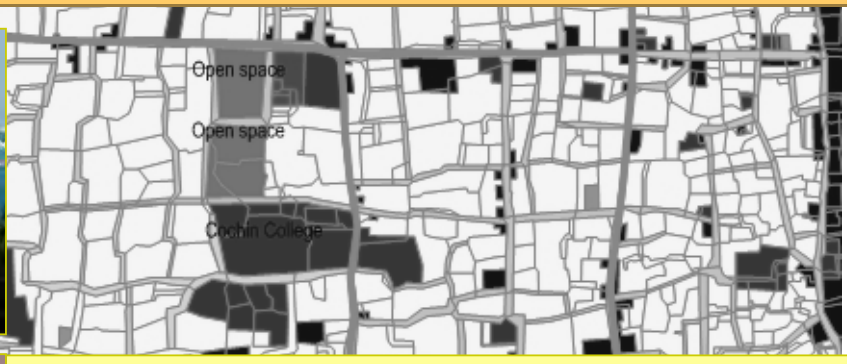
DEVELOPMENT PLAN FOR

KOCHI CITY REGION 2031

(Draft)

VOLUME I

STUDY & ANALYSIS



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PREFACE

Kochi is the most promising growth oriented development region in the state of Kerala. Developments in the city and surrounding area have taken a fast stride in the last two decades. The Information Technology Institutions at Kakkanad, the International Airport at Nedumbassery, the new bridge linking Vypeen islands to the main land and the high impact residential and commercial developments in the city and the surrounding areas have caused direct and indirect development impacts in many sectors. These are exerting tremendous stress on the infrastructure components. The most apparent issues in Kochi City are the increasing traffic congestion and the degradation of urban environment.

It is in this context that the Structure Plan for the central city of Kochi approved by Government in the year 1991 and the subsequent variations are reviewed. The zoning regulations of the Structure Plan were revised in the year 2007. Inspite of these, it is seen that all these attempts do not ensure satisfactory planned development in the city of Kochi and the immediate influence area around. Anticipating the future development needs and the population growth, it is envisaged that a revised Development Plan for Kochi city Region has to be prepared, published and got approved by Government. This Development Plan is expected to guide the constituent local governments within the city Region in their respective development actions and also guide them to formulate their individual development policies so as to be part of the whole.

This Development Plan is prepared in 3 volumes - Planning studies and analysis, Development concept and Development strategies and Development Proposals and Development Control Regulations.

It is hoped that the Development Plan would serve to realise the Development Concepts envisaged in volume 2. Development Plan is not just a Government document. It is a Plan of the various Government departments, Semi-government agencies, local governments and the public at large, without whose participation and involvement, the Development Plan for Kochi City Region cannot be translated as implementable and enforceable. The proposals in the Plan are not just confined to the planning area but to areas beyond the City Region.

Implementation of the Development Plan proposals require understanding of the various proposals, translating them into programmes and projects and implementing them in a phased

manner. The Development Plan needs to be reckoned as a Living Document by reading and understanding it, reviewing it, translating it into action programmes and revising the document in part or in full, as and when necessary without disregard to the general development strategies adopted.

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CHAPTER 1

INTRODUCTION

1.1 Why this Plan?

The Urban Agglomeration of Kochi, comprising of the city of Kochi and the surrounding areas, is the fast developing region in the State. It is necessary to guide these developments in an orderly manner based on a Plan Document, so that sustainable development is possible and land development and infrastructure development in a planned manner may support new economic activities and facilitate public and private actions for better housing and amenities. Moreover conservation and equity have to be considered.

Kochi city and the surrounding areas do not have a recently prepared Master Plan. When a major intervention by the Ministry of Urban Development, Government of India happened in 2005 with the scheme for urban reforms backed infrastructure development, the Municipal Corporation of Kochi City prepared a City Development Plan (CDP) to be used as a basic document to prioritise the infrastructure developments in the city region. However, certain basic issues like land use planning etc. were not part of this document since the intention was different. CDP has been an input for this Master Plan, like the earlier Structure Plan for the Central City, Kochi – 2001 which was used as a reference document for preparation of CDP. The attempt through this Development Plan for Kochi City Region is to bring out a comprehensive long range development guideline with Development Regulations to guide the City Region through the plan period.

