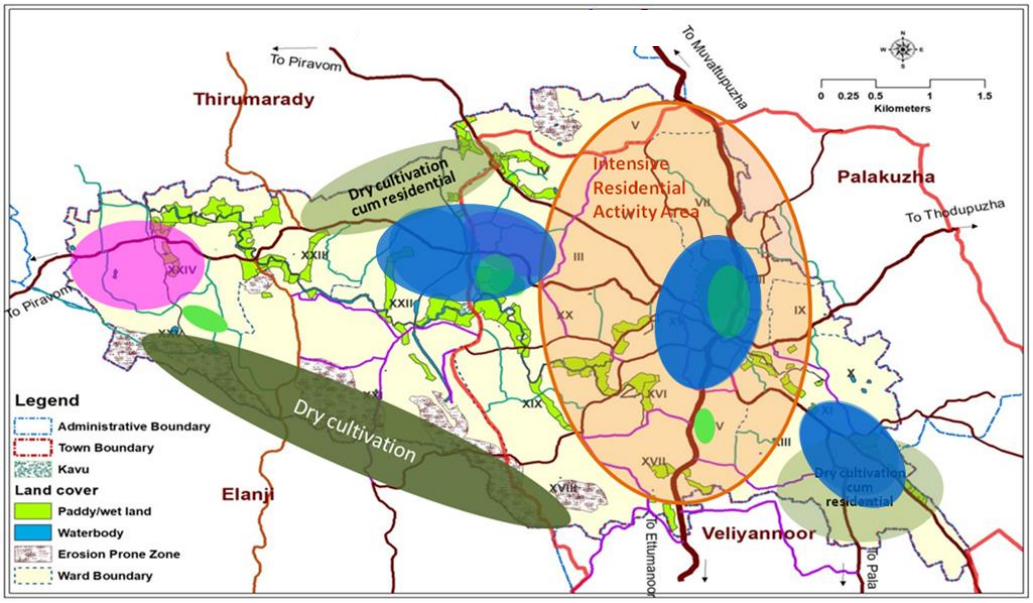


Figure 21-16 : Development concept

21.10 CONCEPTUAL ZONING

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.

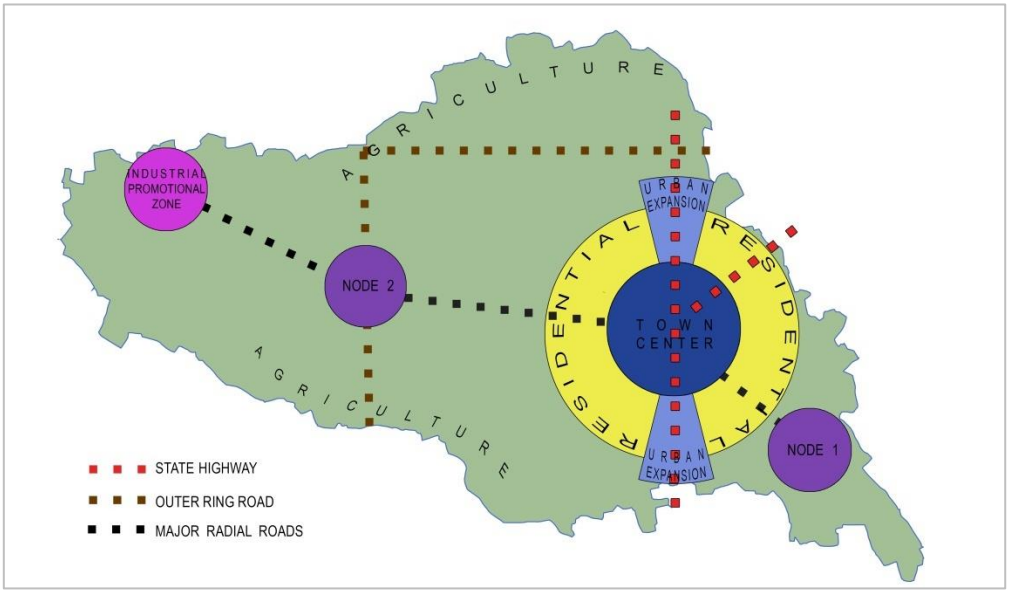


Figure 21-17 : Conceptual Zoning

22 POLICIES AND STRATEGIES

22.1 SECTOR WISE POLICIES AND STRATEGIES

22.1.1 ECONOMIC DEVELOPMENT

Policy: *Uplift the existing economic base of the Town*

Strategies:

- *Strengthen the marketing network by improving connectivity*
- *provide linkage between Town centre and District centre*
- *provide adequate health tourism infrastructure*
- *develop Rubber processing and food processing small scale industries*

22.1.2 WATER SUPPLY

Policy: *To ensure daily supply of water to the users and 100% coverage.*

Strategies:

- *Provision of separate water distribution system for elevated areas.*
- *Performance monitoring - energy audit, leak detection, water quality, etc.*
- *Creation of public awareness.*

22.1.3 SOLID WASTE MANAGEMENT

Policy: *To ensure effective waste management system*

Strategies:

- *Promoting the system of waste segregation and disposal at source itself.*
- *Strengthening the present collection system with additional labours, vehicles etc.*
- *Establishing material recover facility and non-biodegradable processing centres*
- *Promote decentralised waste treatment plant*

22.1.4 SEWERAGE &SANITATION

Policy: *To provide proper sewage and sanitation waste disposal facility*

Strategies:

- *Expansion of drain network to uncovered areas and modify the existing system.*
- *Provision of sewage treatment plant for the drain water before it is directly discharged to an open source of water*
- *Prevent discharge of sewage and sullage to storm water drains.*
- *Provision of septage treatment facility at the sub regional level*

22.1.5 POWER

Policy: *To provide quality power and street light coverage*

Strategies:

- *Provide a good street light system for the Town with 100% coverage in all major and minor roads including residential roads.*
- *Utilization of alternate renewable energy sources*

22.1.6 EDUCATION

Policy: *Improvement and Expansion of existing educational facility to give quality education for all.*

Strategies:

- *Provision of basic infrastructural facilities at all Anganwadies*
- *Support government educational institutions with all basic and advanced facilities to achieve quality education*
- *Utilize the unutilized potentials, including land for starting new institutions/courses.*
- *Provision of adequate infrastructural facilities*

22.1.7 HEALTH

Policy: *Improvement and expansion of existing health care facility to serve the whole Town and its service area.*

Strategies:

- *Providing infrastructure facilities for upgrading the community health centre.*
- *Healthcare facilities at accessible distance*

22.1.8 RECREATIONAL FACILITIES AND OTHER CIVIC AMENITIES

Policy: *Provide adequate recreational facilities for the entire population with an integrated system of Park and play grounds*

Strategies:

- *Protection of existing parks and open spaces*
- *Provision of new residential parks, play grounds and neighbourhood recreational facilities.*
- *Provision of mini stadium to serve the entire Town.*
- *Develop public comfort stations associated with new public purpose developments*

22.1.9 TRANSPORTATION

Policy: *Ease traffic congestion at the Town centre and ensure adequate road network connectivity in the region and inside the Town together with strengthening the existing public transportation system*

Strategies:

- *Establishment of regional linkages for improving regional connectivity considering the future growth potentials.*
- *Providing ring roads and bypass to ease traffic flow and decongest the Town core*
- *Widening and strengthening of existing major roads.*
- *Improvement of main junctions*
- *Developing public transportation plan and its supporting infrastructure*

22.1.10 HOUSING

Policy: *To provide new houses for the land less, houseless and future population and improvement of existing dilapidated houses.*

Strategies:

- *Provide adequate residential areas in land use plan.*
- *Provide housing for the land less and houseless population through various housing schemes*
- *Improvement of substandard housing colonies with basic and necessary physical and social infrastructural facilities*
- *Improvement / provision of basic infrastructure like quality roads with street light, footpath and other supporting infrastructure facilities together with waste management, drainage and recreational facilities, etc. in residential areas.*

22.1.11 ENVIRONMENT

Policy: *To promote development by conserving the environment*

Strategies:

- *Conservation of paddy, wet lands, water bodies and other eco sensitive areas*
- *Conservation of hilly terrain*
- *Prevent development in slopes*
- *Adopt water and soil conservation measures*

23 PROJECTED REQUIREMENTS

23.1 POPULATION

Population of 1981, 1991, 2001 and 2011 has been drawn from the relevant Census reports for India, for Koothattukulam. The estimated population of Koothattukulam for 2036 has been derived based on the estimates worked out from Census data, and updating it in accordance. Taking into account the population growth and the migratory population and the subsequent distribution, the following is the final population projected and aimed for in 2036.

Table 23-1 : Population Projection

Year	Population
1981	**15057**
1991	**16828**
2001	**17682**
2011	**17253**
2021	**18723**
2031	**19377**
2036	**19624**

23.2 EMPLOYMENT

From the analysis of work force participation rate of Koothattukulam with nearby urban local bodies as well as nearby local bodies, it is observed that Koothattukulam has the maximum of 41% WPR. It is generally observed that work participation ratio for new Towns creates more employment. With this in view for Koothattukulam a work participation ratio adopted for 2036 is 41 percent itself. With this work participation rate the total employment of the Koothattukulam works out to 8045.

23.3 TRANSPORTATION

23.3.1 Projected Link Volume on Existing Network

Table 23-1 presents the estimated daily traffic for different horizon years on various road stretches in Koothattukulam Town. Volume-capacity ratio for the horizon years is also presented in this table. It can be seen State Highway 1 (MC Road) would be severely congested in the horizon year with the anticipated traffic exceeding the capacity of the

roads under "do-nothing option". Other roads in the CBD area of the Town will also experience saturation flow in five-year time.

The projection of traffic on the existing road network within the CBD area implies that the existing road network would not be able to handle the traffic in the horizon year without up gradation of the transport infrastructure facilities. Augmentation of the capacity of the existing road network by strengthening/ widening and the construction of alternate link roads is a must considering the dramatic increase in the traffic volume. Base year volume-capacity ratio of different homogeneous section is shown in fig 23-1. Horizon year volume-capacity ratio of different homogeneous section is shown in fig 23-2.

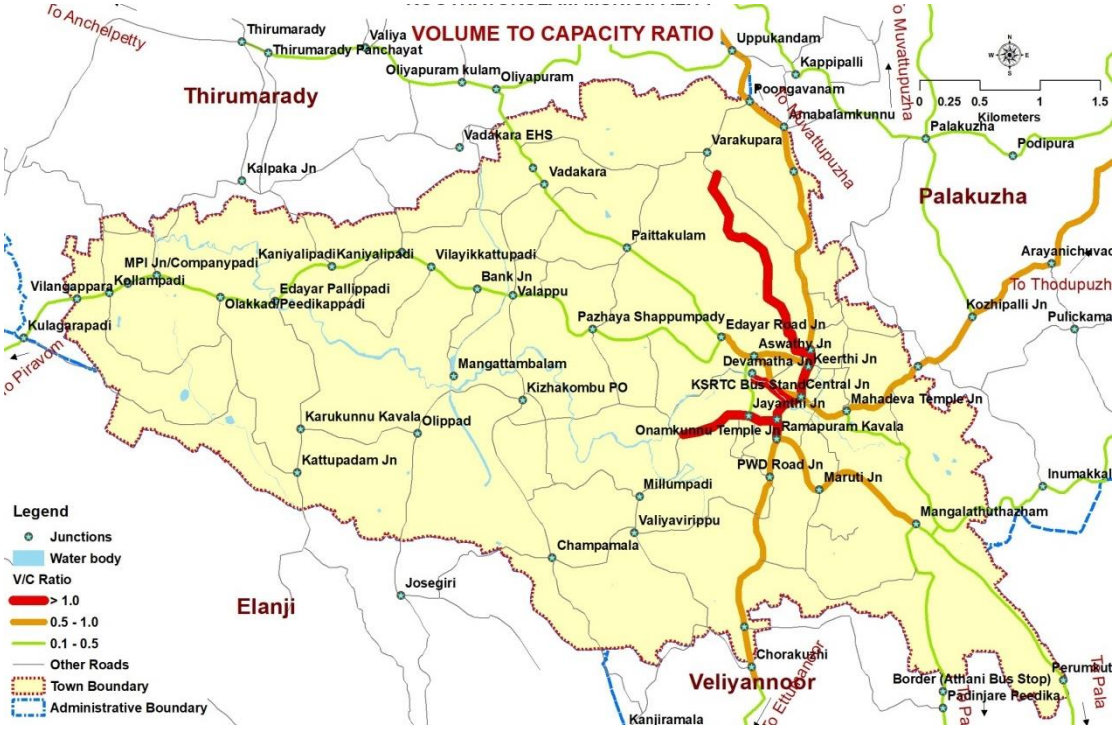


Figure 23-1 : V/C ratio of roads in Koothattukulam for base year (2016)

Table 23-2 : Anticipated volume-capacity ratio on major road links in horizon year 2036 in 'Do Nothing' scenario in Koothattukulam Town

Road No	Road Link	Road capacity (PCU/ day)	2016		2020		2026		2036	
			(PCU/ Hour)	capacity ratio	(PCU/ Hour)	capacity ratio	(PCU/ Hour)	capacity ratio	(PCU/ Hour)	capacity ratio
1	SH 1 (Main Central) Road									
HS0	Puthuvely -Chorakuzhy	1200	371	0.3	451	0.3	604	0.5	895	0.7
HS0	Chorakuzhy - PWD Rest House Jn	1200	690	0.5	839	0.7	112	0.9	166	1.3
HS0	PWD Rest House Jn - Ramapuram	1200	966	0.8	117	0.9	157	1.3	232	1.9
HS0	Ramapuram Kavala - Onamkunnu	1200	165	1.3	201	1.6	269	2.2	399	3.3

Road No	Road Link	Road capacity (PCU/ day)	2016		2020		2026		2036	
			(PCU/ Hour)	capacity ratio	(PCU/ Hour)	capacity ratio	(PCU/ Hour)	capacity ratio	(PCU/ Hour)	capacity ratio
HS0	Onamkunnu Temple Jn - Central	1200	171	1.4	208	1.7	279	2.3	413	3.4
HS0	Central Jn - Keerthi Kavala	1200	156	1.3	190	1.5	254	2.1	377	3.1
HS0	Keerthi Kavala - Devamatha Jn	1200	153	1.2	186	1.5	249	2.0	369	3.0
HS0	Devamatha Jn - Ambalamkunnu	1200	104	0.8	126	1.0	169	1.4	251	2.0
HS0	Ambalamkunnu - Uppukandam	1200	696	0.5	846	0.7	113	0.9	167	1.4
HS1	Uppukandam - Aaroor	1200	708	0.5	861	0.7	115	0.9	170	1.4
2	**SH 40 (Alappuzha Madurai Highway)**									
HS1	Mutholapuram - Chorakuzhy	1200	151	0.1	177	0.1	224	0.1	300	0.2
HS1	Central Jn - Mahadeva Temple Jn	600	515	0.8	602	1.0	762	1.2	102	1.7
HS1	Mahadeva Temple - Kozhippally	600	372	0.6	435	0.7	550	0.9	739	1.2
HS1	Kozhippally - Marika	200	195	0.9	228	1.1	289	1.4	388	1.9
3	**SH 42 (Kumarakom - Cumbummettu Highway)**									
HS1	Thirumarady - Oliyappuram	1200	530	0.4	619	0.5	784	0.6	105	0.8
HS1	Oliyappuram - Uppukandam	1200	170	0.1	199	0.1	252	0.2	338	0.2
HS1	Karimbana - Palakuzha	1200	300	0.2	350	0.2	443	0.3	596	0.5
HS1	Palakuzha - Marika	1200	233	0.1	273	0.2	345	0.2	464	0.3
4	**Koothattukulam - Oliyappuram Road**									
HS1	Central jn - Ashwathy Jn	1400	812	0.5	949	0.6	120	0.8	161	1.1
HS2	Ashwathy Jn - Edayar Road	1200	742	0.6	868	0.7	109	0.9	147	1.2
HS2	Edayar Road Kavala -	1200	592	0.4	693	0.5	876	0.7	117	0.9
5	**Ramapuram Road**									
HS2	Ramapuram Kavala -	1200	901	0.7	105	0.8	133	1.1	179	1.4
HS2	Mangalathuthazham -	1200	533	0.4	623	0.5	788	0.6	105	0.8
6	**Moovattupuzha - Pandappally - Koothattukulam**									
HS2	Pandappally- Palakuzha	600	225	0.3	263	0.4	333	0.5	448	0.7
HS2	Palakuzha-Kozhippally	600	224	0.3	262	0.4	332	0.5	446	0.7
7	**Koothattukulam - Edayar - Piravom Road**									
HS2	Edayar Kavala- MPI	600	172	0.2	194	0.3	231	0.3	282	0.4
HS2	MPI- Vilangappara	600	167	0.2	188	0.3	224	0.3	274	0.4
8	**Uzhavoor Koothattukulam Road**									
HS2	Veliyannoor -	1200	443	0.3	518	0.4	655	0.5	880	0.7
9	**Koothattukulam - Marika Road via Karamala**									
HS2	Mangalathuthazham- Inumakkal	600	194	0.3	218	0.3	261	0.4	318	0.5
10	**Koothattukulam - Kizhakombu Road**									
HS3	Onamkunnu Temple - Jayanthi	200	308	1.5	347	1.7	414	2.0	505	2.5
HS3	Jayanthi Jn - Kizhakombu	200	371	1.8	418	2.0	499	2.4	608	3.0
11	**Other Roads**									
HS3	Keerthi Kavala - Aswathy Jn (One-	600	602	1.0	704	1.1	891	1.4	119	2.0
HS3	Central Jn - KSRTC (One-way)	200	293	1.4	343	1.7	434	2.1	583	2.9
HS3	Mangalathuthazham -	200	89	0.4	100	0.5	119	0.5	145	0.7
HS3	Jayanthi Jn - Ashwathy Jn Road	600	226	0.3	254	0.4	304	0.5	370	0.6
HS3	Devamatha Hospital Road	200	268	1.3	302	1.5	360	1.8	439	2.2
HS3	Ambalamkunnu - Kappippally	1200	144	0.1	162	0.1	193	0.1	235	0.2

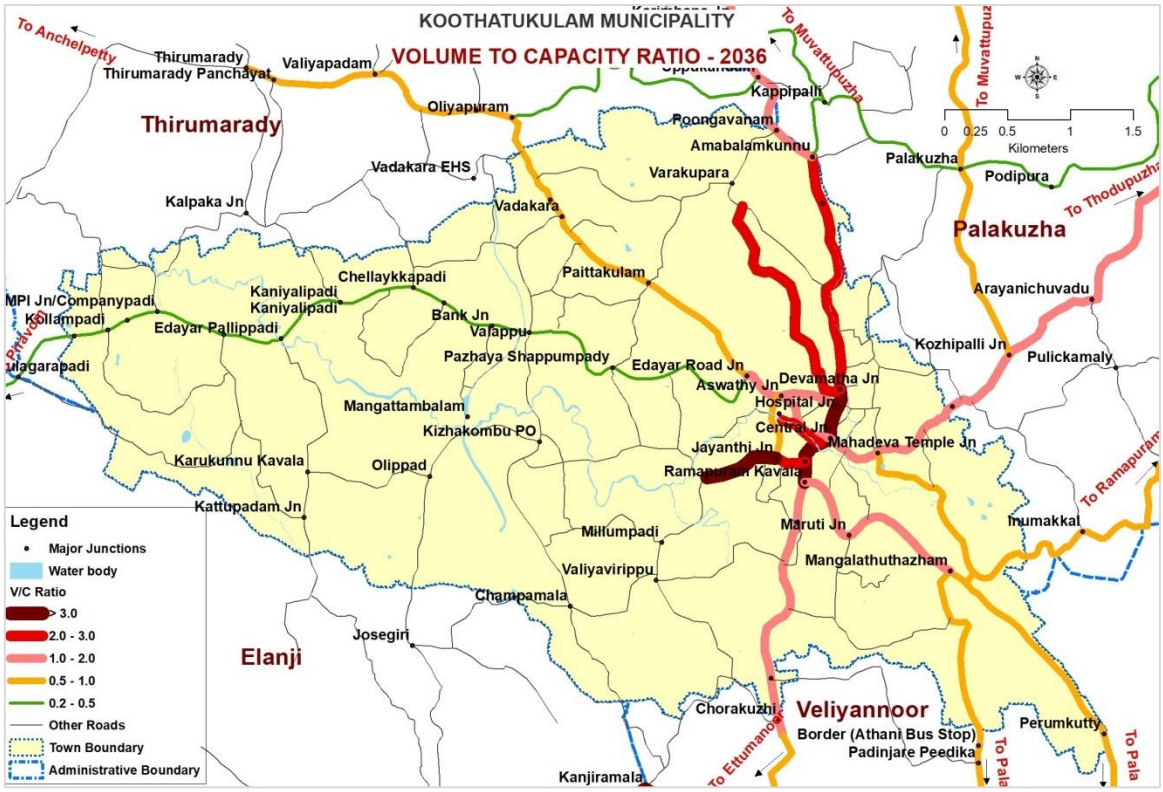


Figure 23-2 : V/C ratio of road section in Koothattukulam for Horizon year (2036)

23.4 WATER DEMAND

Water demand has been estimated for the Master Plan area as per CPHEEO norms. A per capita supply rate of 135 lpcd has been considered for working out the water demand for domestic and commercial uses. Additional 15% of this demand is to be added to account for unavoidable water losses. Hence a total of 3 MLD is required for the future population. Since the existing water supply has a capacity sufficient for the population, concentration should be on coverage and replacement and rectification of the distribution system

23.5 HOUSING

As per the Pradhan Manthri Awas Yojana (PMAY) survey, about 567 houseless and landless were identified which is the present total housing shortage in Town. There were 71 landless among them. This shows that the houseless and those living in dilapidated houses constitutes a total number of 496 households.