1.2 What the Plan aims at?

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

Kochi urban area is the most economically active region in the State. This urban region significantly contributes to the economy of the State. City level activities, residential, commercial and industrial, overspill to the outskirts often causing unplanned urban sprawl. The increasing population and its resultant impacts on the land cause concerns related to land use,

environment and economy. This Development Plan aims at planned development of the city and its surrounding region, promoting improvements and augmentation of infrastructure, compatible land utilization, judicious use of the natural resources and conservation of natural and manmade heritage. The Plan would strive to provide framework to guide the development of the City Region and would act as a development guideline for the City Corporation, Municipalities and the Grama Panchayats included in the planning area, as a broad framework for further actions of the various Government Departments and semi government agencies and also as a guiding document for the citizens. Therefore the scope of this Development Plan does not limit itself to being just a Government Document, but is intended to act as a living document which is consulted by everyone interested in living, working, and investing in Kochi Region and by those who are responsible for governing and managing the urban region.

1.3 How will this Development Plan be implemented?

This Development Plan for Kochi City Region forms the basic guideline document for planned development of the area and it is comprehensive in the sense that it tries to comprehend the issues in various sectors/subjects. Implementation of proposals included in this Development Plan would depend on the understanding of the proposals and translation of the proposals in various sectors to action programs by the Government Departments, Quasi-Government agencies and the private sector, who are concerned with development actions in the Kochi City Region. Priorities and phasing of the various proposals are made part of this Plan, but these would be further improved based on the sectoral action programs. Such action programs may lead to Project Reports, whether by a Government Agency or by a private agency/individual. Guiding development through Development Control Regulations is also part of the implementation of the Development Plan. Such guidance provides individual safety and welfare without adversely affecting their freedom of action.

As per the Kerala Municipality Act 1994, the Kochi City Corporation and the other Urban Local Bodies (ULBs) and the Panchayats shall have the responsibility to process this Plan and coordinate actions envisaged in the Plan with the various public and private involvements and initiatives in development actions. Greater Cochin Development Authority (GCDA) constituted under the Town Planning Act, is expected to provide the required technical expertise to these organizations in understanding and interpretation of the Development Plan and also in the translation of the Plan into action plans.

1.4 Statutory validity

The Development Plan for Kochi City Region is prepared under the provisions of the Town Planning Act. When this receives approval of the Government after observing the statutory formalities as per the Town Planning Act, this Development Plan becomes a statutory

document, which would be legally binding on all the Government, local Government, autonomous, semi-government and private agencies and all the individuals.

1.5 Fate of existing Plans

Once this Development Plan comes into effect after approval by the State Government, the earlier Structure Plan or any other General Town Planning Scheme in force on this area shall automatically be considered as repealed. This Development Plan on approval makes it mandatory for the ULBs, GCDA and the Department of Town and Country Planning to initiate actions for repeal/revision of the Detailed Town Planning Schemes (DTP Schemes) which are now in force, on the lines of the proposals in this Development Plan. Though the earlier DTP Schemes may continue to be consulted, the responsible agencies may have to review and revise these DTP schemes to bring them within the framework of the Development Plan.

1.6 Revision

This Development Plan for Kochi City Region is considered to be conceived as a static plan to guide the growth and development in the city and the surrounding region through the plan period up to 2031. The Plan shall be subjected to periodical review, and revision, if required, in parts or in full. However, such revisions, when carried out, shall follow the provisions of the Town Planning Act in force. The suggested format is:

- Review every five years by the responsible agencies, preferably drawing expertise advises
- Revision, in part or in full, if required, to be followed by the five year review
- Comprehensive review with public consultation in 2021 and subsequent revision, if required

1.7 Validity after 2031

The Plan is prepared with a horizon period in mind. The proposals are projected considering this plan period of 2011-2031. However, the statutory approval accorded by the State Government for this Plan shall continue to be in force until the Plan is repealed, in part or in full, or till a revised Plan comes into effect.

CHAPTER 2

AIM, OBJECTIVES, SCOPE AND LIMITATION

2.1 AIM

The aim of the study is to improve the livability of the city exploiting the diverse potentials and project Kochi as a Global City with a preferred destination for IT, Tourism, Health care, Heritage and port based services.

2.2 OBJECTIVES

1. Identify suitable planning area for the purposes of the plan and assess the growth pattern of the city and the surrounding region
2. Assess the traffic and transportation characteristics, along with modal split, of the region in general and the planning area in particular.
3. Assess the physiography, nature and trend of development and the characteristics of existing land use
4. Assess the impact of development actions on the spatial structure, focusing on inclusive growth, conservation of urban heritage and natural assets for a better environment.
5. Assess the infrastructure requirements and identify suitable measures to provide for infrastructure development.
6. Identify the gaps in implementation of previous planning efforts for Kochi and suggest suitable measures for filling the gaps

2.3 SCOPE

- The Development Plan for Kochi City Region covers a planning area, identified from a wider region, comprising of Kochi City, two Municipalities and fourteen Panchayats. This Plan is intended to be a living document incorporating suitable modifications in tune with the variation in the development trend based on frequent reviews and subsequent revisions.

- Land use surveys were carried out by the State Department of Town and Country Planning as part of preparation of Development Plan for Kochi City Region. However, studies conducted by expert agencies on various subjects such as Traffic and Transportation (NATPAC and RITES), Environment (CED) etc were referred for this study for arriving at inferences and formulating proposals.

- Kochi City Region is experiencing fast developments and may rise to the Status of a Metropolitan City in the plan period, which may necessitate review of the Development Plan incorporating the Metropolitan region, if required.

- The Plan proposes that the City Region shall be comprised of many Planning Divisions with Land Use/ Zoning Regulations suited to the different Planning Divisions.

- A Communication strategy is intended to be brought out as part of the Plan to enable timely identification and implementation of projects.

- The Development Plan for Kochi City Region is meant to be a Plan for guiding developments, rather than being used/ interpreted only as a 'Regulation Plan'. This Development Plan is not an 'immediate problem solving plan' but contains measures to be translated for implementation in a phased manner (short term, medium term and long term) which may mitigate the problems, even when promoting development.

2.4 LIMITATIONS

- The Development Plan is finalised at a time when population count is taking place under the Census. Census 2011 may be available only after one year of this Plan preparation. The secondary data available as per 2001 Census is used for the purposes of this Plan.

- The State is now in the process of 'delimitation' exercise, before the oncoming Local Government elections of 2010, by which the local government (Municipal and Panchayat) boundaries may be reconstituted. Changes in the boundaries of the city of Kochi and that of the Municipalities and Grama Panchayats within the Planning Area are likely to occur. These changes are not considered for the purposes of this Plan.

- This Plan provides for strategies only to address the issues of housing sector, environment, and physical infrastructure like Water Supply, Sewerage and Solid Waste Management. Detailed studies under each of the above development sectors may be carried out and separate proposals in detail may be prepared further to translate the strategies to projects.

- Four urbanizing panchayats in the periphery of Kochi City, which were included in the Structure Plan for Central City, Kochi are now under the jurisdiction of GOSREE ISLAND DEVELOPMENT AUTHORITY (GIDA). This Plan provides for broad proposals for this area; and detailed land use proposals for these panchayats are to be evolved by GIDA, within the broad concept and policy of this Development Plan, while preparing Development Plan for GIDA area.

- The other major constraint is ‘uncertainties’. Kochi is a fast changing / growing urban region, perhaps the fastest growing city region in Kerala. There could be many changes that could occur which cannot be comprehended or anticipated now. One such major change may be related to technological changes due to innovations /developments. Other uncertainties could be related to major impact making investments that may happen within the planning area and in the immediate region around. Such investments may have an impact on the developments in the City Region. Such uncertainties are not and cannot be comprehended in the preparation of this Development Plan. However such events, when they do happen, can be subjected to study for the review and revision of the Development Plan for Kochi City Region, as and when necessary.