Considering the future growth in population the projected housing need with household size of 3.9 is 608 houses. Assuming that all the identified beneficiaries (242 households) under the PMAY scheme is benefitted fully during the scheme period then the remaining

housing shortage and the future demand will constitute the future total housing demand of the Town which is 933 houses.

23.6 SOLID WASTE MANAGEMENT

At present in 93.27% of household, wastes are disposed in their own compound, since a major portion of the Town is agriculture / residential mix area. The wastes from the commercial/Town Centre need to be collected. It is assumed that half of the total population has their own facility at the source itself/ decentralised units. The waste to be collected from the remaining population accounts to 3MT/day .Considering the quantity of waste generated from other sources like Hotels & Restaurants, Institutional, Commercial etc the total quantity of waste generated accounts to 4.6MT.So a system has to be evolved for collection and disposals of a quantity equal to 4.6MT/day by 2036. Separate facility is required for non-bio-degradable waste management for the entire Town area.

24 LAND USE PLAN

24.1 INTRODUCTION

Land use Plan plays a major role in the process of evolving better environment for all the inhabitants in a Town. Better management and distribution of activities in the Town will reduce many problems and conflicts in land use. The Land use Plan for Koothattukulam is developed based on the present trend of land development, ongoing and committed projects, projected requirements, proposed development policies and strategies and based on the development concept evolved.

In order to assess the total land requirement for various uses for the horizon year 2036 in Koothattukulam Town, the existing land use pattern is studied and then compared with the assessed future requirement for major uses using 'Urban and Regional Development Plans Formulation and Implementation (URDPFI) Guidelines, 2014' of the Ministry of Urban Development, Government of India. The URDPFI guidelines for small Towns are used in the land allocation within the settlement for various uses in Koothattukulam Town.

Koothattukulam Town is having several peculiarities among other Towns of Ernakulam District. Being a newly formed Municipality and located in the boundary region of Kottayam, Idukki and Ernakulam Districts, it has the lowest population while comparing with other Towns in the District. Agricultural land use is predominant in Koothattukulam with higher percentage of land used for dry agriculture purpose.

In the proposed Land use Plan, the Town has been divided into various zones based on the development concept. Paddy /Wetland zone, Kavu, Water bodies and all existing Park and open space in the town are retained as such in the proposed land use plan. The Town Centre, Sub Centers, Residential Mix Use Zone, Residential Use Zone, Public and Semi-Public Use Zone, Traffic and Transportation Use Zone, Industrial Promotion zone, Dry Agriculture cum Residential Use Zone, Dry Cultivation Use Zone are the major land use zones proposed. Some areas of the Town are specifically earmarked for certain projects and such zones are named as Special Zones.

Park and Open Spaces

From the analysis of the existing land use, it is found that open spaces constitute only 0.01% 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 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.

The proposed park and open space area is 1 ha of land which is 0.04% of net land area and this area includes the proposed mini stadium, parks and play area. Since the existing park and open space is not sufficient when compared with standards this area can include the area proposed for kattupadamchira and nearby park and canal beatification projects, But it is included in water bodies.

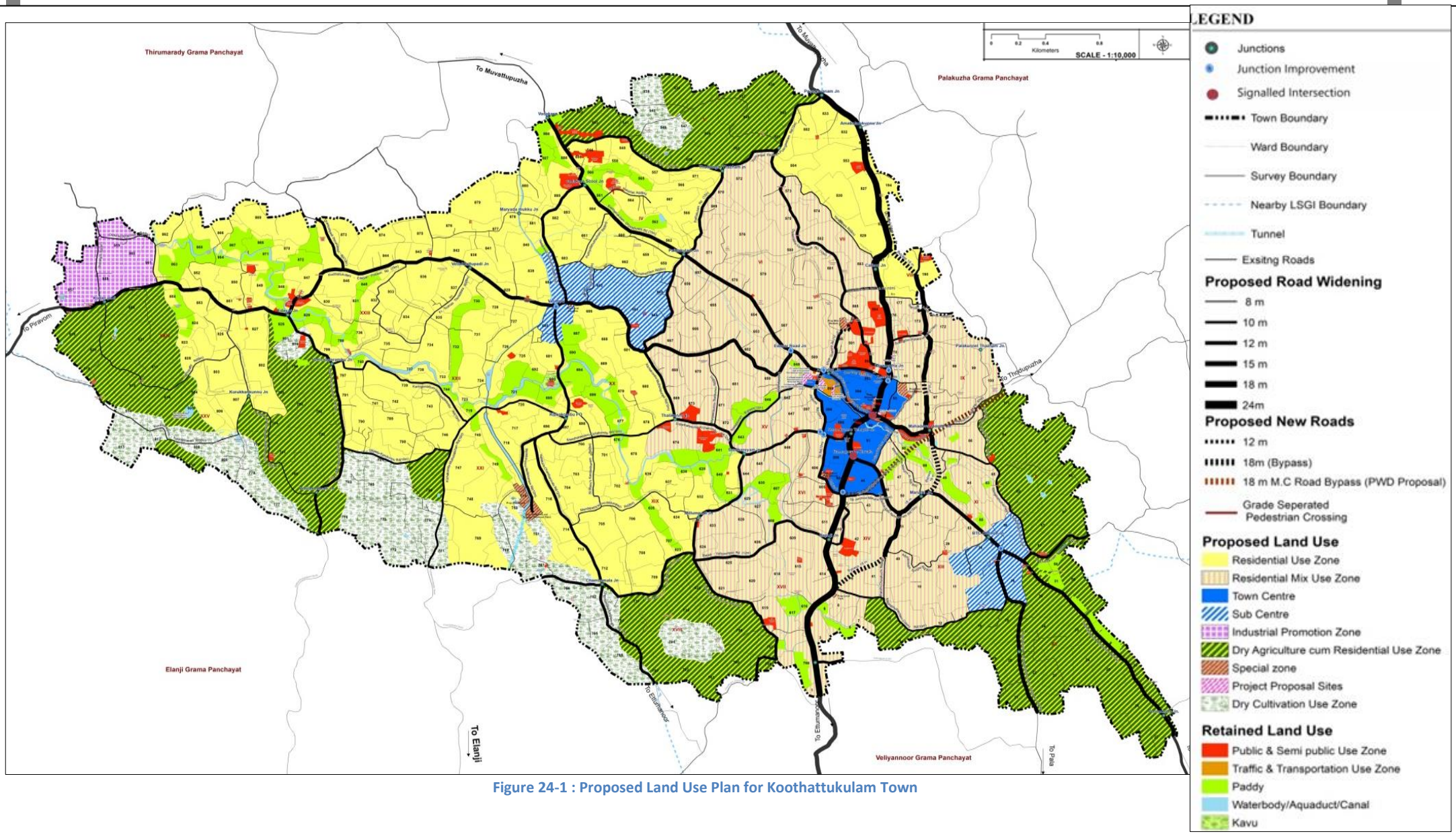


Figure 24-1 : Proposed Land Use Plan for Koothattukulam Town

24.2 LAND USE BREAK UP

The proposed land use break up in hectare and percentage of different land uses of the planning area is shown in Table 24-1. The proposed land use map is shown in Figure 24-1.

Table 24-1 : Proposed Land uses break up

Sl. No.	Land use	Area (In Ha)	Percentage
1	Town Centre	38.76	1.67%
2	Sub centre	63.26	2.73%
3	Residential Mix Use Zone	539.01	23.25%
4	Residential Use Zone	733.87	31.66%
5	Public and Semi-Public Use Zone	36.40	1.57%
6	Traffic and Transportation Use Zone	113.86	4.91%
7	Industrial Promotion zone	32.44	1.40%
8	Dry Agriculture cum Residential Use Zone	447.26	19.30%
9	Dry Cultivation Use Zone	161.02	6.95%
10	Parks and open spaces	1	0.04%
11	Water bodies	24.09	1.04%
12	Paddy/ Wet land	127.03	5.48%
Gross Area		**2318**	**100%**

24.3 PROPOSED LAND USE ZONES

24.3.1 TOWN CENTRE

The proposed Town centre covers the present CBD of the Town with Central junction at its core which is a proposed second order node in DUR. Town centre also covers other existing higher order commercial nodes in Town after central junction i.e., Aswathy junction and Ramapuram kavala. Since connectivity plays a major role in the development of commercial areas, commercial areas are expected to grow along the MC Road. So the proposed Town centre includes the existing commercial nodes in Town along MC Road from Keerthi junction to TB junction and the area inside the inner ring road consisting of 38.76 ha area which is 1.67% of the gross land area.

The entire area in this zone has organic development with high intensity of activities with high and moderately built up areas. Town Centre serves as the main business centre for the Town. All major commercial and business activities of the planning area are concentrated at this zone. In addition to commercial activities, Public uses like temples and churches, hospitals, recreational areas, educational institutions, markets, proposed mini civil station, etc. are there in the Town centre. The proposed Town Centre has to accommodate higher order commercial and related uses so that the requirements of the people in the Town as well as in the service area will be served by this zone.



Figure 24-2 : Bit map showing proposed Town centre

In this zone, a mixed land use of commercial, residential, public and semipublic use and non-nuisance type industrial use shall be permitted.

24.3.2 SUB CENTRE

The basic concept of a Sub centre is to decongest the urban core to the extent possible and to develop commercial areas to facilitate the essential urban services. These zones should be spatially distributed in such a way that other major commercial nodes are included. One major node identified as sub centre towards the south east of Town centre is Mangalathuthazham, since it is an identified fourth order node and proposed third order node in the District as per DUR. It is a major junction in the proposed radial road from Koothattukulam at which the road diverges in to two: one towards Ramapuram and other towards Uzhavoor. Also the presence of major educational institutions and subsidiary activities makes it an important node at the Town level. The provision of mixed use to the buffer of main roads will create scope for development in Town.

Another node to be developed as sub centre is at Valappu junction, which lies almost at the geographical center part of the municipal area. This node lies towards the north west of Town centre and is at the intersection of Koothattukulam Edayar Piravom radial road and outer ring road. The proposed road network for Town makes this area as a major node in the region and the location for a subcentre. Valappu sub centre will be helpful for the people on the western parts of town since the present town centre is geographically more towards the eastern side of the town area.

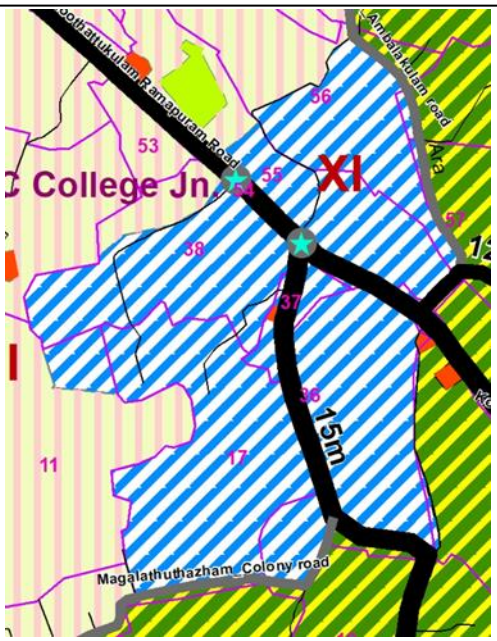


Figure 24-3 : Bit map showing proposed Subcentre at Mangalathuthazham

Both these zones are spatially distributed in such a way that it is easily accessible to the people from the peripheral regions of Town without entering the core area. The provision of mixed use to the buffer of main roads will create scope for development in Town.

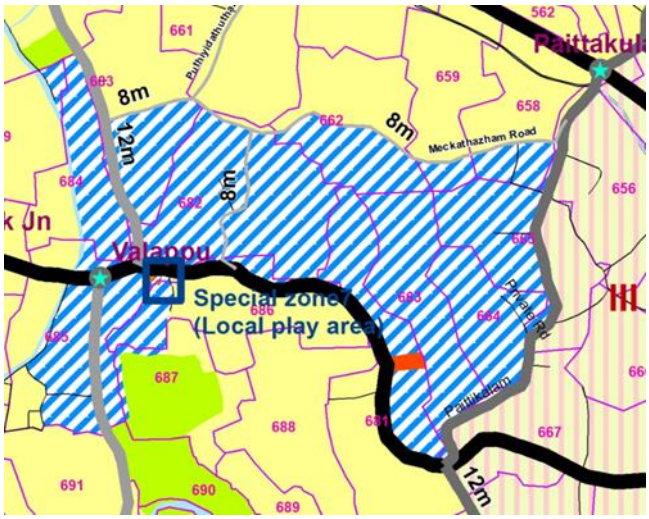


Figure 24-4 : Bit map showing proposed Subcentre at Valappu junction

24.3.3 RESIDENTIAL MIX USE ZONE

Considering the development trend of the Town and in order to accommodate different compatible developments a residential mixed zone has been proposed around the Town centre. It is generally a mixed zone and many non-residential uses like commercial, small-industrial, public use etc. are also permissible in this zone in addition to residential use subject to certain conditions. The basic concept of this zone is to promote the residential use in combination with other urban activities predominantly commercial in a planned manner to satisfy the present and future demand of economic market force and pressure on urban land.

The proposed MC road bypass which passes through the eastern side of the Town core area and inner ring road can produce intense development at nearby areas. An area of 539 ha is proposed as Residential Mix Use Zone in continuum with urban core and is spatially located around the Town centre in order to cater the development potential of the area around the Town centre. This zone is shown in the proposed land use map in Figure 24.1.

24.3.4 RESIDENTIAL USE ZONE

Residential areas are scattered inside the Town area. The total land under residential use in Koothattukulam Town is 733.87 ha, which is 31.66 % of the total area of the Town. The overall density of population is only 7.44 persons/ha and the residential density is 40.92 persons/ha. The projected population for Town by the year 2036 is 19624. For a small Town like Koothattukulam, URDPFI Guide lines propose an average density of 75-125 persons per hectare. Assuming a population density of 75 persons/ ha, 261.65 ha of land is required for residential use by 2036. The net area available in the Town is 2158 ha, in which the proposed Residential Use Zone has an area of 733 hectares. Hence the available net area is found to be sufficient for holding the projected population by the horizon period of 2036.

As per URDPFI standard, 45-50 % of the net area of small Towns shall be under residential use. For Koothattukulam Town, an area of 733 hectares of land which is about 31.66 % of the developable area and 31.92% of the total land area is zoned for residential use. This zone is envisaged to full fill the planned residential development of the Town satisfying the residential demand together with supporting activities. In addition to that, residential uses are permissible in zones like Residential Mix Use Zone, Dry Cultivation Use Zone etc. with certain conditions.

According to the development concept, the area suitable for residential purpose has been identified around central core of the Town. Residential activities of three intensities are proposed in the Town. A Residential Mix Use Zone with permitted other urban activities is proposed around the Town centre followed by Intensive residential area beyond it as Residential Use Zone. It is followed by peripheral areas with low intensity residential development known as Dry Agriculture cum Residential Use Zone, which mainly favours dry cultivation and the residential density is far below the recommended standards. Since

homestead type of development is the character of the area homestead type cultivation can also be done in this zone. This zone is shown in the proposed land use map in Figure 24.1.

24.3.5 PUBLIC AND SEMI-PUBLIC USE ZONE

The present Public and Semi Public land use in the town area which seems to be scattered in the Planning area are proposed to be retained as such under this zone. As per the directions of the council since the Magalathuthazham engineering college is no longer functioning, it is included in the mangalathuthazham subcentre. The proposed special zones and projects under public and semi public use also comes under this zone which constitutes an area of 36.40 ha. In addition to that there are provisions for Public and Semi-Public uses in other zones as per zoning regulations. This zone is shown in the proposed land use map in Figure 24.1.

24.3.6 TRAFFIC AND TRANSPORTATION USE ZONE

An area of 85.67 ha is under traffic and transportation use which is 3.70% of total area present in Town. The present transportation network and facilities together with proposals in traffic and transportation sector are included in this zone. This makes a proposed total area of 113.86 ha which is 4.91% of the land area. In transportation sector, the proposed bypass of MC road will decongest the traffic at the Town centre. As per development concept, proper connectivity between different activity zones shall be ensured for proper integration. Strengthening the radial and ring pattern road network, by pass for MC Road, road widening proposals, public transportation plan, parking facilities etc form part of the traffic and transportation proposals. Detailed Transportation plan for the Town is given in chapter “Traffic and Transportation plan” and the zone is shown in the proposed land use map in Figure 24.1.

24.3.7 INDUSTRIAL PROMOTION ZONE

Industrial land use is only nominal in Koothattukulam Town. Only 8.71 ha of land is available for industrial purpose which is 0.56% of the total area of the Town. As per UDPFI guideline, the industrial land use requirement for small Town like Koothattukulam is 8-10 % of developed area.

Industrial sector is found as one of the key sectors for economic boosting up of any Town and Koothattukulam needs more development in this sector. Based on the objectives for economic development rubber based and agro based industries are promoted in Town. Major industrial land uses are suggested in Industrial Promotion Zone in the proposed land use. In addition to that there are provision for setting up of small scale industrial units in other zones also with certain restrictions as per zoning regulation, hence reduced share of land under industrial use will not affect the overall requirements as per the standards.

One location is identified as industrial promotion zone in the Town, which is at the North West side of the municipal area, due to the presence of the large scale industry (MPI) in Town. It is proposed to develop a new institute associated with MPI and the existence of MPI itself is capable of developing its surroundings to an industrial promotion zone and thereby boosting the industrial sector in Town. The other factors like good transportation, availability of power, water, proximity to other Towns, etc. also shows the possibility to develop this as an industrial promotion zone. An area of 32.44 ha area is poposed as industrial promotion zone in the town which is 1.40% of the gross land area.

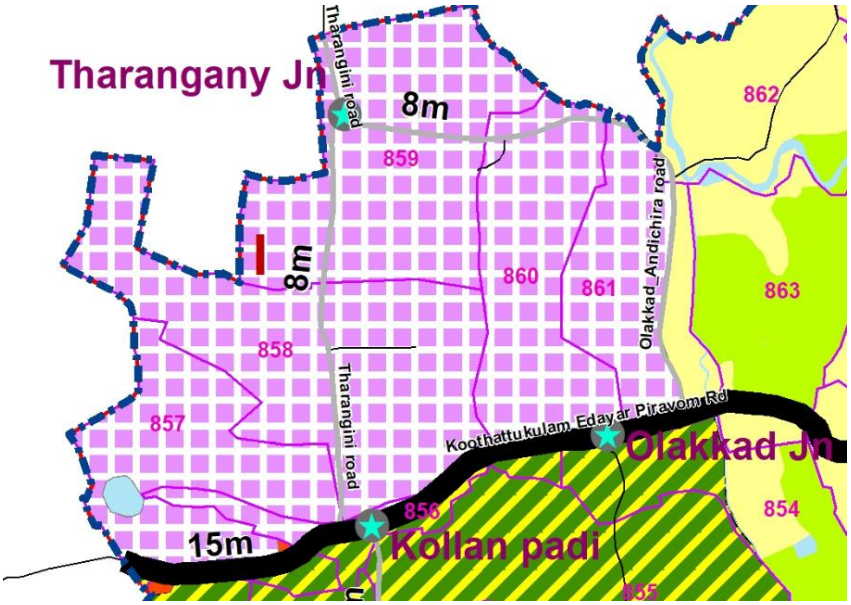


Figure 24-5 : Bit map showing proposed Industrial Promotion Zone

24.3.8 PADDY / WET LAND

Major share of paddy land available in the municipal area remains uncultivated. The pressure on paddy /low-lying land for conversion to other uses is excessive. Hence conservation of paddy/low-lying land shall be enforced due to its environmental importance in order to maintain a healthy environment. In order to conserve these areas, the active paddy cultivation needs to be promoted through strong interference of the local bodies. The

uses permitted in this zone should be in accordance with the provisions in the Kerala Conservation of Paddy land and Wet land Act, 2008 and other wetland conservation acts relevant for the area. This zone is shown in the proposed land use map in Figure 24.1.

24.3.9 DRY AGRICULTURE CUM RESIDENTIAL USE ZONE

About 67.54% of the land is under dry cultivation having an area of 1565.63 ha. Rubber alone contributes the major share of dry cultivation. Nearly 50.14% of total land area which is 1168.60 ha of land is under Rubber cultivation and mixed crop farming constituted an area of 397 ha. Based on the crop suitability analysis of Soil Survey Department, the soils in the side-slopes support dry crops like Rubber, coconut, and Arecanut. Other than these crops nutmeg, pineapple, pepper, cocoa and coffee are also suitable for this soil. In the hill submits and steep slopes teak and rubber plantation are good option. These geographical features of the Town show the land suitability for dry agriculture and especially rubber plantation. The rubber cultivation is to be promoted through modern techniques. As per the development concept rubber cultivation and rubber based industries shall be promoted in the Town. An area of 447.26 ha which is about 1 % of the net land area ie, 19.41% of the gross area is retained under dry cultivation.

Dry Agriculture cum Residential Use Zone shall be used for stimulating homestead cultivation and animal husbandry. Homestead cultivation shall be promoted in order to avoid the dependency towards nearby states for agriculture products such as vegetables, fruits etc. Active involvement of municipal authorities can improve the present situation by providing opportunities for self-employment programmes in these sectors for women and unemployed persons for their economic development. A community level or neighborhood level production and marketing can improve this sector. Marketing of the products shall be made possible through the expansion of the market by providing special places for local people to sell their products as raw or value added products through this farmers market. This zone is shown in the proposed land use map in Figure 24.1.

24.3.10 DRY CULTIVATION USE ZONE

The soil survey report based on cadastral level mapping published by of Soil Survey Department, Kerala during 2011 shows that, there exits Class VI group of capability of land

which have very high restriction of erosion and slope. This area due to steep slope characteristics, require crops with minimum tillage and Suitability of crop is limited to plantation crops. This land is best suitable for forest and grass land. Also the soils in the side-slopes support dry crops like Rubber, coconut, and Arecanut. This zone is considered as environmentally fragile zone. Hence large scale construction should be limited. Most of the south-western boundary of Koothattukulam Town comes under this zone. It is needed to develop different soil conservation measures to reduce soil erosion at this zone and the present cultivation is proposed to be retained under this zone. This includes an area of 162 ha of land which is 7.0 % of the gross area. This zone also includes Soil erosion prone areas, kavu, and other eco sensitive areas. The kavu constitutes an area of 1.34 ha which should be protected and conserved as it is for our future generation and hence it is proposed to retain it in the proposed landuse. This zone is shown in the proposed land use map in Figure 24.1.