All studies and surveys conducted as part of this plan do not pertain to the same base period. Detailed study on traffic and transportation done for the Panchayats included in the planning area pertain to 2001. The existing land use map for the Corporation area was prepared by the Corporation of Kochi during 2004-05; and that for the municipalities and panchayats other than Vadavukode puthen kurisu were prepared by the Department of Town and Country planning during 2006-07. it was later decided to include Vadavukode puthen kurisu also in the planning area; and the survey was conducted during 2007-08. No proper verification of the existing land use survey thus conducted was done which is a major limitation of this exercise.

CHAPTER 3

PLANNING PROCESS

3.1 LEGAL TOOLS

Town Planning Schemes are prepared in Kerala under the provisions of the Town Planning Acts. Since the State of Kerala does not have a unified single Act for the purpose, the existing Town Planning Act, 1108 M.E. (Malayalam Era) (1933 A.D.), Travancore Town and Country Planning Act, 1120 M.E. (1945 A.D.) or the Madras Town Planning Act, 1920 are consulted as applicable to the different areas of the State. These Acts have comparable provisions with regard to contents and processing of a town planning scheme. These Acts envisage preparation of two levels of Plans (i) General Town Planning Scheme and (ii) Detailed Town Planning Scheme. The General Town Planning Scheme is referred to as the Master Plan or Development Plan. This is prepared as an indicative plan for the development of a whole town/city, and the immediate surrounding areas (recognized as the planning region/area) or for the Urban Agglomeration area. The Detailed Town Planning Scheme (D.T.P.Scheme) is a Plan in much detail (considering individual land parcels) on a cadastral survey map and is prepared for a priority development area within a Development Plan area or for such an area not included in a Development Plan. Such a detailed Plan is generally prepared for an area of about 50 to 150 hectares of land. The method of plan preparation, processing for notification & publishing, public consultation, submission to Government for sanction (approval) and granting of Government approval are as laid down in these Acts and Rules made there under.

3.2 CONTENTS OF THE DEVELOPMENT PLAN

The necessary contents of a General Town Planning Scheme (Development Plan) are stated in the Town Planning Act in force.

3.3 PLANNING PROCESS

The planning process shall preferably observe the following steps

STEP 1:

- **Overall study** (city profile) of Kochi city and surrounding areas together with the Regional Context
- Population studies
- Study of previous planning and development efforts
- Major ongoing projects and projects on the anvil
- Study of related national and State level Policies having impact in the development of Kochi

STEP 2:

- Delineation of the **Planning Area** based on definite criteria
- Identification of Development Potentials

STEP 3:

- Consultation with Experts in various fields
- Evolving **Development Concept and Development Strategies** based on generation and evaluation of alternatives
- Validation of Development Concepts and Development Strategies

STEP 4:

- **Detailed Studies** based on primary and secondary data
  - (i) Population related studies with spatial context
  - (ii) Land related studies – land use, extent of land, locations of various uses etc.
  - (iii) Traffic and Transportation Studies - relating the traffic to land use
  - (iv) Economic Base and major economic activities – with spatial context
  - (v) Infrastructure Studies – existing situations, bench marking with desirable standards etc.
  - (vi) Environmental Quality
  - (vii) Special features – conservation areas, water bodies (including canals), disaster prone areas

STEP 5:

- Originating Development Plan Proposals - Preparation of **Draft Development Plan**
  - (i) Estimation of land requirements for various major uses based on the Development Concept and Strategies
  - (ii) Relating land use proposals with transportation network
  - (iii) Preparation of Future Land Use - Transportation Plan
  - (iv) Proposing broad Infrastructure Development Plans
  - (v) Preparation of Special Subject Area Plans
  - (vi) Drafting Development Plan

STEP 6:

- Preparation of Zoning Regulations (Development Control Regulations)
- Preparation of Phasing Plan
- Indicative Implementation Strategy

STEP 7:

- Consultation with Stakeholders (Local Self Governments within the Planning Area, GCDA and Experts and other Stakeholders)
- Improvements to the Draft Development Plan
- Publication of the Draft Development Plan and keeping open the Plan document for public consultations
- Finalisation of the Draft Plan and forwarding the Final Draft through the Chief Town Planner, Department of Town and Country Planning to Government (Local Self Government Department) for approval
- Government Approval of the Development Plan for Kochi City Region after observing statutory formalities
- Notification of the fact of Government Approval and coming into force of the Plan

CHAPTER 4
HISTORY AND EVOLUTION OF KOCHI

4.7 HISTORY AND EVOLUTION OF KOCHI

The development of Kochi as a prime city of Kerala is closely linked with the political and administrative history of the Malabar Coast. Kerala was an important maritime country in the dawn of the Christian era. Its early rulers had their capital at Tiruvanchikulam located about 18 km north of Kochi. The ancient port of Muziris (now Kodungallur on the southern part of Thrissur district) served as an international centre of trade and the main emporium of transit of goods between China and Rome. The trade links attracted settlers to Muziris from many maritime commercial nations of ancient world.

The erstwhile rulers of Kochi established their headquarters at Thripunithura, the present neighbouring town of Kochi, most probably since the present Ernakulam was a waterlogged area then. Cochin Port was formed in 1341, when the heavy floods of that year silted up the mouths of the Muziris harbour and the surging water forced a channel past the present inlet into the sea. The old merchants of Muziris shifted to Kochi as soon as the new outlet became more or less stable. As the harbour gained prominence, the then ruler of the region shifted his capital also to Kochi, giving impetus to the growth of the town.

The early settlement of Kochi was at Mattancherry, facing the protected lagoons in the east, which provided safe anchorage to country crafts in all seasons. Mattancherry was linked to the entire coastal stretch of Kerala through these inland waters. Thus gradually it grew into a busy settlement. Nicolo Conti recorded that, by 1440, Kochi was a city 5 miles in circumference and that Chinese and Arabs carried on brisk trade with the natives of this town.

4.8 MATTANCHERRY MARKET TOWN

Mattancherry, meanwhile, had developed as a typical oriental market town, with commercial activities distributed along the waterfronts. Agricultural produces from the vast hinterland flowed to its markets to be sold or exchanged for textiles, metals and other products of the European countries. Jews and Muslims had their settlements at Mattancherry. Trading communities from Gujarat and the emigrants from Goa also established trading centres in Mattancherry along with the native Hindus and the early settlers. The then rulers found this an opportunity to strike balance of economic power with the European traders. Mattancherry grew into a market town with cosmopolitan character attracting foreign traders. However developments in the adjoining Fort Kochi were strengthened by the foreign traders.

4.9 DEVELOPMENT OF FORT KOCHI

From the 16th century, Kochi witnessed rapid changes through the trading and colonizing attempts of European powers. Portuguese were the first to arrive at Kochi. They founded Fort Kochi, established factories and warehouses, schools and hospitals and extended their domain in the political and religious fronts. The fall of the Portuguese in Kochi came with takeover of the Fort by the Dutch in 1663. The Dutch East India Company tried to persuade the local rulers into giving them monopoly in pepper trade. In this attempt they came across varied interests of the English and the French. For the next hundred years, Kochi became the centre of political and commercial battles. In 1795 the British took over Kochi from the Dutch. Fort Kochi thus became British Kochi. It became a Municipality in 1866.

4.10 DEVELOPMENT OF ERNAKULAM

By 1840, Mattancherry was so much crowded that the activities spread to the eastern side of the backwaters to the Ernakulam side. Public buildings and educational institutions were setup in Ernakulam befitting the splendor of the Maharajas. Roads were laid out, markets were established and temples were renovated. Regional connectivity was improved with the commissioning of the railways in 1905. Ernakulam thus gradually started developing as an administrative town. Mattancherry rose to the status of Municipality in 1912 and was followed by Ernakulam in 1913. However it was to a large extent the Port that catapulted the importance of Kochi.