24.3.11 WATER BODIES

Water bodies constitute about 1% of Town area. Water bodies including streams, thodu, ponds, wells, etc are included in this zone. Conservation and protection of all the existing water bodies is a major objective of this plan. These water bodies are to be protected and maintained due to its environmental importance for avoiding contamination, destructions and encroachments. Side beatification projects identified for selected water bodies for passive recreational purposes are presented in the chapter sectoral proposals. This zone is shown in the proposed land use map in Figure 24.1.

24.3.12 SPECIAL ZONES

Six special zones are proposed in this plan based on the availability and potential of government owned lands which can be handed over to Municipality. These zones are intended for specific purposes such as solid waste management, parks and open spaces, administration, transportation, environmental conservation etc.

24.3.12.1 Special zone 1 (Warehouse)

A ware house facility is proposed at this zone for raw material and product storage in controlled and modified atmospheric conditions to serve the whole service area. An area of

1.12ha is earmarked for this special zone. The access road to this special zone from the outer ring road is proposed to be developed to 12m wide.

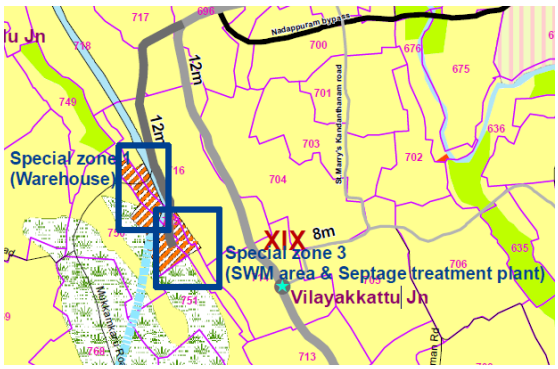


Figure 24-6 : Bitmap Showing Special zone 1 (Warehouse)

24.3.12.2 Special zone 2 (Mini Civil Station)

A mini civil station, housing all State government offices in Town and nearby areas inside a single, smart and green building complex with citizen friendly facilities and well connected with public transportation, will help the public to easily and comfortably access them. The land available at the present location of police quarters can be used for developing the proposed mini civil station, by reserving about 50 cents of land for developing a multi storeyed residential quarters building. This special zone has a total area of 0.73ha of land.

On implementing this, buildings and existing compound of shifted offices can be acquired and used for public recreational purpose activities such as parks and open spaces or uses which can generate revenue for the Municipality. One such example is the land available at the present location of village office and Sub registrar office on shifting them to the mini civil station. This can be converted to a park, which is a public space that will help to improve the quality of life and availability of recreational space for the people at the Town centre. A portion of this area can be used for developing street vending zone since the area is near MC road. On shifting the Sub Treasury to the new mini civil station, the land can be utilised for expansion of the existing police station as additional area is required for the police station.



Figure 24-7 : Bitmap Showing Special zone 2 (Mini Civil Station)

24.3.12.3 Special zone 3 (SWM area & Septage treatment plant)

A material recovery facility, aerobic composting units and green strip are proposed exclusively for solid waste management for the entire Town area at the land under the ownership of Moovattupuzha Vally Irrigation Project (MVIP) in ward number 21. It is proposed to develop this as a special zone for the waste treatment of the entire Town. Considering the existing system of sanitary waste disposal and changing plot size of the residents in Town a new Septage treatment plant is also suggested to be developed at this zone, with sufficient green strip and buffer zone since it is situated at a sufficient distance away from Town centre. A total area of 1.02ha land is earmarked for this special zone for the solid and sanitary waste management of the region. The access road to this special zone from the outer ring road is proposed to be developed to 12m wide.

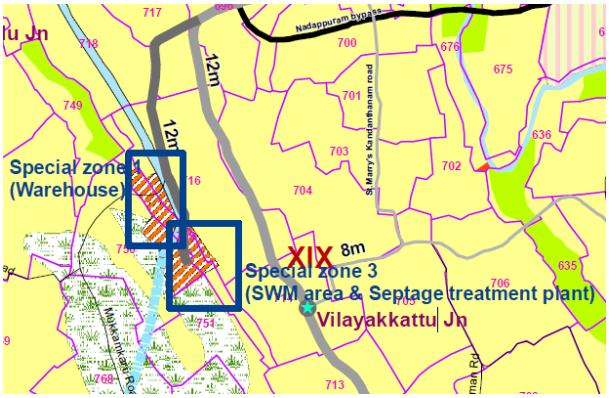


Figure 24-8 : Bitmap Showing Special zone 3 (SWM area & Septage treatment plant)

24.3.12.4 Special zone 4 (Mini Stadium)

An open air mini-stadium is proposed with modern facilities of minimum standard in the land under the ownership of MVIP located in ward no.7 with an area of 0.54 ha. Currently the proposed site is on lease and the area is also not sufficient for a standard stadium. The access road to this special zone from the inner ring road is proposed to be widened to 12m

and it is also proposed to be connected to the Devamatha-Varakupara radial road by a new link road of 12m width and further to MC road by widening the existing road to 12m as shown.

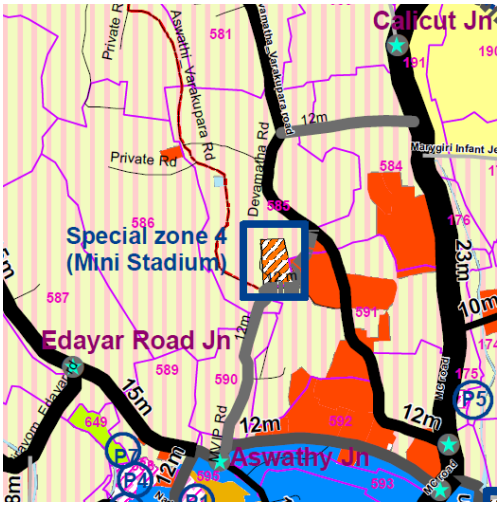


Figure 24-9 : Bitmap Showing Special zone 4 (Mini Stadium)

24.3.12.5 Special Zone 5 (Municipal Park)

The land available at the present location of village office and Sub registrar office can be used for developing a Municipal park. Green patches and sitting arrangements are to be provided.

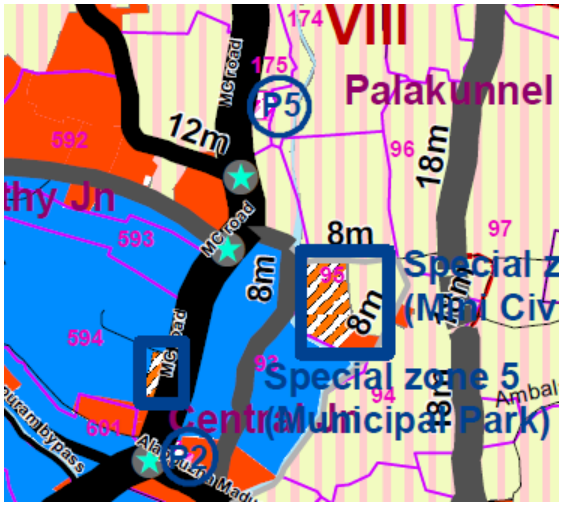


Figure 24-10 : Bitmap Showing Special zone 5 (Municipal Park)

24.3.12.6 Special Zone 6 (School Play ground)

It is suggested to use the land under the ownership of MVIP near the inner ring road for recreational purpose and to use as a play ground to be used by the Govt UP School Koothattukulam and the nearby population during other times. The school and playground

are needed to be well connected with each other by means of a foot over bridge in between school and proposed ground by the concerned authority to avoid the crossing of inner ring road by the students considering their safety.

Measures should be taken to separate play equipment and play areas for older children (>6) from equipment for younger children (0-6). Also adequate separation between the two play areas should be ensured for safe circulation. Entrances to the playground should be clearly marked and the border clearly defined. Providing low rail fencing creates a sitting edge and also creates a sense of security.

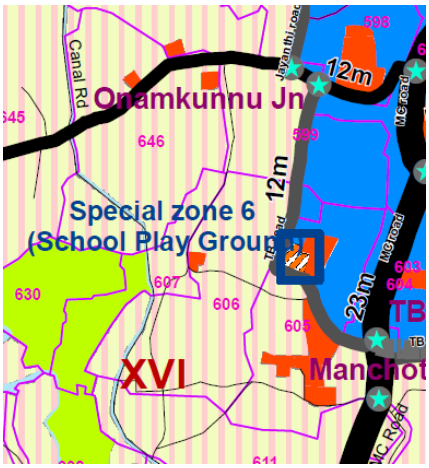


Figure 24-11 : Bitmap Showing Special zone 6 (School Play ground)

24.3.12.7 Special zone 7 (Local play area)

A Local play area is suggested to be developed in the west side of Municipality catering the local population in the area. Currently, the land is under the ownership of block panchayath and left unused.

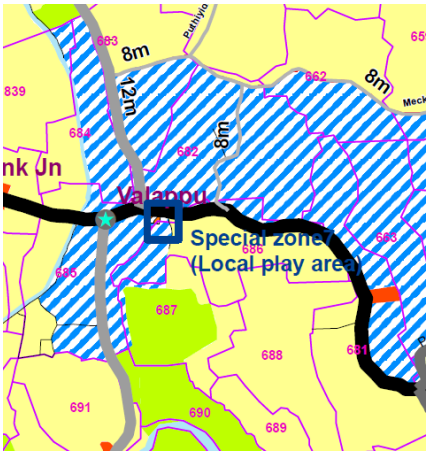


Figure 24-12 : Bitmap Showing Special zone 7 (Local play area)

24.3.12.8 Special zone 8 (Local Park)

A Local Park is identified in the south to Town center, which is also under the ownership of Block panchayath. Currently an Anganwadi is functioning in the plot; however the remaining land can be transformed as a park which will cater the anganwadi as well as the nearby residential areas.



Figure 24-13 : Bitmap Showing Special zone 8 (Local Park)

25 TRAFFIC AND TRANSPORTATION PLAN

Road transport is the only mode of transport available in Koothattukulam so, a road Development Plan needs to be developed for the Town ensuring better inter-connectivity and intra-connectivity. The long term development strategy for the Town should aim at decongesting the Town core areas by augmenting road capacity and scientific design of intersections together with enhancing the existing public transportation facilities. On the basis of the projected volume of traffic and alternative network development schemes, a road development plan has been formulated for Koothattukulam Town.

A detailed discussion with the governing body of the Municipality in a meeting presided over by the chairman with active participation of the ward counselors of the Municipality on the future traffic and transportation development strategies for the Town helped to arrive at suggestions and proposals for future transportation plan including the proposed ROW of roads considering the geographical and other constrains for widening of the roads.

25.1 DEVELOPMENT STRATEGY

The existing pattern of road development has been found to be in a radial and ring form. The future pattern proposed is based on strengthening of the existing radial pattern by widening of existing roads and at the same time strengthening the identified important roads. The most important aspect of traffic and transportation problem of the Town is the congested central core with limited scope for road widening. Hence, emphasis has been given to develop alternative linkages so as to divert the traffic passing through the CBD area. This would also help to reduce the unwanted intermix of intra-city and inter-city traffic within the central part of the Town.

Emphasis should also be given to improve the pedestrian facilities, junction improvements and public transportation facilities. As per the future road development plan for the Town, the proposed network constitutes radial roads complemented with circumferential roads to form ring and radial pattern of urban road network. Development of radial road, ring roads and their link roads, bypass roads and widening of existing roads to decongest the core

along with provision of appropriate parking and pedestrian facilities helps to ease the traffic problems at the Town core region.

The Road Development Plan for Koothattukulam region envisages hierarchical pattern of road network conforming to the following categories of road system.

- Primary distributor road
- Secondary distributor road
- Tertiary road
- Local road

25.1.1 Primary Distributor Roads

Primary distributor roads provide connectivity to state and District headquarters with a 'right of way' width of minimum 24m. In Koothattukulam, MC road, SH 40 and Koothattukulam- Ramapuram road (Ramapuram Kavala - Mangalathuthazham) are the primary distributor roads. Thalayolaparambu- Koothattukulam road (currently upgraded as SH40) and Kumarakom- Cumbummettu SH 42 pass through the outskirts of Town; these roads are needed to be developed as primary distributor roads in the region.

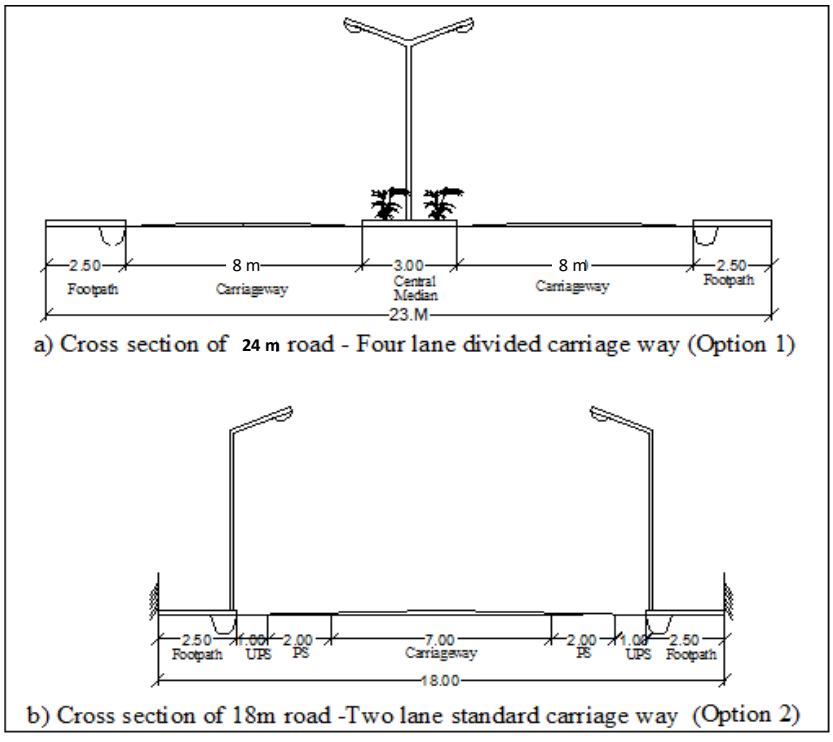


Figure 25-1 : Typical cross section of proposed Primary Distributor Road for Koothattukulam Town

25.1.2 Secondary Distributor Roads

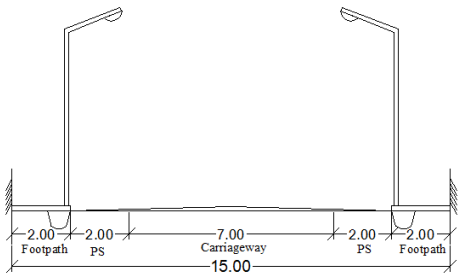
Secondary distributor road provides connectivity to neighboring Towns within and outside District having ROW ranges between 12 and 15m. In Koothattukulam region, the following roads need to be developed as secondary distributor roads.

a) Koothattukulam - Oliyappuram Road
b) Koothattukulam- Ramapuram road (Mangalathuthazham - Ramapuram)
c) Uzhavoor- Koothattukulam Road
d) Moovattupuzha- Pandappally- Koothattukulam road
e) Koothattukulam- Edayar-Piravom road
f) Ambalmkunnu- Kappippally State Highway Link

25.1.3 Tertiary Roads

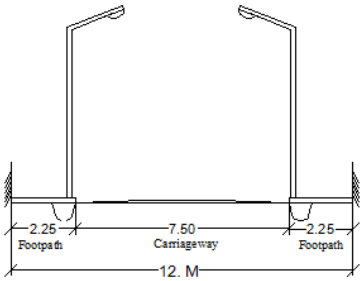
These roads provide connectivity to Town centre and growth centre from the hinterland. These roads are envisaged to develop in 8 to 12 m ROW. The following roads need to be developed as tertiary roads.

a) Koothattukulam- Kizhakombu road
b) Vadakara- Chakkalpara road
c) Sub station Kavala- Palakuzha Road
d) Koothattukulam Marika road via Karamala
e) Mutholapuram- Kizhakombu road
f) Mutholapuram- Edayar road
g) Thirumarady- Edayar road
h) Paittakkulam- Kunkumassery road



Cross section of 15m road -Two lane standard carriage way

Figure 25-2 : Typical cross section of proposed Secondary Distributor Road for Koothattukulam Town



Cross section of 12m road -Two lane standard carriage way

Figure 25-3 : Typical cross section of proposed Tertiary Distributor Road for Koothattukulam Town

25.1.4 Local Roads

Local roads or residential roads connect residential areas with the above categories of roads. Other local roads, which are not included in the category of residential roads and those connect the individual residential plots with other category of roads, are categorized as other local roads. All local roads in Koothattukulam are proposed to develop in absolute minimum 8m ROW.

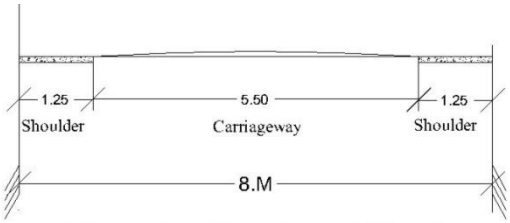


Figure 25-4 : Typical cross section of Proposed Local roads in Koothattukulam

The roads inside the Town included in the above hierarchies are to be developed as per the proposed road network plan for the Town. The different hierarchical roads are proposed to be developed in such a manner that it forms a well connected network of ring and radial pattern roads.

25.2 ROAD NETWORK PLAN

As per the future Road Development Plan for the Town, the proposed network constitute of radial roads complemented with circumferential roads and other link roads to form ring and radial pattern of urban network. Inner and outer ring roads 14 radial roads and other link roads connecting the radial roads are proposed for Koothattukulam region, in which those roads which come under Koothattukulam Town are detailed out.

25.2.1 Radial Roads of Koothattukulam

As indicated earlier, the road network of Koothattukulam follows a radial and ring pattern, the radial roads serve as mobility corridor. These corridors would be expected to have the following cross sectional elements:

- The road cross section would be at least 12m (2 lane) minimum for mixed traffic condition
- Continuous kerb, Footpath cum drain

- Restriction or preferably prohibition of parking on the carriageway/shoulders. Parking must be shifted to off street parking locations or cross roads
- Proper Bus bays

The existing ROW of 12 radial roads in Koothattukulam Town along with proposed ROW as per the traffic study and incorporating the suggestions made by the municipal governing body is shown in table 25-1.

Table 25-1: The existing and proposed ROW of radial roads

Sl. No	Road Name	Existing ROW (m)	Proposed ROW (m)
1	MC Road (Muvattupuzha side)	16 to 20	24
2	MC Road (Kottayam side)	14 to 16	24
3	Alappuzha - Madurai SH 40	7 to 7.5	18m From MC Road to the Mahadeva temple junction
4	Koothattukulam - Ramapuram Road	12 to 13	15
5	Koothattukulam - Edayar - Piravom Road	8	15
6	Koothattukulam - Uzhavoor Road	11	15
7	Koothattukulam -Oliyappuram Road	10 to 11	10m till proposed inner ring road & 15 m in the remaining stretch
8	Devamatha- Varakupara Road (Upto Kumkumassery Jn.)	6	12
9	Koothattukulam - Mutholapuram Road	5.5 to 12	12
10	Koothattukulam (Mangalathuthazham) - Karamala Road	7	12
11	Substation Kavala - Palakuzha Road	5.5	10
12	Nadappuram Bypass	4 to 8	8m till proposed inner ring road & 10 m in the remaining stretch

Since the following roads have v/c >1 in the base year itself it is proposed to widen them as follows.

1. Devamatha- Varakupara Road (Upto Kumkumassery Jn.) to be widened to 12m ROW.
2. Nadappuram Bypass is proposed to be developed to 8m ROW by permitting only one way traffic operation till the proposed inner ring road and the remaining stretch is to be developed to 10m ROW with two way traffic operations.

3. Koothattukulam -Oliyappuram road is proposed to be widened to 10m ROW with preferably one way operation till inner ring road and the remaining road stretch is to be developed to 15m ROW by permitting two way traffic operations.

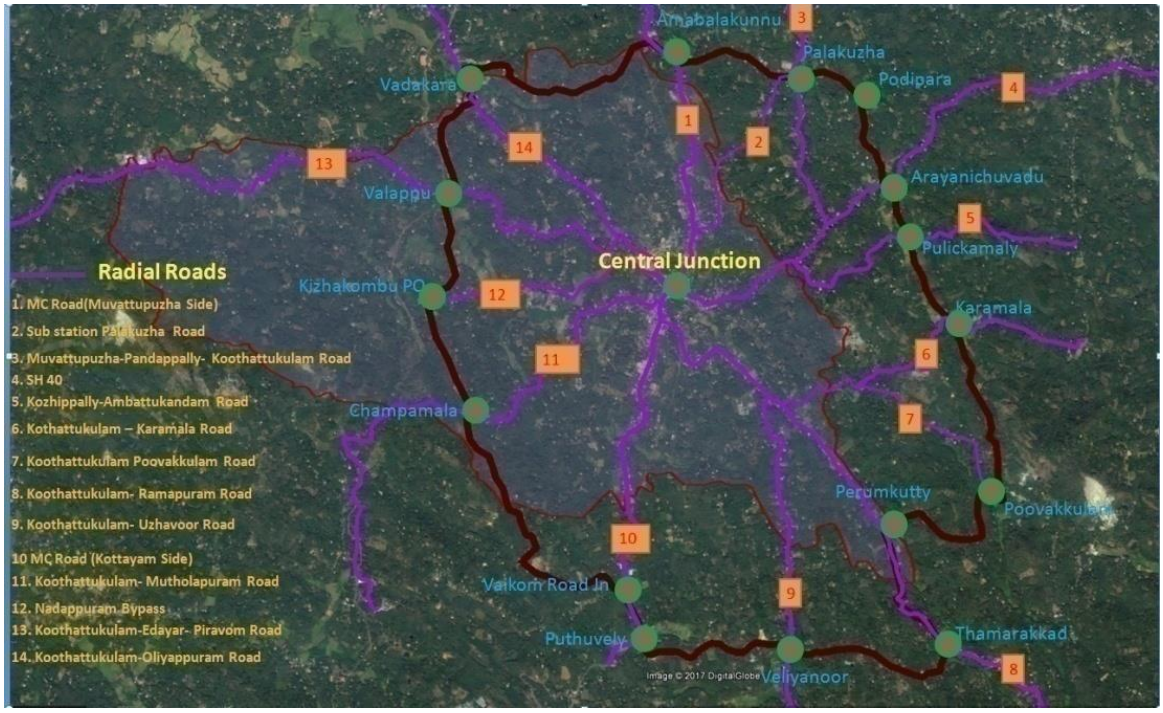


Figure 25-5: Proposed Outer Ring Road and radial roads for Koothattukulam Region

25.2.2 Ring Roads

For the decentralization of traffic in the core areas, it is deemed necessary to develop a network of ring roads for the Town. By developing ring roads, dependence on any single corridor gets fragmented into multiple corridors in a ring radial pattern.

25.2.3 Inner Ring Road of Koothattukulam

An inner ring road is proposed for Koothattukulam through the circumference of CBD area of the Town. This road connects MC Road (Kottayam Side), Koothattukulam- Mutholapuram Road, Koothattukulam- Oliyappuram Road, MC Road (Moovattupuzha Side) and Koothattukulam- Ramapuram road. Traffic not destined to the core area can utilize this inner ring road thereby relieving congestion inside CBD area. This ring road has been proposed along the existing road links through the periphery of the CBD area. Width of proposed ring from Keerthy junction in MC road (Moovattupuzha Side) to Koothattukulam Ramapuram radial road near the proposed bypass is to be developed with 8 ROW and the remaining stretch from Ramapuram road to MC Road (Kottayam Side) is proposed to widen

with 10m ROW on the eastern side of MC Road due to the presence of proposed bypass. The total length of inner ring road for Koothattukulam is 3 km and the part of ring road on western side of MC Road proposed to be developed as two lane road having 12m ROW due to the presence of markets, bus terminals, hospitals, etc.

25.2.4 Outer Ring Road of Koothattukulam

Koothattukulam outer ring road is a regional ring circumscribing Koothattukulam Municipality and its surroundings with a total length of 23.78 km. The proposed outer ring road connects all the 14 radial roads in the region out of which 2 roads are outside and 12 roads are inside the Town area. The entire stretch of proposed ring road passes through existing road links in which some are outside the municipal boundary. It is recommended to develop outer ring road with a minimum carriageway width of two lanes in 12m ROW since it is envisaged to improve regional connectivity and new bus routes are proposed through them. The Proposed Outer Ring Road and radial roads for Koothattukulam Region is shown in the proposed road network map (Figure 25.7).

25.2.5 Link Roads

There are 10 link roads inside the municipal boundary out of the total 14 roads proposed as link roads in the region, the existing ROW and proposed ROW as per the suggestions of the municipal governing body are shown in Table 25-2. Along with this, the access road to the proposed warehouse (special zone 1) and acess road to the proposed ministadium (special zone 4) are proposed as link roads inside the town. These access roads are proposed to be developed as link roads with 12m ROW. The existing roads which are proposed as link roads to be widened to accommodate future traffic inside the Koothattukulam Town area are as follows.

(i) **Sreedhareeyam – Varakupara Link road** connects Koothattukulam Mutholapuram radial road and Koothattukulam outer ring road. The link road is proposed to start from the junction near Sreedhareeyam hospital in Koothattukulam Mutholapuram radial road and ends near Varakupara. This link road will be beneficial for the traffic from Moovattupuzha side and destined to Sreedhareeyam Hospital/ Kizhakombu region. This link connectivity is proposed by utilising three roads viz Nadappuram bypass, Karippal Post office road,

Paittakulam road and Paittakkulam Kukumassery road. The proposed link connectivity is suggested to be developed as tertiary distributor in 12m ROW

(ii) **Mutholapuram Kizhakombu Road** from Josegiri to Kizhakombu PO is proposed as link road connecting proposed Koothattukulam- Mutholapuram Radial road and Koothattukulam outer ring road. This single lane road is proposed to upgrade to two lane road having 10m ROW.

(iii) **Ambalakkulam- Mangalathuthazham** connects Koothattukulam- Karamala- Marika road and SH-40. This road starts from Govt. LPS Mangalathuthazham and ends at Koothattukulam Mahadeva Temple. This road is in intermediate lane standard and has ROW of 7 m. This 1.6 km stretch is proposed to be developed in 10 m ROW.

Table 25-2 : The existing and proposed ROW of link roads

Sl. No	Road Name	Existing ROW (m)	Proposed ROW (m)
1	Bappuji ValiyavirippuRoad	6	12
2	Millumpadi – Pallikkavala- Chorakuzhi Road	7	12
3	Chorakuzhi – Pallikkavala- Elanji Road	9	12
4	Chorakuzhy Aathani Road (Link beween Uzhavoor Road and MC Road)	6	12
5	The access road to special zone (warehouse)at MVIP land (Ward 21)	6	12
6	The access road to special zone (Ministadium)	--	12
7	Sreedhareeyam – Varakupara Link road	6	12
8	Mutholapuram Kizhakombu Road	6.5	10
9	Ambalakkulam- Mangalathuthazham	7	10
10	Olippadu Karukunnu Road	4.5	10
11	Karingamattom Vettikkaparambu road	5 to 7	10
12	Mangalathuthazham- colony road (Link between Uzhavoor Road and MC Road)	6	10

- The access road to special zone 1 (ware house) at MVIP land (Ward 21) from outer ring road is proposed to be included in the category of link roads, and it is to be widened to 12 m ROW since it will experience heavy container traffic once the ware house facility becomes operational.

- The access road to the proposed special zone 4 (Ministadium) from the Inner ring road is proposed to be included in the category of link roads, and it is to be widened to 12m ROW. It is also proposed to be connected to the Devamatha-Varakupara radial road by a new link road of 12m ROW and further to MC road by widening and modifying the existing road to 12m ROW as shown in the proposed road network map.

25.2.6 North-South and East- West Corridors for the Region

Apart from the above mentioned radial, ring and link roads, two east- west and two north-south corridors are proposed for Koothattukulam region. 2 East-West Corridors with a suggested ROW of 18m passes through the northern and southern outskirts of Koothattukulam Town and 2 North- South Corridors with a suggested ROW of 12m in which one passes through the outskirts of the Town in the eastern side and the other passes through the western side of the Town with some roads inside the municipal boundary.

(i) **North- South Corridor 1**: is proposed proposed from Mutholapuram to Thirumarady through the western boundary region of the Municipality. This road will facilitate north south movement by connecting SH-40 near Mutholapuram and SH-42 near Thirumarady. This north south connectivity is proposed to be developed by upgrading two ODRs viz. Mutholapuram Edayar road (Mutholapuram to Edayar Pallippadi) and Kaniyalipadi -Thirumarady Road (Kaniyalipadi to Thirumarady). Both these ODRs are single lane roads and ROW varies from 6 to 7.5m. The proposed corridor road has a length of 7.1km and is proposed to be developed as a tertiary distributor in 12m ROW.

(ii) **North- South Corridor 2:** passes through the outskirts of Koothattukulam Town on the eastern side from Marika junction to Koothattukulam (Mangalathuthazham)-Poovakkulam radial road.

(iii) **East-West Corridor 1:** Thodupuzha- Piravom reach of SH-42 passes through outskirts of Koothattukulam Municipality on the northern side and connects Koothattukulam with District headquarter - Ernakulam on the west and Idukki District on the east

(iv) **East-West Corridor 2:** Thalayolaparambu- Koothattukulam reach of SH 40 passing through the outskirts of Koothattukulam Municipality on the southern side connects koothattukulam with Vaikom and Alappuzha.

25.2.7 MC Road Bypass

As the most important problem of Koothattukulam is the high volume of traffic plying on MC road, development of alternate north- south connectivity needs to be considered with highest priority. Developing a bypass for MC road in Koothattukulam will reduce the mixing of intra-city and intercity traffic. The through traffic which has no purpose in the Town and having its origin and destination lying outside the urban area are divertible to the bypass and will reduce the congestion in the core Town. Proposed Koothattukulam bypass consists of existing roads and new road links and it shall be developed as primary distributor in 18m ROW.

Bypass is proposed on the eastern side of MC Road starting from Kottayam side of MC road near Bappuji Jn. and ends on Moovattupuzha side of MC road near Calicut Jn. The proposed bypass consists of existing roads and new road links.

The proposed bypass starts by using a new link road through the plantations in the initial portion with minimum acquirement of the existing residential areas as shown in figure 25.6 (new link 1) and deviates to Maruti Jn- Bappuji road. The road passes through the base of Arjunanmala and reaches Maruti Jn. The alignment then passes along Koothattukulam – Ramapuram road for a length of 263m, since the Koothattukulam - Ramapuram Road is a proposed major radial road to be developed in the Town with adequate carriage way width at present itself, this will reduce the residential area acquirement. An environment friendly approach in development is considered by conserving the existing paddy land and hence it is proposed to develop a new link as shown in figure by protecting the paddy (new link 2). Thus a new link road of 333m is required to reach Ambalakkulam-Manglathuthazham road and runs through the same road for 112m.

The bypass joins Alappuzha- Madurai SH 40 near Koothattukulam High school ground. The bypass then uses Temple- Police Quarters road and Substation- Police quarters road to reach Sub Station- Palakuzha Radial road. As the end of existing temple- police quarter's road causes difficulty for smooth flow of traffic (due to the curved alignment). It is proposed to develop a new link (new link 3) as it will also reduce the amount of residential area acquisition since residential areas are along the existing curve road. The new proposed

alignment (new link 3) passes through plantations and lesser residential areas. The alignment passes through Substation kavala- Palakuzha road for 474m. The bypass is connected to MC road with the help of new road link (new link 4) having 286m. Thus, the total length of the new bypass road will be 3.2km.

The general alignment of Koothattukulam Bypass is shown in figure 25-6 and the inventory of road links along proposed bypass is shown in table 25-3. Proposed bypass is passing through nearby local body, as bypass is a general necessity facilitated to commuters other than the Municipality population. A detailed feasibility study should be done before developing the final alignment for the bypass with consideration to environment and other factors.

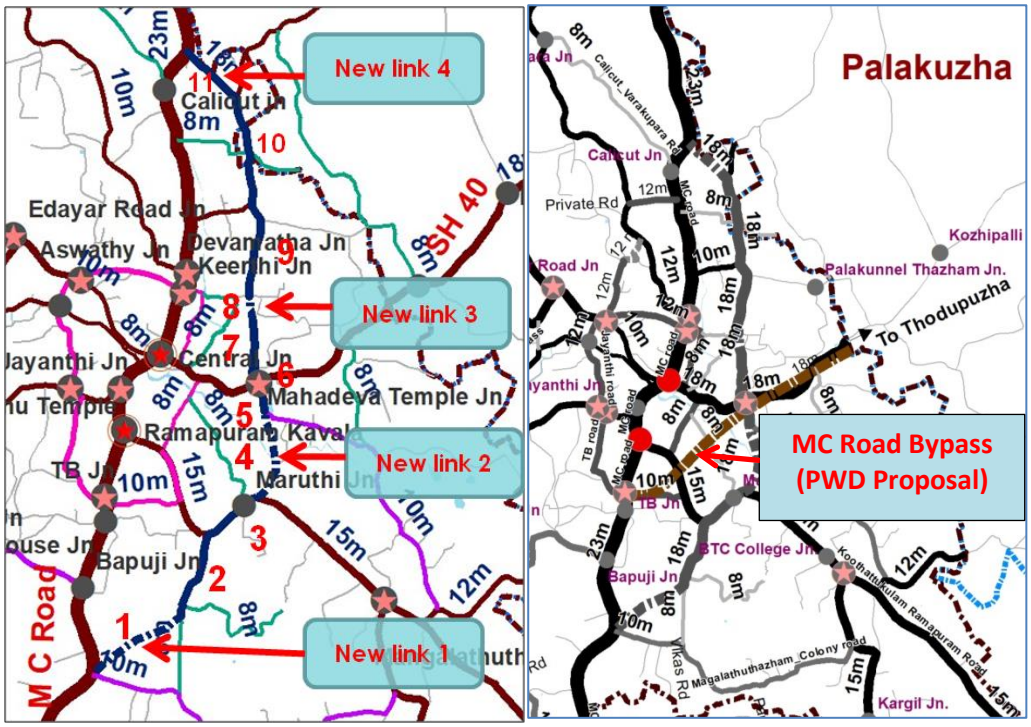


Figure 25-6: Alignment of MCRoad Bypass, for Koothattukulam Town.

Table 25-3: Inventory of roads along proposed bypass for MC Road

Sl no.	Road Name	Length (m)	ROW (m)	Land use	
				LHS	RHS
1	New link Road 1 (starting From Bappuji - Mangalathuthazham Road)	437	New link Road (through dry agriculture and residential areas)		
2	Maruthi Jn - Bappuji Road	388	0.4	R/P	R/P
3	Koothattukulam - Ramapuram Road	256	13	R/C	R/C

Sl no.	Road Name	Length (m)	ROW (m)	Land use	
				LHS	RHS
4	New link Road 2	404.5	New link Road (through dry agriculture and residential areas)		
5	Ambalakkulam-Manglathuthazham road	112	7	R	R
6	Alappuzha - Madurai SH 40	32	7 to 7.5	School ground	Temple
7	Temple- Police Quarters road	285	3.5	R	R
8	New link Road 3	108	New link Road (through dry agriculture and residential areas)		
9	KSEB Substation Road	422	3.5	R	R
10	Substation - Palakuzha road	474	5.5	R/A	R/A
11	New link Road 4	286	New link Road (through dry agriculture and residential areas)		

R-Residential; P-Plantation; A-Agriculture; C-Commercial.

Another MC Road Bypass is also included as the proposed bypass as per the directions by the Municipal council. This alignment proposed by council is based on the detailed New Byepass alignment for MCRoad as per the Public Works Department, Kerala and is proposed on the eastern side of MC Road starting from Kottayam side of MC road near TB junction and leaves the town boundary on the north eastern side as shown in the proposed road network plan Figure 25.7. It is proposed to be developed as a new bypass for the MC road from Koothattukulam to Thodupuzha with 18m ROW.

25.2.8 Local Roads/ Residential roads

These roads connect residential areas with the above categories of roads. All local roads in Koothattukulam are proposed to develop in absolute minimum 8m ROW.

Table 25-4: The existing and proposed ROW of Residential roads

Sl. No	Road Name	Existing ROW (m)	Proposed ROW (m)
1	Olakkad – Andichira road (Olakkad Jn at Edayar Piravom Road to Tharangani Jn at Tharangini Road)	7.5	8
2	Tharangini Road	3.5	8
3	Kurukkankunnu - Kulangarapadi Road	5.0	8
4	Muthupathy road (Kollampadi Jn at Edayar Piravom Road to V K N Jn at Peedikapadi Vellilamthotty Road)	5.5	8

5	Peedikapadi- Kurukkankunnu - Vellilamthotty Road	5.5	8
6	Fr.Thomas Thurappara Road	5.8	8
7	Santhula Charitable trust Hospital road	4.5	8
8	Meckathazham Road	4.5	8
9	Puthiyidathuthazham road (Link road between Oliyappuram road and Outer ring road)	4.2	8
10	Valappu vadakara road (Link road between Edayar Piravom Road and Meckathazham Road)	3.5	8
11	Manjerikkunnu Thalikkunnu road (Link road between Edayar Piravom Road and Nadappuram bypass)	5	8
12	One Link road between Edayar Piravom Road and Nadappuram bypass	5	8
13	Mandapathikkunnu-Millumpady road (Link road between Koothattukulam Mutholapuram Road and Outer ring road)	6	8
14	St. Mary's Kandanthanam road (Link road between Outer ring road and Mandapathikkunnu-Millumpady road)	5	8
15	Marygiri- Infant Jesus road (Road between MC road and near east boundary of Infant Jesus School)	3	8
16	Calicut - Varakupara Road	5	8
17	Road between Inner ring road (near Keerthi Jn.) and SH40 (near Co operative hospital).	4	8
18	Mundani- Varakukalathazham road (Road between SH40 and Ambalakkulam- Mangalathuthazham link road)	3	8
19	Menamattom- Maruthi Jn road (Road link between inner ring road and Koothattukulam Ramapuram radial road at Maruti Jn.	5	8
20	Arjunanmala temple Road	6	8
21	Maruthi - Chorakkuzhi road (Road near sawmill and Arjunanmala temple Road)	5	8

25.2.9 Other Local Roads

All residential roads other than the above mentioned residential roads and access streets which connect the residential roads to the individual residential plots in Koothattukulam are proposed to be developed in absolute minimum 8m ROW. The proposed road network plan together with the proposed width for road widening proposals for the Town is shown in figure 25.7.

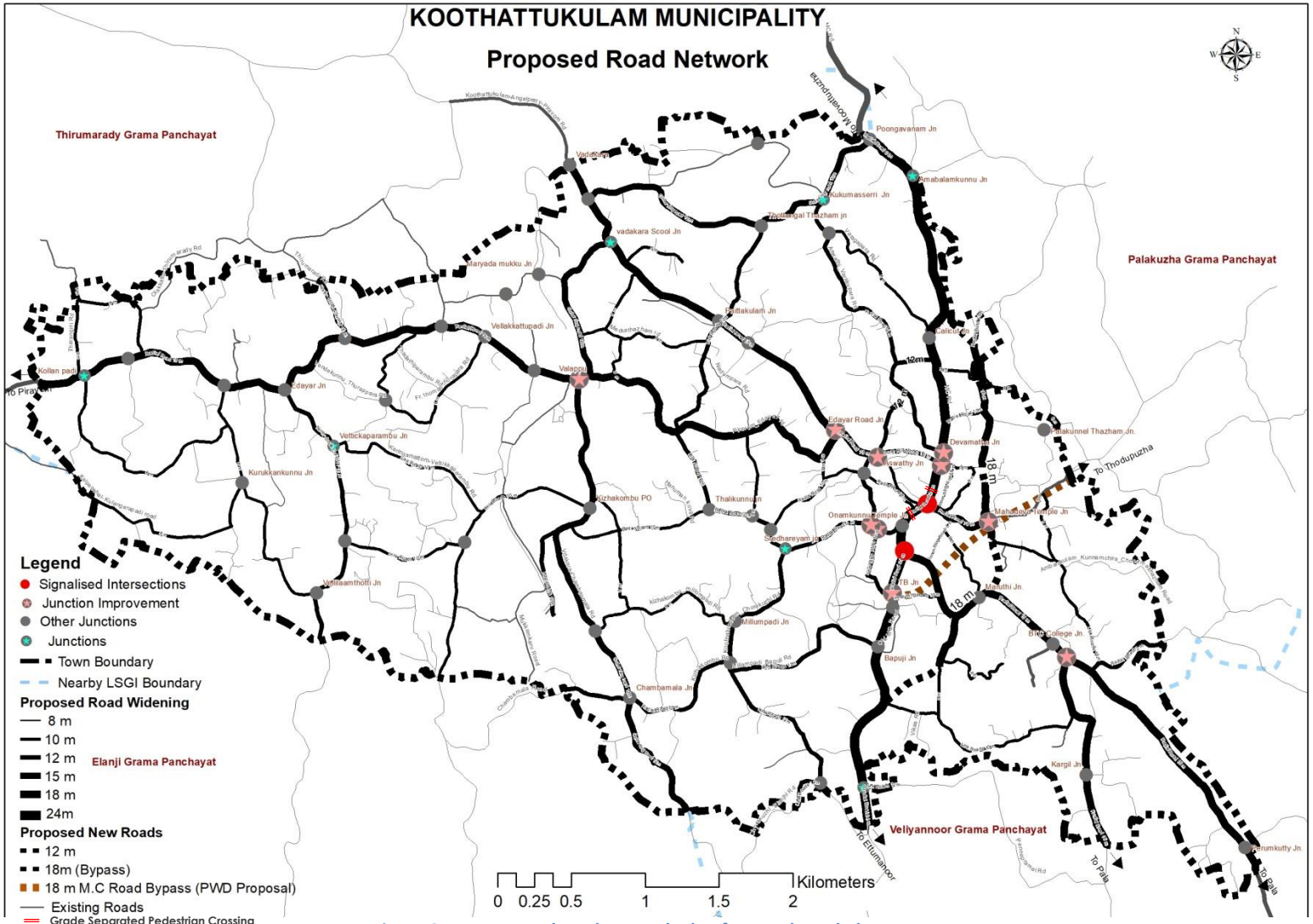


Figure 25-7: Proposed road network plan for Koothattukulam Town

25.3 INTERSECTION IMPROVEMENTS

Intersections are the major sources of traffic conflicts and bottlenecks in a transportation system. Road intersections cause safety problems as accident rates are usually higher at intersections than at other sections of the road. Many factors affect accident occurrence at intersections, including traffic volume, geometry of the intersection, traffic control, frequency of access points, number of legs, speed limit, lighting level, as well as human factors. Many of the road intersections in Koothattukulam are acute with non- standard geometrics.

MC road is the central axis of transport network system in Koothattukulam and intersections on this road are the major points of traffic congestion. Apart from the intersection on MC road, there are some problematic intersections on other radial roads also. Major intersections in Koothattukulam CBD area house many commercial establishments and also avenues of business and commerce on all its arms. Besides that, bus stand and market are situated in the heart of the CBD area. The following traffic intersections in Koothattukulam Town need to be taken up for detailed design with higher order priority considering the existing traffic flow and the need for future road widening.

i. Central Jn
ii. Ramapuram Kavala
iii. Keerthi Junction
iv. Ambalamkunnu Jn
v. Aswathy Jn
vi. Onamkunnu Temple Jn
vii. Mangalathuthazham

Central junction and Ramapuram kavala at MC Road need signalization for traffic regulation. Once the bypass becomes operational the starting and ending points of bypass also need to be developed as signalized intersections.

The following intersections also need to be considered for improvement with second order priority.

i. TB Jn
ii. Devamatha Jn
iii. Edayar Road Jn
iv. Mahadeva Temple Jn
v. Jayanthi Jn

Valappu junction is also proposed for junction improvement because of the special zone (ware house facility) site at the MVIP land which will fetch heavy container traffic at this intersection.

Proper and scientific design of intersection is required to enable smooth, safe and efficient flow of traffic. A well designed intersection can increase the capacity of the same and also enhances the aesthetics of the area. A detailed investigation needs to be undertaken for implementing junction improvements.

25.4 STRAIGHTENING OF ACCIDENT PRONE CURVES

Smoothen accident prone horizontal curve near PWD Rest house. The proposed alignment starts after Government UP School and ends near the present godown building. On widening of the proposed inner ring road, this smoothening is to be considered.

25.5 PUBLIC TRANSPORTATION PLAN

Public Transport Plan plays an important role in the transportation system in Town as there is only road ways transportation exists in the Town. A public transportation plan should be developed with focus on moving people rather than vehicles. Public transport infrastructure with bus terminals and bus stops as the contact points between the public transport user and the bus system needs to be improved with respect to the following proposed measures.

- Provide a facility for stoppage of buses to facilitate fast, safe and convenient boarding and alighting of passengers including differentially abled persons.
- Provide passenger information regarding 'arrivals' and preparation of services,
- Provides seamless integration of trips by facilitating easy transfer/ interchange amongst passengers traveling by various modes. Adequate parking spaces for cars, two wheelers, IPTs and other vehicles need to be ensured for acheiving this.
- Provide sheltered space along with basic conveniences for waiting passengers at terminals and bus stops.
- Act as information centers for passengers, tourists, and first time visitors to the city, through supply of route maps, travel guides, hotels, etc
- Act as a catalyst for planning high density land use– being points of easy accessibility for large number of passengers thereby becoming favourable locations for residential colonies, offices, shopping complexes etc of high commercial value.

Public transport system of Koothattukulam consists of bus transportation operated by State owned KSRTC buses and private buses. In order to improve the bus transport system in the Town, the following measures are proposed.

25.5.1 Passenger Friendly Bus Stands

Bus stands play an important role in the public transportation system. Up gradation of private bus stand and modernization of KSRTC bus stand needs to be done by prioritizing the needs of the public who are the primary users of the public transportation system in Koothattukulam Town.

25.5.2 Modernization of KSRTC Bus Stand

Existing bus stand building houses station offices and passenger waiting area but it lacks bus bays for the safe boarding and alighting of the passengers. The modernization of the existing bus stand incorporating advanced facilities and infrastructure would help in improving the efficiency and patronage of the public transport of the region. Adequate parking space needs to be provided for private vehicles for better utilization of public transportation. The following facilities need to be ensured in the terminal building.

- Well demarcated bus bays and boarding alighting platforms
- Passenger information kiosks, wi-fi facilities
- Cloak room, toilets, rest areas etc
- Tapping of solar energy by means of roof top solar panels for in house lighting
- Demarcated parking for IPT services



25.5.3 Up Gradation of Private Bus Stand

The bus stand is located in a two-acre plot owned by Koothattukulam Municipality and is in a wretched condition. The surface area inside the bus stand has many pot holes and during rainy season, the area gets flooded making the pedestrian movement very difficult. The bus stand lacks many basic necessities like comfort station, resting area, passenger information

system, drinking water facilities etc. For revamping the public transport in Koothattukulam, it is recommended to restructure the bus stand for ensuring smooth entry and exit of buses and efficient handling of the passenger volume. Passenger amenities such as comfort station, clock room, passenger waiting area, crew waiting area, passenger information system, drinking water facilities etc. need to be ensured in the new bus stand. The area inside the bus stand needs to be paved with heavy duty interlock tile or bituminous surface.

25.5.4 Provision of Bus Bays and Bus shelter

Bus stops are important to facilitate easy, convenient and safe access to the service. On an average, bus stops may be located at a spacing of 500-600 meters. At traffic junctions, bus stop shall be located at 75m from the intersection. Segregated bus bays are absent in Koothattukulam Town. Due to the same, buses are stopped on the carriageway itself, blocking the free flow of traffic. Bus stops need to be provided with bus bays and bus shelters. The bus shelters need to be designed scientifically so that they add to the aesthetic quality of the streetscape. Facilities like electronic passenger information system inclusive of time table and route details, fare information, Wi-Fi facility etc could be provided to benefit the commuters. Facilitated bus shelter will attract the waiting passengers to confine to the shelter rather standing on the carriageway or roadway.

Table 25-5: Proposed location of bus stop with bus bay and shelter in Koothattukulam

Sl. No.	Name of the Road	Location Of Proposed Bus Shelter
1	SH1 MC Road	Ambalamkunnu, Calicut Junction, Taxi Stand, Central Junction, Ramapuram junction, TB Junction, Chorakuzhy
2	Koothattukulam - Uzhavoor Road	Kargil Junction, Athani Bus Stop
3	Koothattukulam - Ramapuram road	Ramapuram Kavala, Maruti Junction, Mangalathuthazham, Perumkutty Junction
4	Koothattukulam Edayar Road	Valappu, Bank Junction, Vilayikkattupadi, Chelakkapadi, Kaniyalipadi, Edayar Pallippadi, Peedikapadi, MPI, Vilangappara
5	Koothattukulam Oliyappuram Road	Aswathy junction, Edayar Road Junction, Paittakulam, Vadakara



Figure 25-8: Conceptual view of bus shelter proposed for Koothattukulam Town

25.5.5 New Bus Routes

In Koothattukulam, bus operation mainly exists on state highways and Major District roads. There exist areas such as Kizhamobu, Edayar West, Champamala etc. which lack adequate bus services. Koothattukulam- Mutholapuram radial road is proposed for the faster connectivity of these regions with Town centre. It is proposed to start new bus services from Koothattukulam to Vaikom/Alappuzha via Koothattukulam- Mutholapuram radial road.

The bus transport system in Koothattukulam needs to be augmented to increase the share of public transport and to attain sustainable mobility.

- 25 seater buses need to be introduced for local Town service and should be operated in the proposed outer ring road. This will connect under developed settlements with the Town as well as to growth centres near the periphery of the Town.
- Bus frequency need to be increased in the following sectors:
    - Koothattukulam-Edayar- Piravom
    - Koothattukulam- Vaikom

25.5.6 Intermediate Public Transport Plan

Like other medium sized Towns in Kerala, Koothattukulam also has significant number of auto rickshaws serving the needs of intra city travel as well as to neighbouring Panchayaths. Many remote locations in Koothattukulam Town have poor accessibility by public transport and people are forced to depend on these modes. So its facilities need to be strengthened

to go hand in hand with the public transportation system of Town to enhance it and thereby providing ease of travel for the people.

25.6 NON MOTORIZED TRANSPORT

Non motorized trips in Koothattukulam include walk trips and cycle trips. Past studies reveal that nearly 40% trips in medium sized Towns in Kerala are non- motorized trips. Walking is the start and end phase of all motorized trips. There are ten UP schools and seven high schools functioning in Koothattukulam region and considerable share of school trips are performed by cycles. The traffic and transportation Master Plan should give focus on planning of NMT facilities such as provision of continuous and even foot path, safe pedestrian crossing facilities and slow moving vehicle lanes to give more importance to the pedestrians who are the most vulnerable among road users in the entire ring, radial, link and other local/ residential roads.

25.6.1 Pedestrian Walkways

In general, one third of the total trips in a Town are performed by walk. Streamlining of pedestrians from motor vehicles is the most import part in ensuring safe and comfortable movement of them. Pedestrian sidewalks and raised footpaths significantly reduce pedestrian conflicts with motor vehicles. But, roads of Koothattukulam are devoid of footpath. Even the newly developed MC road has a small footpath with a width of 1.2m only where the absolute minimum requirement is 1.8m on urban roads.

In order to promote the non-motorized transport, it is proposed to augment the following facilities for Koothattukulam Town.

- Footpath need to be installed on both sides of all the major roads as per the minimum requirement. Additional footpath need to be installed on all school access roads and residential roads wherever possible.
- Taking into consideration of differently abled people, the absolute minimum width suggested for footpath is 1.8m.
- The height of the footpath should be 15cm from the finished road level.
- Footpath should be even, continuous and free from all kind of obstructions.

- Railing guards should also be installed on the footpath to segregate the pedestrians by restricting the entry of two wheelers on to footpath.

25.6.2 Crosswalks and zebra crossings

Marked crosswalks indicate preferred locations for pedestrians to cross the road. Signal controlled pedestrian cross-walk is necessary at those locations where the volume of traffic is very high. Crosswalks are often installed at signalized intersections and other selected locations. Zebra crossings are desirable at intense pedestrian volume locations (often in conjunction with other speed control measures) to channelize pedestrians along a preferred walking path. The following are suggested regarding the installation of marked cross walks in Koothattukulam Town:

- Marked cross-walks with stop line are required at all arms of the major intersections
- Mid-block crossings shall be provided near all educational institutions, bus stops, major commercial centres, hospitals and all other important locations.
- For ensuring night time visibility of these crossing facilities, road studs/ solar powered cat eyes with bidirectional yellow reflector need to be placed near all four corners of pedestrian crossing blocks.
- Controlled crossings are warranted on locations where PV^2 value crosses $1x10^8$ at the base year itself.

25.6.3 Grade Separated Crossing Facility

Grade separated crossing facility completely eliminates the possibility of pedestrian- vehicle conflicts. In urban situations where pedestrian crossing signals would cause congestion or crashes (due to high traffic speeds), a grade separated pedestrian crossing, such as an overpass or an underpass, may be used. 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.

In Koothattukulam, Grade separated Pedestrian crossing facilities are recommended as long term solution at the following two locations on MC road where the projected PV^2 value is greater than $3x10^8$.

(i) Between Keerthi Jn and Central Jn- near Koothattukulam Municipality office
(ii) Between Central Jn and Ramapuram Kavala- near the starting of Nadappuram by pass.

25.7 PARKING FACILITIES

Inadequate parking spaces have resulted in the use of existing carriage way for parking, thereby creating higher levels of congestion in the CBD areas. A Parking Policy is, therefore, essential for the following:

- To discourage greater use of personal motor vehicles and encourage greater use of public transport and NMT.
- To realize the true value of the carriage way and land occupied for parking and recover economic costs accordingly.
- Introduction of progressive parking fee to discourage longer duration on street parking.
- Act as a feeder to public transit systems, thereby increasing their attractiveness

25.7.1 Development of off street Parking Space

Considering the acute parking demand-supply gap, it is proposed to have off street parking spaces for Koothattukulam Town at the following locations.

- Space located by the side of Koothattukulam KSRTC bus stand, which belongs to Koothattukulam Municipality and has an approximate area of 4,300sqm. With the development of this facility, on-street parking present on Aswathy-Jn – Central Jn stretch can be minimized.

- Existing stand for Taxi/Goods Auto/LCV near Devamatha Jn on the side of MC road is not fully utilized. Parking spaces for private vehicles also can be allotted in this space with proper segregation from the taxi vehicles.

25.8 CONCLUSION

It is expected that the proposed traffic and transportation plan including various elements like proposed road network which includes radial, ring, link and other local roads and a bypass for MC road, junction improvements and parking facilities with more emphasis on Non Motorized Transport and public transportation plan for Town will help to achieve its main objectives in a long run.

26 SECTORAL PROPOSALS

This chapter includes the various sectoral proposals based on the goals and objectives set as per the development concept for the future development of Town and the projects are identified in the land owned by the Municipality.

26.1 INDUSTRY

Meat Products of India (MPI) is the only large scale industry in Town. There are small scale industries like Sreedhareeyam Ayurvedic medicine manufacturing unit and a few micro industrial units functioning in different part of the Town. Agricultural produces especially cash crops are the raw materials available in the region. Since most of the land is under dry agricultural use, there is a scope for rubber based industries in the region. The region to the west of Town centre which is of low density population, having good connectivity and the availability of dry agriculture land is suitable for setting up of industries. The following types of industries are to be encouraged for creating more employment opportunities and for strengthening the economic base of Town.

26.1.1 Agro based industries

Industries which are based on agricultural produce and industries which support agriculture come under agro-based industries. Establishment of agro-industries in areas like Koothattukulam helps in the up-liftment of economy and to act as a major centre in a regional level to achieve a balanced growth of industry and agriculture. Higher potential for Eco green units like production of biodegradable bowls, plates, mats as by-product of rice husk, banana fibre, coconut fibre, palm leaves etc can be utllised. Income generating activities through the 'wealth from waste' concept can be adopted.

26.1.2 Food Processing Industries

The food processing industry is growing at a rapid pace and it offers lot of scope to entrepreneurs for sustainable development. The availability of raw materials such as Jack Fruit, Tapioca, Pineapple, Mango, banana, etc. in Koothattukulam region give scope for developing new food processing units in Town to improve its economic base. Vegetable

processing units, dairy units, Milk processing units with chilling plant, flour mills and curry powder manufacturing units, food parks etc. can be proposed.

26.1.3 Small Industrial units

Developing Small scale industrial units for value addition of agricultural and other products in the region proposed. Provisions are there in all major zones for establishing Small scale Industrial units subject to satisfaction of conditions stipulated in the zoning regulation.

26.2 TRADE & COMMERCE

As Koothattukulam is an important commercial and trade centre at both local and regional level and is proposed to function as a sub regional centre serving the population even outside the Town limits, it requires development of commercial centres or area and redevelopment of existing commercial area.

26.2.1 Expansion of Koothattukulam Market

The new market constructed is proposed to be expanded to the adjacent cattle market land thereby creating more organised space. The existing cattle market is to be shifted as it is used only twice a week, thereby expanding the market to a modern complex with sufficient facilities for trading of different merchandise like agricultural produces, hill produces, fruits & vegetables, space for street vendors, proper drainage and sanitation facilities, parking plaza etc. Care should be taken to provide sufficient parking areas to avoid congestion and there by promoting the wholesale or retail market facility. The general market which functions only on Wednesdays should be expanded and made useful to people in all days and its past glory can be recaptured. The locally produced raw and value added products can be marketed through this available facility by prioritising and providing space for them in the new proposed market building as farmers market areas.

26.2.2 Cattle Market

As cattle trading is a major activity performed in the Town, the land near market is proposed for cattle market which will define character of each function. A veterinary care unit is also suggested in the compound. This can be utilised for checking the



Figure 26-1 : Bitmap - Location of Cattle market

health condition of the cattle that are to be traded for ensuring safety.

26.2.3 Cinema theatre cum shopping complex

The existing market land after shifting could be used for constructing a cinema theatre cum shopping complex under PPP model which will generate revenue for the Municipality as well as an asset to the service population. It is good to develop such commercial complexes of international standards with facilities like sufficient parking, loading and unloading area, storage area, connectivity with neighbouring centres, modern drainage and waste disposal facilities etc.

26.2.4 Parking Plaza

Inadequate parking spaces have resulted in the existing right-of-way being used for parking, thereby creating higher levels of congestion in the CBD areas. Existing stand for Taxi/Goods Auto/LCV near Devamatha Jn on the side of MC road is not fully utilized. Parking spaces for private vehicles also can be allotted in this space by providing proper segregation from the taxi vehicles. A new multi-level parking plaza is also proposed at the existing taxi and goods parking land which reduce the roadside parking in the Town centre. If needed more floors above parking are suggested for office or shop purposes and levy on street parking fines to discourage on street parking and generate income for the Municipality.



Figure 26-2 : Bitmap – Location of proposed Parking Plaza

26.3 AGRICULTURE

In the low density areas there is ample scope for home stead cultivation. A combined action in agriculture and animal husbandry will improve the self-sufficiency and health standard of inhabits.

26.3.1 Promoting sustainable Commercial farming

- Mixed cropping
- Mixed farming with integration of farming and livestock
- Dairy Farming
- Collective farming through Kudumbasree

Cultivation of rubber is predominant in Koothattukulam. The other cultivations in the planning area are tapioca, coconut, arecanut, plantain, banana, pineapple, pepper, nutmeg, clove etc and these cultivations are to be further promoted by giving technical support and joint farming programmes whereever possible.

26.3.2 Cold storage & Warehouse



Figure 26-3 : Bitmap – Location of proposed Warehouse

Large quantity of export oriented commodities like rubber, spices, and hill produces, fruits and vegetables growing in the nearby regions of Ernakulam, Idukki & Kottayam Districts need storage facility. The Koothattukulam Town is the best potential interior location in the south eastern region of Ernakulam District since it is adjacent to Idukki & Kottayam Districts with this increased demand for storage space and facilities in the region. Storage facilities for perishable cargos (fruits and vegetables, meat and fish) can be attached to this in due course with chillers and reefer plug points. Perishability is responsible for high marketing costs, market gluts, price fluctuations and other similar problems in the production and storage of vegetables and fruits. At low temperature, perishability is considerably reduced and the shelf life is increased and thus the importance of cold storage or refrigeration is beneficial. A warehouse (godowns) for storing of goods and reefer cargo including perishable and non-perishable goods is proposed in the region which will support the local agriculturists and traders of Koothattukulam, Piravom, Pampakuda, Elanji, Peruva, Ramamangalam, Arakkunnam, Maneed & Mulanthuruthy markets. The land under the ownership of MVIP in ward 19 can be utilised for the same as it is accessible as well as away from the residential and Town centre.

Major cargos and commodities locally expected for storage includes Dry Cargo like Rubber, Dry Ginger, Black Pepper, etc. and perishable commodities like Tapioca, Jack fruit, Banana, Pine apple and Vegetables. The Food Corporation of India and Civil Supplies Department of Kerala can use this facility to procure their ration items for public distribution.

Major Cargos expected for storage from High ranges & Tamilnadu includes Dry Hill Produces like Rubber, Tea, Coffee, (Cardamom – restricted), Dry Ginger, Black Pepper, Turmeric, Marayoor Jaggery etc. It also includes Fruits and vegetables from Munnar, Kanthallur, Marayur, Vattavada & Tamilnadu.

26.4 ANIMAL HUSBANDRY

Utilizing the advantage of MPI at Koothattukulam, the animal husbandry sector can be improved. MPI is having schemes in supplying piglets to the farmers and buy back them when grown up at reasonable price. Similarly, various schemes are in consideration for MPI with Government of Kerala for supplying of male calf buffaloes for rearing to the farmers. Utilizing the facilities provided by MPI, it is possible to enhance the animal husbandry sector and thereby improve the economic base of the Town through it.

26.4.1 New dairy farms

Considering the vast agriculture land available in the periphery of planning area establishing private small scale dairy farms with 10 to 25 cows in a unit are proposed to be encouraged by the Municipality.

26.4.2 Poultry farm / Broiler farm

As in the case of dairy farms small poultry farms with 75 to 100 hens per unit can be started in those areas identified as suitable for agriculture, for meeting the demand of eggs and meat of the Town to an extent.

26.4.3 Establishing Slaughter houses

A Slaughter house with modern facility is proposed in association with the Meat Product of India. At present no legal slaughter house is functioning in the Town due to the multiple issues such as waste disposal, land availability due to opposition of inhabits etc. However in association with the Meat Product of India a slaughter house can be established thereby solving such issues.

26.5 WATER SUPPLY

26.5.1 Replacement of the old and worn out pipe system

Augmentation of present water supply scheme to ensure supply of water for Planning Area by the year 2036 is suggested by increasing the coverage and capacity of the pipes. Replacement of the old and worn out pipe system is necessary as the current system cannot withstand pressure when pumped to higher areas. This project may be implemented by Kerala Water Authority.

26.5.2 Small Schemes

Expansion of water supply schemes, mainly small water supply schemes developed using the available sources of water and the water potential areas is proposed to benefit population in higher areas. Schemes can be developed for digging new farm ponds and use them as source of small drinking water supply schemes.

26.5.3 Protection of natural water sources

The wells, ponds and natural drains of the planning area are to be protected and deepened as they are the major source of water to the Planning area.

26.5.4 Water Harvesting

Adopt water harvesting methods for ground water recharge. Promoting water harvesting methods in the hilly regions like roof top harvesting, well recharging etc and using the existing old quarry ponds as rain water harvesting tanks. These water harvesting, conservation and deepening projects may be taken up by the LSGIs.

As the area is prone to natural water scarcity more priority should be given to increase the potentiality of infiltration capacity. The following regulations and methods will help to improve the surface and ground water potential of the Town.

- Restriction to dig bore wells in ward 1, 2, 4,21,22,24 and 25. Bore well extract water from confined aquifer zone. This will result in uncontrolled decrease of permanent water table.
- Promoting water harvesting methods in the hilly regions like roof top harvesting, well recharging etc.

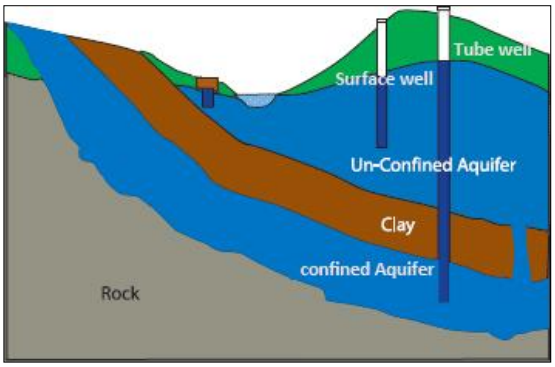


Figure 26-4 : Representation of surface and tube wells

- Supporting cover crops to improve infiltration and soil moisture in Rubber plantations.
- Digging farm ponds.
- Removal of clay from ponds and unused paddy fields at regular intervals.

- Removal of silt from river bed at ward 19 (Water divide area).

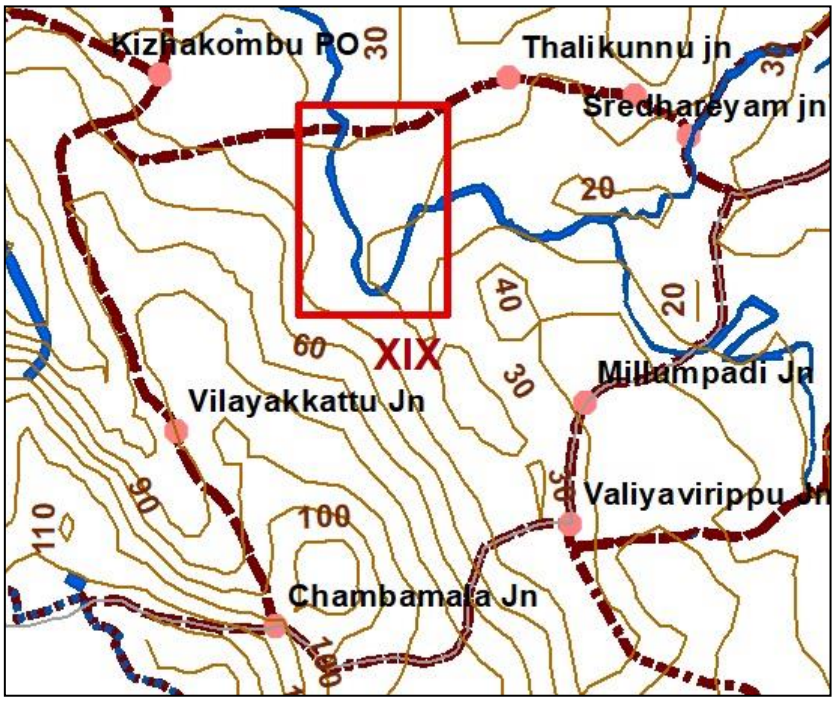


Figure 26-5 : Location of river bed at ward 19

26.5.5 Irrigation Projects

The high lands of ward 21 and 25 have hard impermeable gneiss exist as out crops and at shallow depth; this resulted in very high runoff and low infiltration in these wards. Minor irrigation projects are suitable for these regions. Water potential zone for irrigation projects are given in the figure 26-6.

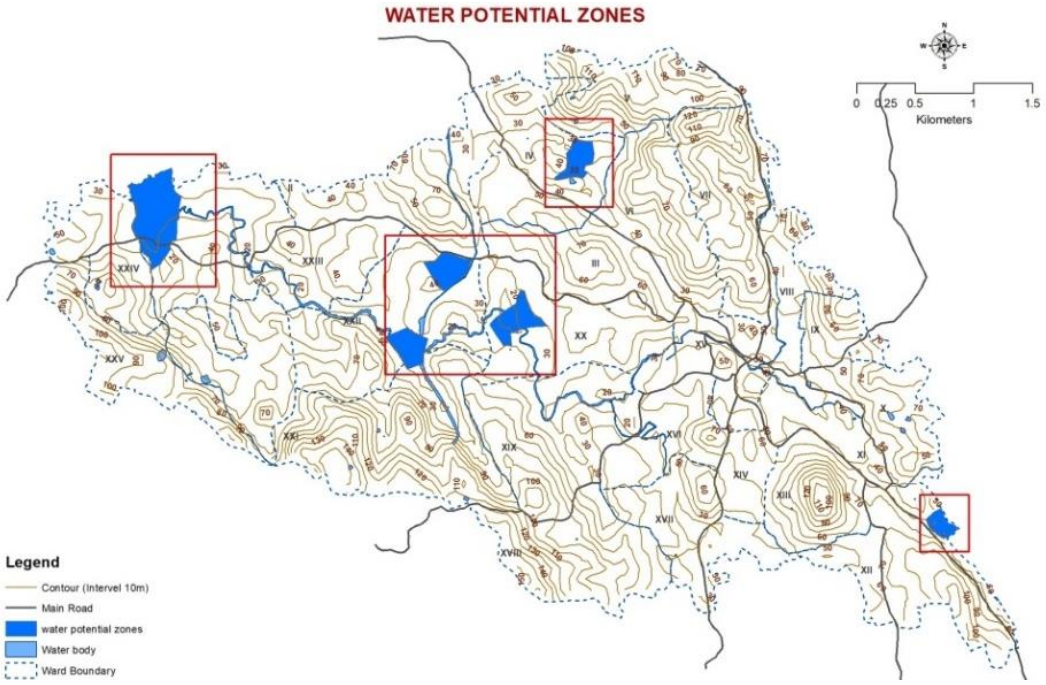


Figure 26-6 : Water potential areas in Koothattukulam

26.5.6 Use of old quarry ponds

Koothattukulam Town has number of abandoned quarries. These are currently filled with water and are acting as natural water tanks. A small quarry pond (Parakulam) can hold more than one million litres of water.

The quarry ponds in Koothattukulam Town are concentrated near the water scarcity zone. Hence they can be used as rain water harvesting tanks and through lift irrigation these water can be used for domestic and agricultural activities.



Parakkulam- Quarry pond

26.5.7 Construction of water conservation structures

1. **Construction of Check Dam:** Construction of check dam with shutter and to develop and deepen a new farm pond of at the location of natural pond at the north side of Koothattukulam market. The major outlet of surface and underground water of north and eastern part of the Town centre is running through this region. The flow of water can be checked at this point. Removal of clay and deepening of pond will improve the water holding capacity and infiltration. The excess of water can be emptied through check dam shutters before flooding.



Location of proposed check dam



Area near market for new farm Pond to be developed and deepened

2. **Construction of sub surface Dykes:** Two locations in Koothattukulam Town are suitable for the construction of sub surface dykes. One is at the south of Olipad junction behind the pond and another one is at the valley region at the western side of Aathipilli junction. The hard rock on the either side of the valley at these places will become a strong frame for the sub surface dyke.



Place of proposed sub surface dyke at south of olipad junction

The following map in figure 26-7 shows the site of water conservation structures

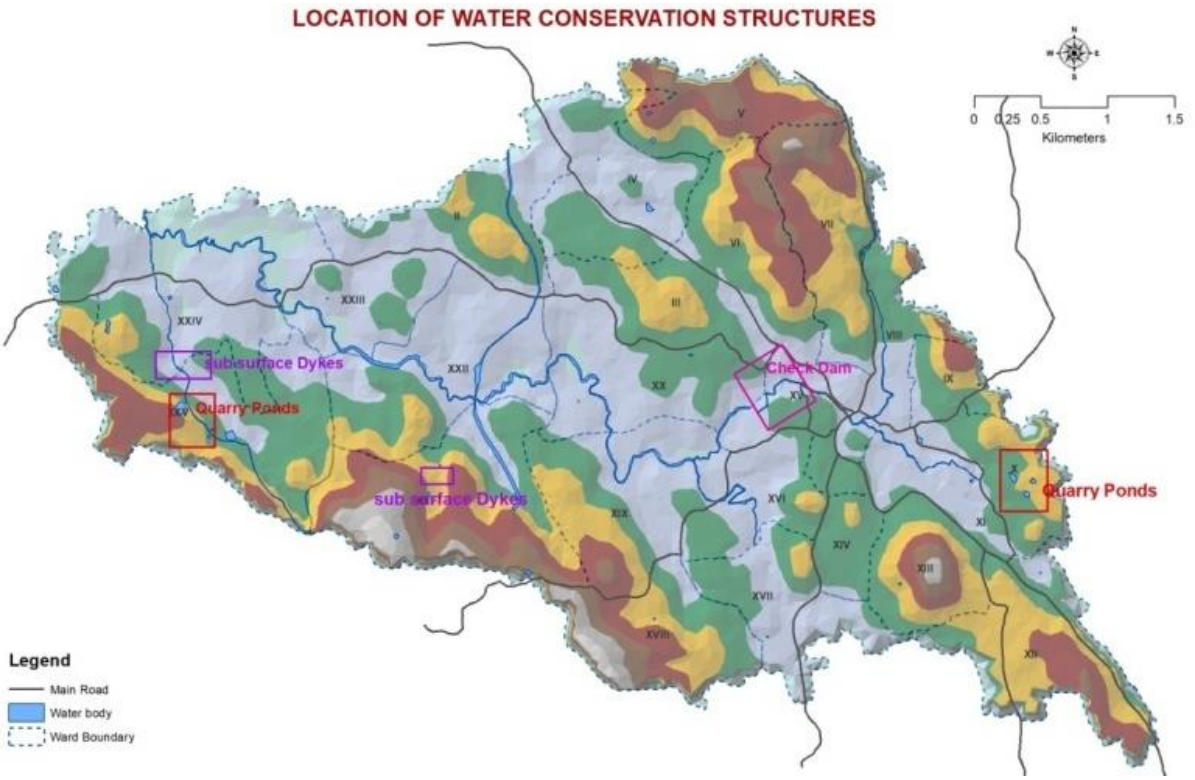


Figure 26-7 : Location of water conservation structures

From the primary data it is analysed that from January to May most of the Town area is facing water scarcity. The remaining months are monsoon season hence water is widely available. A sustainable management of this water through storage and maximisation of infiltration can minimise the water scarcity problem of Koothattukulam Town.

26.6 DRAINAGE

It is proposed to conserve the natural drainage network, and to plan and prepare a drainage network for the Town area. Surface drains are to be provided along the sides of all important roads and they are needed to be connected to suitable disposal destinations. Prevent entry of sewage and sullage to storm water drains and a separate covered drainage system needs to be provided for it if necessary with a sewage treatment plant at the common outlet point. In cases where they are disposed to storm water drains, a sewage treatment plant is to be provided at the exit point to avoid pollution. This may be included as the part of drainage plan.

26.7 SEWERAGE

There is no sewerage system in Koothattukulam as most of the city is served by Septic tanks instead of a proper water carriage system. The Town area requires Sewerage system as most are connected to the drains. The waste water from market and cattle market also needs to be treated and disposed. The depositing of sewage directly into a nearby open water source or vacant land without any kind of treatment will lead to unsanitary conditions in those areas. Hence a Sewage treatment plant is proposed in the Town ward to treat the water from the market as well as drains. A part of present solid waste dumping site can be utilised for this purpose.

26.7.1 Septage Treatment Plant

Since Koothattukulam is an open defecation free Municipality the way forward is to develop a Septage treatment plant. For a small Town like Koothattukulam, even a Gravity-based biological septage treatment plant can be used. Considering the existing system of sanitary waste disposal and changing plot size of the residents in Town a new Septage treatment plant is to be developed.

In February 2017, MoUD issued the National FSSM Policy. National Policy on Faecal Sludge and Septage Management (FSSM) states that the urban local body plays a lead role in Design, develop, plan and implement ULB level FSSM strategy. The local body should Set up and ensure operation of systems for 100% safe and sustainable collection, transport, treatment and disposal of faecal sludge & Septage. Also the ULB should play a supporting

role to Create enabling environment for NGOs and private initiatives to achieve safe and sustainable FSSM.

A new septage treatment facility is suggested to be developed at the land under the ownership of MVIP in ward number 21 by providing sufficient green strip by taking the advantages of its natural slope, connectivity and distance from Town centre.

26.8 SOLID WASTE DISPOSAL

The existing solid waste disposal is by dumping waste as land filling at the Town centre ward which is not functioning properly. A modern solid waste treatment plant is to be proposed outside the Town centre with facilities such as MRF, Plastic shredding unit, Aerobic compost units for treatment of bio waste etc. The existing site can be utilised for subsidiary activities for solid waste management instead of dumping. Along with following proposals for efficient management are suggested:

- Provision of community collection or door to door collection with a nominal charge for the same in all the areas
- Segregation of waste at household level by provision of 3types of bins (organic, recyclable and non-compostable). This reduces the load on the landfill site
- Waste segregation areas for sorting of waste from the collection.

26.9 POWER

The proposal in the power sector is furnished below

- Street Lighting - Provision of High mast lights or Sodium vapour lamps in the Town at major and minor junctions and road intersections. Provision of separate street mains for street lights. Proper lighting of all minor, local and residential roads.
- Electrification of houses - Electrification of all houses especially the houses of economically weaker section.
- Non-Conventional Energy – Incorporation of energy conservation and energy efficiency measures like green buildings and adoption of nonconventional sources of energy like bio gas, solar energy, etc.

26.10 EDUCATION

The existing numbers of educational institutions are quantitatively enough for projected population for 2036.

Primary Educational Facilities

Even if the municipal area has enough number of schools to serve the existing as well as the future population, there are some areas/wards which do not have even primary schools at walkable distances, so it is suggested to provide primary educational facilities in the identified gap area for Town to cater to the population of that area. New school proposals could be encouraged in those wards such as 18, 19, 20, 21 & 22. The existing higher secondary school has can be improved with modern facilities such as digital class rooms, well equipped library, laboratory and facilities for outdoor games. It will help to raise the academic level of schools to provide quality education.

Upgradation of Government UP School



Figure 26-8 : Bitmap – Location of proposed School play ground

The existing government UP school can be upgraded to high school level with supporting facilities since there is no government high school present in Town. It is suggested to use the land under the ownership of MVIP (which is not being used for any purpose and left as unused store yard at present) near the inner ring road as a play ground to be used by the Govt UP School Koothattukulam. The school and the playground need to be well connected with each other and the crossing of inner ring road by the students to reach the play ground should be avoided considering their safety. This can be achieved by providing a foot overbridge or by acquiring the residential areas in between school and the proposed play ground. The land available with UP school is only 1.5 acre, the provision of this land for UP School play ground can help to upgrade it to a Govt High school by replacing the existing dilapidated buildings in the school with multi storey blocks. Acquiring the land also gives scope for future expansion and upgradation of school to higher levels.

26.10.1 Smart Anganwadis

Upgrade all the existing anganwadis by providing basic and advanced infrastructure facilities. The facilities such as adequate furniture, drinking water, electricity, toilet, space and facilities for outdoor and indoor activities for children, etc should be provided. Mobile application can be launched for monitoring nutrition status of anganwadi children. Progress and daily duties of anganwadi workers are to be tracked through a suitable application. Monitoring system of health and learning of the children should be implemented and compared with standards and indicators.

26.10.2 Rural Food Technology Institute

In association with Meat Products of India a food technology institute is proposed which can utilise the availability of land and the proximity to the food processing by MPI and availability of raw materials such as Jack Fruit, Tapioca, Pineapple, Mango, etc. in the region. A Product Innovation Centre with Laboratory aiming at product innovation and food safety can be developed as part of the Institute. The proposed institute would be able to provide trained manpower to the food processing industry in and outside the state. The institute can play a major role in stimulating entrepreneurship in food processing, creating awareness about nutritive, safe & healthy food, and serving as a centre for educating and training food processing personnel and entrepreneurs.

The Institute will be able to cater the Rural Skill Development in Food Processing Technology. Short term courses, training of trainers, entrepreneurship in food processing, food safety management, detecting adulteration in food etc. are other areas where the Institute can deliver service. It can help in providing knowledge and developing skills of the students on various food quality parameters / systems, techniques of food processing analysis, food laws and standards, etc. Providing education and training in food technology and related skills, especially for under graduate students will enhance their employability scope in food related areas, they can also be trained to produce new food products which can be patented. This would generate Job opportunities for students & entrepreneurs together with fetching additional income for MPI.

26.11 HEALTH

Upgradation of CHC

The healthcare sector in Koothattukulam is mainly under private ownership. The existing government community health centre which is functioning in the Town centre is depended by the population but the lack of staff is a major setback. The current CHC is spread over an area of 1 acre 63 cent with 3000 sq.mtr of hospital building. Average daily inpatients of 30-35 only are occupied out of 90 bed strength with 3 doctors. Average O.P is about 300-350 per day. The new building which is constructed for gynaecology department has not yet started functioning. The old hospital building which is dilapidated need to be reconstructed and recruiting more staffs will create potential to upgrade the CHC to a taluk hospital as there are no other facilities in public sector in the influence area of Koothattukulam.

26.12 HOUSING

The survey on homeless was conducted by Kudumbasree in 2017 as part of LIFE mission and beneficiaries were identified to provide houses with the help of existing schemes under LIFE and PMAY schemes. Site has been proposed by the Municipality at ward 21 rehabilitating the houseless. Apart from this additional future population can be accommodated in the proposed residential area in the Master Plan. The sub-standard housing colonies at certain areas identified in the analysis have to be given importance by improving the supportive infrastructure facilities.

26.13 RECREATION

Recreational and other civic facilities are inadequate in the Town. As sub regional centre, higher order facilities are to be provided in the Town.

- New parks are proposed at land under the ownership of block panchayath in ward no 12 and 20. Parks and recreation impacts values such as Economic Health and Environmental benefits, Social importance that make them essential services to community's value.
- The new Stadium partly built should be completed with modern facilities with minimum standards. Galleries are to be constructed with necessary facilities and

lighting. The stadium and environment should be beautified. The access road to the stadium needs to be widened and adequate parking places are to be provided.

- Kattupadamchira and other such water bodies can be developed to be used for passive recreational purpose. Canal protection and beautification projects can be implemented at all possible locations.
- The land with the government offices which if shifted to other places are to be used for recreational purpose considering the present shortage of recreational space in Town.
- Free spaces if available in residential areas are to be developed as recreational spaces with active community participation among the local resident population which will improve their quality of life.

26.14 OTHER CIVIC AMENITIES

A Socio cultural centre is proposed after demolishing existing Town hall Municipality building situated in the Town centre. The proposed centre would be centre for promotion of various performing arts like music, dance, and theatre thereby reviving the history of the name Koothaattukulam which originally derived from 'Koothu' and 'aatam' which are dance forms.

It is suggested to develop new public comfort stations associated with all the proposed new public purpose developments and commercial complexes.

26.15 ENVIRONMENT

Regulations for the use of eco sensitive areas are included in the zoning regulation for the protection of the environmentally sensitive areas. Following are the proposals in this regard

- Conservation of all the existing paddy land, wet land and other eco sensitive areas.
- Conservation and revitalisation of existing water bodies, natural drains, thodu, canals,etc.
- Conservation of hilly terrain and prevention of development in slopes.
- Adopt water conservation measures through structures like check dams and sub surface dykes.

- Adopt new irrigation, water conservation and revitalisation projects approved by the concerned departments with out inversely affecting the environment.

26.16 GOVERNANCE

For providing better services to the people and to improve the efficiency of functioning, the infrastructure of government offices and the municipal office has to be improved.

A new building for municipal office is a proposed project under the Municipality. The design of the building should be in such a way utilising optimum area by vertical development, providing sufficient parking facilities and other necessary amenities thereby generating revenue for the Municipality.

A new office complex such as a mini civil station is proposed for government offices functioning in owned and rented buildings inside the Town and to attract new offices functioning in the vicinity of Town with a view to develop Koothattukulam as a regional sub centre to serve the region effectively with provision of all the basic and advanced infrastructural facilities for the entire population in its service area by coordinating all under a single roof. On implementing this, buildings and existing compound of the shifted offices can be acquired and used for public recreational purpose activities such as parks and open spaces or uses which can generate revenue for the Municipality.

Modernization and reforms in various activities are also proposed for providing more services to the people. Application of e-governance through GIS support in Eight functional service areas of ULBs namely -registration and issue of birth & death certificate, payment of property tax & utility bills, management of utilities that come under the ULBs, Citizen grievances & suggestions, Building Plan approvals, procurement and monitoring of projects, health, accounting system and personal information system.

26.17 PROJECTS IDENTIFIED

Figure 26-9 shows the location of Projects identified in town area, and are described as follows:

26.17.1 Municipal office complex (P1)

A project identified to build a new Municipal office building and shopping complex with all the basic requirements like ground floor municipal office, council hall, adequate parking and other basic infrastructural facilities, commercial or shopping facilities, etc. The land near KSRTC bus stand with an area of 1 acre is identified for this project.

26.17.2 Socio-cultural centre (P2)

A Socio cultural centre is proposed to develop after demolishing existing Town hall and Municipality building with an area of 0.53 acres of land situated at the Town centre. This can act as a gathering space for the population during socio cultural events to enhance the social and cultural heritage of the Town.

Socio cultural centre can accommodate

- An air-conditioned and fully equipped auditorium for arts performance
- A multipurpose hall
- A Seminar & an Exhibition Room
- Public library and reading room
- Meditation and spiritual centre
- An Office space, canteen
- Public comfort station

26.17.3 Multiplex cum shopping complex (P3)

A cinema theatre cum shopping complex is an identified project inside the Town centre with ground floor commercial areas and cinema theatre at the top floors with all other necessary facilities. This project is located in between KSRTC and Private bus stand at the old market area in 0.47 acres of land owned by the Municipality.

26.17.4 Modernization and Reconstruction of Municipal Market (P4)

Even though the municipal market is a newly built one it lacks basic facilities. New better designed and clean shopping area with parking facility is essential. A self sufficient hi-tech Modern Market with all the basic and advanced infrastructural facilities is needed for the horizon year. Hence reconstruction of the municipal market with new buildings, drainage

facility, waste disposal system, parking facility, cold storage facilities and shops are proposed at the existing new market areas.

Facilities to be provided at markets include:

- Provision for adequate parking facilities
- Provisions for solid waste and Garbage disposal system
- Waste water treatment plant, where the waste water from market and the waste water drain line from the nearby areas as per the drainage plan.
- Public toilets to maintain cleanliness.
- Storage facilities including cold storage
- Loading and unloading bays
- Ripening chamber
- Systematically arranged trader shops
- Bank with ATM
- Street vending zones

The proposed new market area includes the cattle market with all the requirements to raise its potentials to become a regional level cattle trading market. A veterinary care unit is also suggested to be developed together with the cattle market. All these facilities are proposed to be developed at the area of 0.80 acres of land of the existing cattle market and general market areas.

26.17.5 Parking Plaza (P5)

A new off street multilevel Parking cum commercial complex is proposed at the existing stand for Taxi/Goods Auto/LCV near Devamatha Jn on the side of MC road which is not fully utilized now. Considering the higher levels of congestion in the CBD areas due to on street parking and acute parking demand-supply gap existing in Town, the proposed off street Parking with adequate parking provisions for private and taxi vehicles with proper segregation among them is proposed at this area of 0.33 acres of land.

26.17.6 Material Recovery Facility and Aerobic Composting Units (P6)

A material recovery facility, aerobic composting units and green buffer zone in the remaining area are proposed at the present Town dumping yard at ward 15 with 0.25 acre of land after proper management of the existing situation. The method of decentralized waste treatment by Thumburmuzhi model aerobic composting bins can be used in solid

waste management of the market waste and the nearby areas. A project of one MRF unit and 2 units with total 4 numbers of "Thumburmuzhy Bins" i.e, ferro-cement bin with airspace and grooves is proposed at the site. "Thumburmuzhy Model Aerobic Composting Technique (TMACT)" is used in these bins for aerobic composting. The remaining area is used to develop green strip by doing vegetable cultivation or gardening by using the manure from the composting units.

New decentralised waste treatment facilities like this project are to be developed at different locations inside the Town for the proper management of solid waste in the whole Town. Such a facility is suggested to be developed at the land under the ownership of MVIP in ward number 21 by providing sufficient green strip.

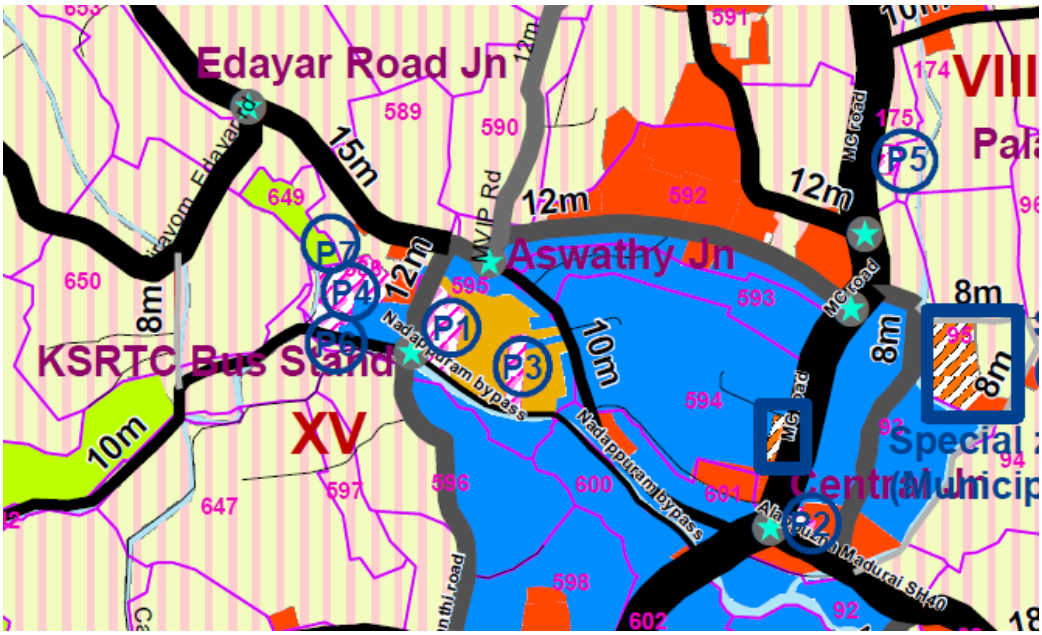


Figure 26-9 : Location of Projects identified

26.17.7 Drainage plan for central area

Rain water falling in an area flows towards a particular direction depending upon gravity and slope. So while planning the drainage network or storm water drains these two factors should give prime priority. Koothattukulam Municipality is located in the rolling hills of midland area of Ernakulum District; hence a proper drainage plan is essential for solving the problem related to water logging and surface runoff.

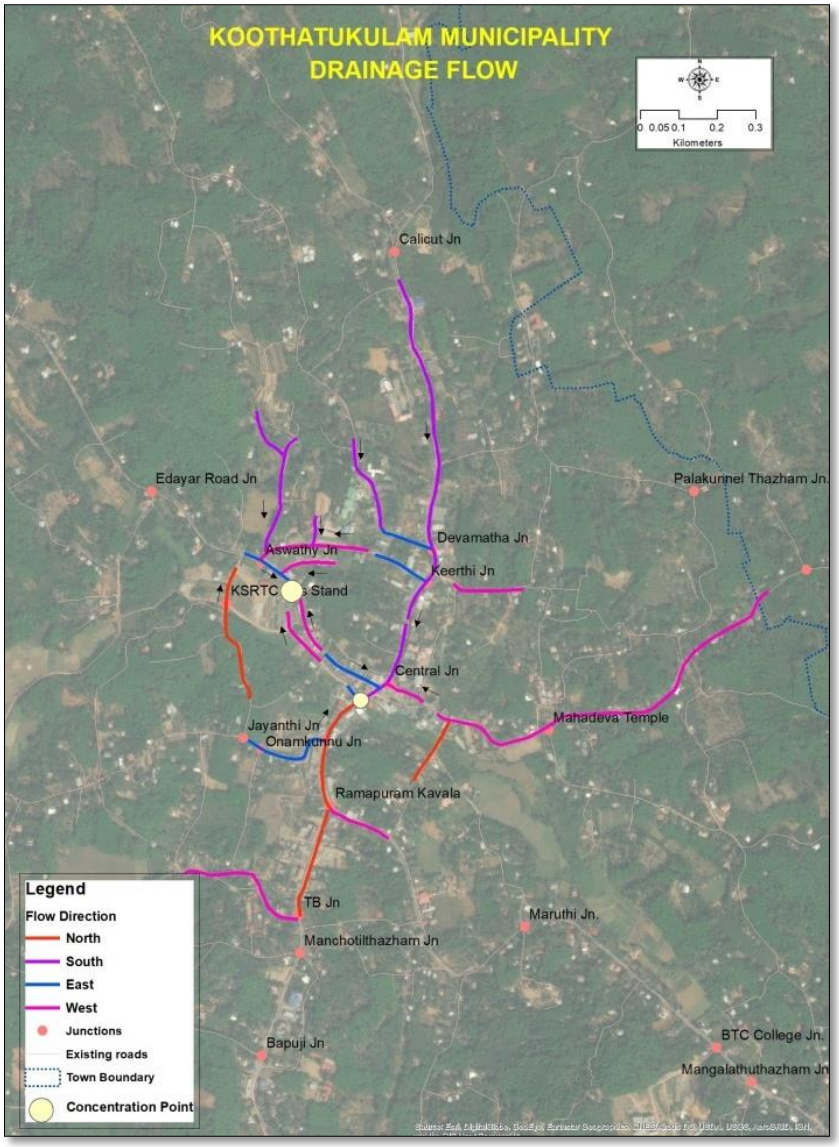


Figure 26-10 : Drainage Flow

The study conducted in the central area identified two concentration zones of drainage water. One is at the north-western side of private bus stand where the water is channelled to the wetland region behind the new market and the second one is at the southern side of Central junction. The storm water reaching here is directed to the canal nearby. The current drainage system of the Municipality is a well-planned one.

Even though the drainage system constructed in the Municipality centre is based on the slope and water flow, the drainage flow is not properly maintained in this region. A proper management is very essential and critical. The following are the observations made during the site visit.

- The main problem identified here is, instead of storm water waste water is running through the drainage channels.
- The flow of water from the concentration point near the private bus stand to the wet land behind the market is obstructed with waste materials and clay deposits.
- Dissolving of waste water from the city drain with the pure water flowing through the wetland.



- Deposition of sand and waste in the major canal channel.



Suggestions

- Strong restriction in constructing sewage outlets to storm water drains for commercial and residential buildings.
- Construction of small scale waste water treatment plant near new market.
- Cleaning of drainage system.
- Cleaning and deepening of canal channel.

The waste water from market and the waste water coming through the drainage network from the nearby areas are to be collected and treated by a waste water treatment plant, which needs to be developed as a first priority project as it is now being discharged directly

to the natural wetland area thearby causing severe surface and ground water pollution at this location.

26.17.8 Farm pond, Check dam and associated Recreational open space (P7)

It is suggested to clean and develop a farm pond at the wetland near the market area to increase the ground water infiltration. The side protection work and associated walkway can be used for recreational purpose. The remaining wetland area needs to be cleaned and protected as such. The major outlet of surface and underground water of north and eastern part of the Town centre is running through this region. This fresh water from the elevated areas can be collected at the proposed farm pond to increase infiltration and ground water recharge and the flow of water can be checked at this point. During dry period water can be collected and during rainy season the excess of water can be emptied trough check dam shutters before flooding. Removal of clay and deepening of pond will improve the water holding capacity and infiltration.



Existing Situation



Proposed farm pond (Representative image)

26.17.9 Canal protection and beautification project

The canal near the market extending to the Town centre along road sides is suggested for protection and side beautification project. The canal needs to be cleaned and deepened to achieve natural flow of water and should be protected from present and future pollution. The side protection and prevention from encroachments can be done through providing canal side walkways and planting trees as part of the beautification project. The development, deepening and protection of the new farm pond and construction of check dam at the intersection of canal and pond as part of this project will improve the quality of environment at the Town centre. The treated water from the suggested waste water

treatment plant can be redirected to this canal without polluting the proposed farmpond and the conserved wetland.

26.17.10 Kattupadamchira beautification and Green Park (P8)

Kattupadamchira is suggested for protection and beautification project together with development of passive recreational purpose park in the surrounding area. Seating arrangements can be provided surrounding the water body. This can give recreational space for the nearby residents.

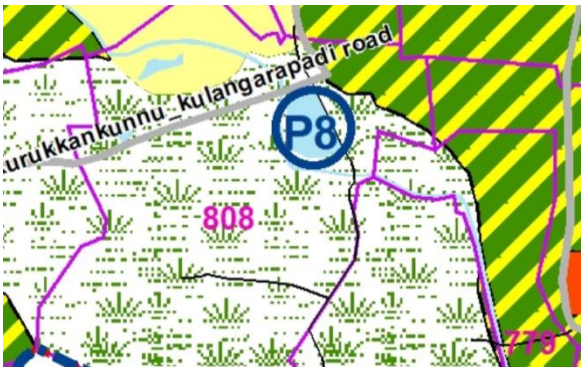


Figure 26-11 : Bitmap – Location of proposed Project (P8)



Kattupadamchira

27 ZONING REGULATIONS

Land use zoning for sustainable development has been done for the Municipality 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 Koothattukulam Town 2036'.

26.1 ZONING REGULATIONS

1. For the implementation and enforcement of the proposals envisaged in this Master Plan, areas have been zoned under various categories such as *Residential Use Zone, Residential Mix Use Zone, Town centre, Sub centre, Public and Semi-Public Use Zone, Industrial Promotional zone, Traffic and Transportation Use Zone, Paddy/Wet land, Dry Agriculture cum Residential Use Zone, Dry Cultivation Use Zone, Kavu, Water bodies, and Special Zones* for securing the most efficient and effective use of land in public interest. Details regarding the nature of uses 'permitted', uses 'restricted' and uses 'prohibited' in each zone are presented in the Table 26-1. These regulations shall be enforced in conjunction with other specific provisions if any mentioned elsewhere in this scheme.
2. 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 of the Local Self Government Institution concerned (hereinafter refer to as the Secretary. 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 special locational factors. Such cases which come under this category are classified as "Uses Restricted". Restricted-1 category deals with the uses that shall be restricted by the Secretary with the concurrence of the Town Planner of the District office of the Local Self Government Planning Wing, Restricted -2 category deals with the uses that shall be restricted by the Secretary with the concurrence of the Chief Town Planner of the Local Self Government Planning Wing.

3. “Used prohibited” enlists the various objectionable uses in each zone which shall not be permitted under normal circumstances.
4. 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 scheme. All existing uses in every zone shall be permitted to continue.
5. If any portion of a zone is put to a “Use prohibited” as stated in Para 2, before the sanctioning of the scheme, such use shall be termed as non-conforming use. A non-conforming use may be allowed to continue in its existing location and essential repairs and maintenance for the structure may be permitted by the Secretary, provided that the said use create no adverse environmental influence in the zone. Addition, alteration or reconstruction, if found necessary as part of any mitigation measures may be permitted for such uses by the Secretary with the concurrence of the District Town Planner concerned.
6. Existing areas and structures of archaeological importance, wet agricultural uses and religious uses shall be permitted to continue in all the zones and shall not constitute non-conforming uses.
7. Regulation of constructions and/or 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 centre line of the road, unless otherwise specified in the Master Plan or any detailed road alignments approved by Chief Town Planner concerned.
    a. In case of widening affecting paddy/canal/central govt. land, shall be done to the other side
8. Constructions and / or land developments, if any, in paddy lands and in wet lands, shall be in conformity with the paddy land and wet land act in force in the state.
9. All existing ponds shall be preserved considering its infiltration capacity for ground water recharging, other environmental and aesthetic values.
10. The Government shall have the power to issue clarifications in respect of technical interpretations, if any, required in any of the provisions of the scheme in consultation with the Chief Town Planner concerned.
11. Any use not specified either in the ‘uses permitted’ or ‘uses restricted 1’and ‘uses restricted 2’ category of a particular use zone, but which is of a similar nature to any

use permitted or restricted in that particular use zone, can be considered by the Secretary, with the concurrence of the District Town Planner and Chief Town Planner respectively.

12. Coverage, floor space index (FSI) and area limitation of all constructions wherever it is not specified in a particular use zone shall be as per the values prescribed in the Kerala Municipality Building Rules, 2019 and its time to time amendments.

Table 27-1 : Zoning regulation for the land use zones in Koothattukulam

SL. No	Uses Permitted	Uses Restricted -1	Uses Restricted-2	Uses Prohibited
1	2	3	4	5
1	**RESIDENTIAL USE ZONE**			
1.1	Residential buildings consisting of single or multifamily dwellings, residential flats/apartments, residential quarters, night shelters, orphanages, old age homes, dharmasala, guesthouse, hostels and boarding houses.	Ashram, Madrasa, Places of Worship		Any other use not specified
	Shops, Professional Offices, Commercial Offices, Banks & other Financial Institutions, Restaurants, Canteen, Hotels – built-up area **limited to 200 m^2.**	Fuel Filling Stations		
	Cottage Industries including coir, Service Industries of non-nuisance Nature (See Annexe-I), with number of workers limited to 6 without power or 3 workers with power limited to 5 HP.	Cremation Ground/Crematorium, Burial Ground/ Common Vault.		
	Educational institutions essentially serving the needs of residential community such as Day Care, Crèche, Nursery Schools, Kindergartens and schools offering general education (up to High school level).	Public utility areas and Public Utility buildings other than those included in the permitted category.		
	Health institutions essentially serving the needs of residential community such as dispensaries, clinics (Out Patient), Diagnostic Centres etc having a built-up area **limited to 300m^2**.			

	Community facilities such as Community Halls, Recreational Clubs, Social Welfare Centres, Gymnasium/ Yoga Centers, Swimming Pool, Libraries etc. having a built-up area **limited to 300m^2.**			
	Godowns, ware houses, Storage of non-hazardous materials, Stacking yard			
	Utility Installations and Civic Amenities essentially serving the needs of residential community such as post office, police station, telephone exchange, fire station, tot lots, parks, play grounds, open grounds, water treatment plants below 5 MLD.			
	Plant Nurseries, Pump House, smoke houses or similar uses for agriculture value addition attached to a residential building. Poultry farms, dairy and kennel.			
	Wells and Irrigation Ponds incidental to community needs.			
1.2	**Provided that the access road has a width of 5m minimum.**			
	Automobile workshops for two/ three wheelers with built-up area **limited to 200 m^2.**			Any other use not specified
1.3	**Provided that the access road has a width of 8m minimum.**			
	Hospitals with 5 beds	LPG distribution centres (excluding bottling plants and bulk storage) limiting the built-up area limited to 500 m^2.		Any other use not specified
	Educational institutions up to Higher Secondary Schools.			
	Shops/Professional Offices, banking and financial institutions.			
	Markets, Automobile workshops for Light Motor Vehicle - built-up area **limited to 500 m^2.**			
1.4	**Provided that the access road has a width of 12m minimum.**			

	Educational institutions of higher order such as collages/ universities/ general education institutions/ specialised/ professional education institutions/ research and development institutions.		Multiplex	Any other use not specified
	Convention Centres/ Auditorium/ Wedding Halls/ Community halls/Exhibition Centers and Art Gallery. Hospitals / Health institutions with more than 5 beds.			
	Automobile Workshops / Automobile Service Stations for Heavy Motor Vehicles - built-up area limited to **1000 m^2.**			
2	**RESIDENTIAL MIX USE ZONE**			
2.1	All uses that are permitted in Residential Use Zone are permitted in this zone unless otherwise specified in the following:	Museum, Exhibition centres and art gallery, Places of worship		Any other use not specified
	Automobile workshops for 2/3 wheelers, Service Industries of non-nuisance nature (See Annexe I) engaging not more than 19 workers without power or 9 workers with power limited to 15 HP, Civil defence and home guard.	Fuel filling stations		
	Parking Plaza, Taxi/Jeep Stand.			
	Plant Nurseries, Pump House, smoke houses or similar uses for agriculture value addition attached to a residential building. Poultry farms, dairy and kennel with built-up area limited to **100m^2.**			
2.2	**Provided that the access road has a width of 5m minimum**			
	Diagnostic Centres, Clinics (Out Patient), Shops, Professional Offices, Commercial Offices/Establishments, Banking and financial institutions, Restaurants/Canteen, Hotels, IT/ Software units with built-up area more than **500 m^2**.			Any other use not specified
2.3	**Provided that the access road has a width of 8m minimum**			
	Shops, Professional Offices, Commercial Offices/Establishments, Banking and financial institutions, Restaurants/Canteen, Hotels, IT/ Software units with built-up area more than **500 m^2**.	Sawmills with timber yards, slaughter house		Any other use not specified

	Social Welfare Centres / Movie Halls/ Auditorium/ Wedding Halls/ Community Halls.			
	Secondary/ Higher Secondary Schools, Technical High Schools.			
	Hospitals and health centres with number of beds limited to 25.			
	Markets of plot area limited to **500 m^2.**			
	Weigh Bridge			
	Godowns/ Warehouses/ Storage non-hazardous built-up area limited to **300 m^2**.			
	Marble and Granite Storage Centres, Industrial Estates & Industrial Parks. Automobile Workshops / Automobile Service Stations for Light Motor Vehicles - built-up area limited to **500 m^2.**			
	Service Industries of Non Nuisance Nature (see annexure I) engaging not more than 9 workers with power limited to 30 HP in areas other than industrial estates/parks.			
2.4	**Provided that the access road has a width of 12m minimum**			
	Educational Institutions of Higher Order	Bus Terminals, Lorry Stands	Multiplex	Any other use not specified
	Shops, Offices, Markets.			
	Hospitals & Health centres with number of beds limited to 100.			
	Godowns / Ware houses/ Storage (non-hazardous) built-up area limited to **500 m^2**.			
	Automobile workshops/ Automobile showrooms / Automobile Service stations for Heavy vehicles, Industrial estates, Industrial parks– built-up area **limited to 1500m^2.**			
	Movie halls/ auditorium/ wedding halls/ community halls/outdoor games stadium.			
2.5	**Provided that the access road has a width above 15m minimum**			
	Hospitals & Health centres **up to 300 beds**			Any other use not specified
	Movie halls/ auditorium/ wedding halls/ community halls – shall be provided with parking at 1.2 times that of KMBR for built-up area above 1500 m^2.			

	Tourism amenities, restaurants, canteen, hotels, resorts, passenger amenity and refreshment centres.			
3	**TOWN CENTRE**			
3.1	All shops including shopping complexes, shopping malls, multiplex, hypermarkets, restaurants, hotels, markets.	Places of worship	Multiplex	Any other use not specified
	Professional offices, commercial offices & establishments, banking and financial institutions, IT software units, Movie halls, Community Halls.	Fuel filling stations		
	Single Family Residences, Residential flats/apartments with or without lower floor(s) for commercial use, night shelters, orphanages, old age homes, dharmasala, hostels and boarding houses, lodges and guest houses, Ashram.	Other public utility areas & Public utility buildings.		
	Gymnasium/ Yoga centres/Day care, Creche, Nursery/ Kindergarten, Expansion of existing educational institutions			
	Godowns/warehouse/storage of non-hazardous materials, stacking yards limited to **200 m^2**			
	Cottage industries, automobile workshops, automobile service stations, cold storage, service industries of non-nuisance nature with number of workers limited to 19 without power or 9 workers with power limited to 30HP(See Annexe-1), printing press, IT hardware / electronic industries.			
	Government (Local /State/Central) or Public Sector Offices, IT software units	Museum, Exhibition centres and art gallery		
	Social welfare centres, library and reading rooms.			
	Clinics, diagnostic centres and hospitals			
	Tot lots, Parks & playgrounds, fair grounds, open air theatres.			
	Parking plaza, Transport terminals, public utility areas and buildings.			
	Plant nursery, Storage of agricultural produces and seeds, Pump House, Wells and Irrigation Ponds			
3.2	**Provided that the access road has a width of 12m minimum**			

	Educational institutions of higher order such as collages/universities/general education institutions/specialised/professional education institutions/research and development institutions.			Any other use not specified
	Hospitals & Health centres			
4	**SUB CENTRE**			
4.1	All uses that are permitted in Town centre are permitted in this zone unless otherwise specified in the following:	Fuel Filling Stations.	Multiplex	Any other use not specified
	All Shops including Shopping Complexes, Professional offices, Commercial Offices & Establishments, Banking and financial institutions Restaurants, Hotels, Markets.			
	Hostels, Boarding Houses, Guest Houses, Lodges, Night Shelters.			
	Godowns/ Warehouses/ Storage of non-hazardous materials, stacking yards limited to **500 m^2.**			
	IT Software units.			
	Movie Halls, Auditorium / Wedding Halls / Community halls/ Convention Centers.			
	Gymnasium / Yoga Centers.			
	Cottage Industries, Automobile workshops, Automobile Service Stations, Cold storage, Service Industries of non-nuisance Nature (See Annexe I) engaging not more than19 workers without power or 9 workers with power limited to 30 HP, weigh bridges, IT Hardware / Electronic Industries.			
	Marble and Granite Storage / Cutting centers.			
	Local / State/ Central Govt. or Public Sector offices.			
	Day Care and Crèche, Nursery / Kinder Garten / Schools up to Higher Secondary level, Library and Reading Rooms, Tot Lots/Parks/Play Grounds.			
	Library and Reading Rooms, Social Welfare centers.			
	Museum, Exhibition Centers and Art Gallery.			
	Indoor Games Stadium.			
	Public Utility Areas & Buildings.			
	Places of Worship.			

	Parking Plazas, Transport terminals.			
	Plant Nursery.			
	Storage of Agricultural Produces and Seeds.			
	Colleges, University, Technical training centre/Polytechnic, General Educational Institute, Secondary and Higher secondary school, vocational training institute, Specialised and Professional Institute, Research & Development institutes.			
	Clinics, diagnostic centres and hospitals up to 100 beds			
5	**PUBLIC AND 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 addition of new blocks without altering the use.	Cremation Ground / Crematorium, Burial Ground, Common Vault.		Any other use not specified
	Residential Quarters incidental to public and semi public use, Ashram/Convents. Single family residential buildings, public utility areas and buildings.	Fuel Filling Stations.		
	Parking plazas, auto rickshaw/ taxi/jeep stands. Auditorium / wedding halls / community halls incidental to public and semi public uses. Tot lots/parks/play grounds, open air theatre, camping sites.			
	Educational institutions (including professional education/collegiate education /higher education institutions),library and reading rooms, social welfare centres, museum, swimming pools, exhibition centres and art gallery, convention centers, indoor/ outdoor games stadium. Clinics, diagnostic centers and hospitals.			
6	**INDUSTRIAL PROMOTION ZONE**			
6.1	All industries other than obnoxious and nuisance type industries, ice factory, cold storage, fish and meat processing units, printing press, water treatment plants.	Public Utility Areas & Public Buildings.		Any other use not specified
	Godowns/Warehouses/Storage of non-hazardous material, stacking yards, weighbridge.			

	Dairy and dairy Farms, dairy related industries, poultry farms, piggery farm, and smoke houses, slaughter houses.	Junk yards, Storage of Explosive and fireworks, Gas Godowns		
	Single family, Residential buildings incidental to the industrial use. Tot lots, parks and play grounds attached to incidental residential use.	Saw mills with Timber Yard, Slaughter Houses/Fish / Meat processing Centers		
	Industrial estates & industrial parks, Institutes incidental to industrial estates. Shops, Professional Offices, Commercial Offices, Banks & other Financial Institutions, Restaurants, Canteen, Hotels – built-up area **limited to 200 m^2.**	Fuel Filling Stations, Obnoxious and nuisance type industries (see Annex III).		
	Dry cleaning plants, power plants, sub stations.	Dumping yards and Sewage Treatment Plants		
	Government or public sector offices, transport terminals incidental to industrial use. Any other activity incidental to industrial use			
7	**TRAFFIC AND TRANSPORTATION USE ZONE**			
7.1	Transport terminals including constructions that form an integral part of the terminal.	Fuel Filling Stations		Any other use not specified
	ATM's, comfort stations, fuel filling stations			
	Any incidental uses to the transport terminals such as Retail Shops, Restaurants, Canteen etc.			
	Staff Quarters, Offices, Night Shelters, Guest Houses etc incidental to the transport terminals, Parking Plazas.			
8	**DRY AGRICULTURAL CUM RESIDENTIAL USE ZONE**			
8.1	Agriculture, horticulture and fodder cultivation, pastures, grazing ground, and other types of cultivation including social forestry, farm tourism.	Place of worship, Cremation ground/ crematorium, burial ground, common vault		Any other use not specified
	Dairy Farms, Fish farms, Seed farms, Poultry farms, piggery farms, smoke house, Plant nursery, pump house, wells and irrigation ponds.	Slaughter Houses, Gas Godowns, Dumping Yard.		

	Single and multi family Residential Buildings. Orphanages, old age homes, dharmasala, ashrams, convents.	Saw mills		
	Public utility areas and buildings like water supply and electrical installations, sewage treatment plant etc.	Fuel filling stations.		
	Clinics (Outpatient) and diagnostic centres – built-up area limited to **200 m^2.**			
	Shops, professional offices, commercial offices and establishments, banking and financial institutions, restaurants, canteens – built-up area limited to **200 m^2.**			
	Social Welfare centers, Gymnasium / Yoga Centres – built-up area up to **500 m^2**			
	Police Post/ Police Station, Post and Telegraph office, Fire Post/ Fire station, Telephone Exchange.			
	Day Care and Creche, Nursery / Kinder Garten / Primary & Upper primary schools.			
	Library and Reading Rooms			
	Storage facility for Agricultural Products			
	Cottage industries, Service industries of non-nuisance Nature (See Annexe - I)engaging not more than 6 workers without power or 3 workers with power limited to 5HP,			
	Tot Lots/Parks/Play Grounds, Weigh Bridge.			
8.2	**Provided that the access road has a width of 5m minimum**			
	Shops, professional offices, commercial offices and establishments, banking and financial institutions–built-up area limited to **500 m^2.**			Any other use not specified
	Automobile workshops for 2/3 wheelers.			
	Godowns/ warehouses/ Storage – non hazardous –built-up area limited to **500 m^2.**			
8.3	**Provided that the access road has a width of 8m minimum**			
	Hospitals & Health Centres – built-up area up to **500 m^2**	Higher education/ Health care facilities.		Any other use not specified
	Godowns/warehouses/ Storage – non-hazardous.			

	Shops, professional offices, commercial offices and establishments, banking and financial institutions.			
	Automobile workshops for Light Motor Vehicle			
	Auditorium/Wedding Halls/Community halls.			
	Residential flats / apartments, residential quarters.			
9	**PADDY/WET LAND**			
9.1	Paddy cultivation, fish farms			
	Constructions/ land developments in conformity with the Conservation of Paddy Land and Wet Land Act in force in lands designated as paddy land or wet land under the said Act.			Any other use not specified
	Pump house with maximum built-up area of **5 m^2**			
10	**WATER BODIES**			
10.1	All existing water bodies shall be conserved.			Any other use not specified
	Bridges, Side protection walls, Bathing Ghats, Floating jetty etc may be permitted based on community level requirements.			
11	**DRY CULTIVATION USE ZONE**			
	All single family residences and its incidental uses below built-up area of **300 m^2**			Any other use not specified
	Shops, professional offices, commercial offices and establishments, banking and financial institutions, restaurants, canteens – built-up area limited to **100 m^2**.			
	Agriculture, horticulture and fodder cultivation, pastures, grazing ground, and other types of cultivation including social forestry.			
	Dairy Farms, Fish farms, Seed farms, Poultry farms, piggery farms, smoke house, Plant nursery, pump house, wells and irrigation ponds, water treatment plants.			
	Any construction/land development essential for the development/improvement of open air recreational facilities only are permitted in this zone.			

12	**KAVU**			
	All existing kavu shall be conserved considering its environmental and historical significance. New constructions shall not be permitted in this zone; however, any work required to be carried out for the structural safety of temple or ancillary building to support the main use shall be permitted.			Any other use not specified
13	**SPECIAL ZONES**			
	Special use zones include the areas specifically demarcated for certain projects. No other activity unless otherwise specified should be permitted in such areas. If the project is not materialized within a period of 5 years from the date of the scheme, the area shall be deemed as part of immediate surrounding zone and constructions shall thereafter be allowed with the concurrence of the Senior Town Planner, Ernakulam.			
13. 1	**Warehouse**	Godowns/ Warehouses/ storage of non-hazardous materials.		
13. 2	**Mini Civil station**	A mini civil station, housing all State government offices in town inside a single, smart and green building complex with citizen friendly facilities		
13. 3	**Material Recovery Facility Site / SWM site**	Any construction/land development essential for the development/ improvement of solid waste treatment only are permitted in this zone.		
13. 4	**Mini-stadium**	Any construction/ land development essential for the development/		
13. 5	**Municipal park**			
13. 6	**School Playground**			
13. 7	**Local play area**			

13. 8	**Local Park**	improvement of open air recreational facilities only are permitted in this zone.		
14	In addition to the regulations of the proposed zoning, regulations as per clause 3 & 4 above, is also applicable to land to a depth of 150m on either sides of following stretches of roads except in Paddy & Weland and Water Bodies.			
	MC Road (SH 1)			
	Alappuzha - Madurai (SH 40) for the proposed 18m wide stetch.			
	Proposed Bye pass and MC Road Bye pass.			
15	In addition to the regulations of the proposed zoning, regulations as per clause 3 & 4 above, is also applicable to land to a depth of 100m on the sides of **inner ring road** except in Paddy & Weland and WaterBodies.			
16	In addition to the regulations of the proposed zoning, regulations as per clause 3 & 4 above, is also applicable to land to a depth of 75m on either sides of roads with existing and proposed width of 12m or more and also for the following stretches of roads except in Paddy & Weland, Kavu and Water Bodies.			
	Outer ring road			
	Koothattukulam - Ramapuram Road			
	Koothattukulam - Uzhavoor Road			
	Koothattukulam - Mutholapuram Road			
	Koothattukulam - Edayar - Piravom Road			
	Koothattukulam -Oliyappuram Road			
	North South Corridor 1 inside municipal limit			

26.2 GENERAL GUIDELINES

1. The general guidelines shall apply to all zones irrespective of the zoning regulations for individual zones.
2. 'Built- up area' means the total area covered by the building at all floor levels. It shall also include area of mezzanine floor, galleries, barsati and pent house at terrace level.
3. Zoning Regulations will prevail over the provisions in Kerala Municipality Building Rules in force.
4. Kerala Conservation of Paddy Land and Wetland Act and Costal Regulation Zone Notification will prevail over all the provisions in this Master plan.
5. Subject to the Zoning Regulation of the respective zones, more than one uses may be combined in a building, provided that the total built-up area on all floors of such a building shall not exceed the maximum built-up area permitted for any of such use in that zone. Also the built-up area of the individual uses shall be limited to that prescribed by the Zoning Regulation for the zone.
6. Silence Zone, as prescribed by the Noise Pollution (Regulation and Control) Rules, 2000 under the Environment (Protection) Act, 1986and its subsequent amendments, shall be applicable to the area under this scheme.
7. If a plot under a survey number/ numbers falls in two different use zones, zoning regulation of major portion of land use will be applicable for the whole plot.
8. LSGI should initiate necessary steps and should get hold of the areas specially demarcated for certain projects and Special zones (Warehouse, Mini Civil station, Material Recovery Facility Site/ SWM site, Solid Waste Treatment Area, Market, Mini-stadium, Parks & Playground, Municipal park, Local play area, Local Park) within a period of 5 years from the sanctioning of the plan. If the proceedings has not been initiated within this stipulated period, freezed land may be released and returned back to the possession of the original holder and it can be included in the adjacent suitable land use with concurrence of District Town Planner.
9. In case of road widening within the Town centre zone, appropriate incentives in the form of tradable FAR shall be permissible to land/property owners affected. TDR rights shall be given to the private owner who foregoes land for the public use, where it is applicable only for residential and commercial type of buildings. Other formalities of the

TDR (maximum FAR with the TDR, validity of TDR, methods of keeping records to keep generating TDR & utilized TDR etc) is to be detailed out before its implementation.

10. Irrespective of zoning regulations, 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 can be implemented anywhere in the planning area except at special zones.

11. Future expansion of existing public and semi-public institutions to adjacent plots shall be considered as uses permitted in all zones subject to restrictions imposed under other acts and rules.

12. Transmission Towers, Telecommunication Towers and Wireless Stations are permitted in all the zones except water bodies and paddy wetland areas.

13. No person shall construct any building within 2m from any plot boundary abutting natural/manmade drains having minimum width of 2m to 5m and 3m from drains and canals having width more than 5m. In case of existing authorised buildings in these protected areas, only repair/reconstruction of the existing building limiting to the existing area or existing FSI is permissible and the construction outside the protected areas are shall be guided as per the zoning regulations in the specific zone.

14. For all proposed roads in Master Plan, a construction free area shall be provided at every intersection. Minimum visibility distances to be provided at intersections and no constructions shall be carried out within the visibility triangle. This distance shall be measured from the edge line of the road and for this purpose, the proposed width of road shall be considered as the width of the road and minimum visibility distances to be provided as per KMBR.

(Detailed alignment plans, which shows building lines and visibility triangles for roads, which will be sanctioned according to the proposals in this plan, will prevail over this provisions).

15. GENERAL GUIDELINES FOR LARGE SCALE PROJECTS

Large Scale development proposals in an area not less than 2 hectares, exceeding an investment of Rs.50 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

Special Zones and Dry Cultivation Use Zone, subject to the recommendation of a committee to be constituted by the Government for this purpose, under the Chairmanship of the Secretary, Local Self Government Department, consisting of Chief Town Planner concerned of Kerala State Local Self Government Planning Wing and the Secretary of the LSGI concerned as members and the District Town Planner as convenor and satisfying the following conditions

a. The developer shall produce project cum feasibility report and environmental impact assessment report, if required, of the project to the convener of the committee, 15 days in advance of the committee meeting.
b. The developer shall produce before the committee, all required clearances from the State and Central Government agencies concerned.
c. Adequate provision shall be made for supporting infrastructure such as water supply, Sewerage, Solid Waste Management etc. Separate sewage treatment plant and solid waste management measures shall be provided and maintained by the developer at his /her cost.
d. Adequate Memorandum of Understanding between the developer and Secretary of Local body concerned shall be undertaken to bring this into effect.
e. Minimum access width shall be 12 meter.
f. The project shall be completed within a period of 3 years if not specified otherwise.

ANNEXURE 1

LIST OF NON-OBNOXIOUS AND NON-NUISANCE TYPE OF INDUSTRIES

Type of non-obnoxious and non-nuisance type of service or Light industries permissible in Residential Use Zones.

1. Production of copra
2. Processing of arecanut
3. Rice and Flour Mills.
4. Production of rice, flour etc., by hand pounding.
5. Processing of Cardamom, ginger, pepper etc.
6. Production of Khandasari from sugar-cane
7. Carrying and preservation of fruits and production of jam, jelly etc.
8. Processing of and preservation of cashew nuts.
9. Bakeries and Confectioneries
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), Pappad.
15. Production of vinegar.
16. Manufacture of soda water, lemonade, other aerated waters, mineral water, fruit beverages etc.
17. Chilling plants and cold storage
18. Manufacture of Ice and 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. Cotton ginning, clearing, pressing etc.
24. Cotton spinning other than in Mills
25. Cotton spinning and weaving in Mills.
26. Cotton weaving in handloom.
27. Cotton weaving in power looms.
28. Handloom weaving.
29. Khadi Weaving in Handloom.
30. Printing of cotton textiles.
31. Manufacture of Cotton thread, rope twine etc.
32. Jute spinning.
33. Manufacture of jute products including repairing of gunny bags.
34. Weaving of silk by Handloom.
35. Manufacture of hosiery goods.

36. Making of embroidery products and Lace manufacturing
37. Tailoring
38. Block making for printing
39. Gold and silver thread saree work
40. Manufacture of quilts and mattresses.
41. manufacture of Foam bed, latex thread
42. Carpet weaving
43. Manufacture of Coir and Coir Products.
44. Manufacture and assembling of umbrellas and production of spare parts of umbrellas.
45. Repairing of umbrellas.
46. Manufacture of wooden furniture and fixtures.
47. Manufacture of structural wooden goods such as doors, beams etc.
48. Manufacture of wooden industrial goods such as parts of handloom ambarcharka, bobbirs etc.
49. Manufacture of wooden utensils, choto frames, toys, etc., photo and picture framing.
50. Bamboo and cane products including baskets, weaving etc. (only dry operations)
51. Manufacture of miscellaneous wooden articles such as sticks, sandals, rules etc.
52. Manufacture of paperboard.
53. Making of paper boxes, bags, envelopes etc.
54. Card board or corrugated box and paper products (paper or pulp manufacturing excluded)
55. Printing and publishing of newspapers and periodicals.
56. Printing and publishing of books.
57. Miscellaneous printing works including type cutting, book binding.
58. Manufacture and repairing of leather shoes and chappals.
59. Manufacture of leather products such as suitcase, bag etc.
60. Vulcanizing and repairing of tyres and tubes.
61. Manufacture of rubber gloves.
62. Manufacture of Rubber products such as rubber sheets, nipples and rubber shoes including smoke-rubber.
63. Manufacture of pharmaceuticals, Ayruvedic medicine etc.
64. Manufacture of agarbathi and other cosmetics.
65. Manufacture of plastic products such as nameplates etc.
66. Manufacture of lemongrass oil, candles etc.
67. Manufacture of cement products such as well-keros, tube, closets etc.
68. Manufacture of structural stone goods, stone crushing, stone carving, stone dressing, marble carving etc.
69. Manufacture of stone wares.
70. Manufacture of stone images.
71. Manufacture of chinaware's and crockery.
72. Manufacture of large containers and chinaware.

73. Manufacture of glass and glass products.
74. Manufacture of clay models
75. Light engineering works
76. Manufacture of iron and steel furniture.
77. Manufacture and repairing of brass and bell metal products.
78. Manufacture of aluminum utensils and other products.
79. Manufacture of tin cars and copper vessels.
80. Electroplating, tinplating, welding etc.
81. Gold and silver smithy and Manufacture of Jewellery.
82. Manufacture of agricultural implements, screws etc. (blacksmith and foundry)
83. Manufacturing assembling and repairing of machinery such as water pumps, oil mill chuck etc.
84. Manufacture of small machine tools and machine parts.
85. Manufacture of sewing machine parts and assembling and repairing of sewing machine.
86. Manufacture of electrical machinery and repairing of electric motors armature winding etc.
87. Manufacture and repairing of electric fans.
88. Charging and repairing of batteries.
89. Manufacturing of formulated synthetic detergent products
90. Repairing of radios, microphones etc.
91. Manufacture of electric meters, production of electric and allied products, repairing and servicing of electrical appliances.
92. Bodybuilding of motor vehicles.
93. Manufacture and repairing of motor engine parts and accessories.
94. Servicing and repairing of motor vehicle.
95. Manufacture Assembly and repairing of bicycles, baby carriage and other small non motorized vehicles parts and accessories.
96. Repairing of photographic equipments, spectacles etc.
97. Repairing of watches and clocks.
98. Manufacture, repair and tuning of musical instruments.
99. Manufacture of sports goods, balloons etc.
100. Miscellaneous industries.

(Note: In addition to the above, industries categorized as 'White' and 'green' by Kerala State Pollution Control Board are also to be treated as non-obnoxious and non-nuisance type of industries)

ANNEXURE 2

LIST OF OBNOXIOUS OR NUISANCE INDUSTRIES

List of obnoxious or nuisance industries subject to objectionable odours, fumes effluents or processes (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

2. Production of distilled spirits, wines, liquor etc from alcoholic fruits and Malts in distillery and brewery
3. Production of country liquor and indigenous liquor such as toddy, liquor from Mahua, palm juice

III. Manufacture of textiles

4. Dyeing and bleaching of cotton

IV. Manufacturing of wood & wooden products

5. Sawing and planning of wood and creosoting
6. Wood seasoning
7. Manufacture of veneer & plywood
8. Paper, pulp and straw board

V. Manufacture of leather & leather products

9. Currying, tanning and finishing of hides and skins and preparation of finished leather.

VI. Manufacture of Rubber petroleum & local products

10. Manufacture of tyres and tubes and tyre re-trading
11. Manufacture of industrial and synthetic rubber
12. Reclamation of rubber
13. Production of petroleum, kerosene and other petrol products in refineries

VII. Manufacture of chemical and chemical products

14. Manufacture of basic industrial chemicals such as acids, alkalies and their salts, not elsewhere specified (specially sulphurious, sulphuric, nitric, hydrochloric etc aids, ammonia chlorine and beaching powder manufacture.)
15. Manufacture of dyes, paints, colours, ink powder, varnishes, printing ink etc
16. Manufacture of fertilizers (specially from organic materials)
17. Manufacture of disinfectants and insecticides
18. Manufacture of Ammunition, explosives and fire works
19. Manufacture of matches

VIII. Manufacture of Non-metallic mineral products other than Petroleum and coal

20. Manufacture of cement and cement products
21. Manufacture of lime
22. Manufacture of plaster of Paris

IX. Manufacture of Basic Metals and their products

23. Manufacture of iron and steel including sheeting, refining, rolling and conversion into basic forms
24. Manufacture including smelting, refining etc of non-ferrous metals and alloys in basic forms
25. Manufacture of ornaments

X. Manufacture of machinery (other than transport) and electrical equipment

26. Manufacture of all kinds of battery

XI. Miscellaneous items not covered above

27. Incineration, dumping and reduction of offal, dead animals, garbage or refuse
28. Manufacture of gelatin and glue
29. Fat, tallow, grease or lard refining or manufacture
30. Bone meal, bone grist and bone powder
31. Manufacture of cashew nut shell oil and
32. Other similar types of nuisance industries

(Note: In addition to the above, industries categorized as 'Red' by Kerala State Pollution Control Board are also to be treated as obnoxious and nuisance industries)



















LOCAL SELF GOVERNMENT PLANNING
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