4.11 DEVELOPMENT OF COCHIN PORT

In the early nineties the existence of a sand bar in the sea mouth prevented large ships from entering safely into the backwaters of Kochi. Western industrialisation brought in revolutions in overseas trade with the wrought iron ships of greater draught and the consequent need for deeper and safer harbours and stronger moorings. The opening of Suez Canal in 1869 further emphasized the importance of the Port at Kochi as a coaling station for this route. The idea of making it a great harbour, out of the unique lagoons in Kochi was mooted as early as in 1870. Though Kochi had proposed for a dredged channel leading to the inland harbour, due to the non-availability of adequate technology for dredging at that time, it was only in 1920 that the port works were initiated. Under the direction of Sir Robert Bristow, the sand bar at sea mouth was cut open and a deep shipping channel was dredged to the backwaters. The spoils of the dredging were used to reclaim Wellington Island from the backwaters. Road and rail connectivity to the west Kochi and the island from the main land on the east were completed in 1940 when Government of India declared Kochi as a Major Port. Wellington Island developed with its wharfs, quays and other infrastructure as a transport terminal complex.

Cochin port gradually became the focus of the city. Centered on the port facility grew a large number of business and commercial establishments providing the economic base to the city and the environs. The development of the port also coincided with the commissioning of the Pallivasal Hydro Electric Project supplying ample power, heralding a new era of industrial growth in the region. In this wake a number of major propulsive industries were established in the region.

4.6 GENESIS OF KOCHI CORPORATION

The industrialization in turn resulted in population increase and consequent urban growth. Kochi thus witnessed unprecedented trend of urbanization during the past four decades. The growth of population and activities necessitated efforts to tackle urban problems, to regulate city building and to guide future development. Though the Municipal Governments of Fort Kochi, Mattancherry and Ernakulam were able to exercise their powers and evolve schemes in their respective areas of jurisdiction, they were not in a position to perceive the problems of urban growth as a whole and to plan for it. In order to streamline the municipal administration, the Kochi Municipal Corporation was formed in 1967, incorporating the three municipalities (Fort Kochi, Mattancherry and Ernakulam), Wellington Island and a few surrounding areas in the suburbs.

The 74th Constitution Amendment and the resultant new enactment of Kerala Municipality Act in 1994 grossly changed the role, powers and functions of the Kochi Municipal Corporation (*and the other ULBs as well*) from being just an Urban Local Body to that of Local Government. Adequate provisions built into the Act for public participation, participatory planning and development, transparency and public disclosure and mandatory ward level community participation etc. brought in a sea change in the functioning of Kochi Municipal Corporation.

CHAPTER 5

REGIONAL AND DISTRICT LEVEL STUDIES

5.1 LOCATION AND REGIONAL SETTING

The city of Kochi is located by the Lakshadweep Sea in Ernakulam district and is the commercial and industrial hub of Kerala. Geographically Ernakulam district is situated between Northern Latitude 9^0 47'and 10^0 17' and Eastern longitude 76^0 9' and 76^0 47'. It is bounded by Thrissur district on the north and Alappuzha and Kottayam on the south, Idukki on the east and Lakshadweep Sea on the West.

The importance of Kochi in the region is evident from its population size and growth. Kochi Urban Agglomeration (UA) is the most economically forward looking growth region in the state. This can be inferred from maps 5.2, 5.3 and 5.4.

Map 5.2

Map 5.3

Map 5.4

Three major national highways connect Kochi with other parts of the country. NH 17 from Kochi to Mangalore**,** connects Kochi with Mumbai via most of the major towns in the Malabar area, the west Karnataka port town of Mangalore and the State of Goa. The **NH 47** from Kanyakumari to Salem connects Thiruvananthapuram with Kochi and continues to connect to Coimbatore and Salem in Tamil Nadu via Palakkad and Thrissur. **NH 49** connects Kochi with Rameswaram in Tamil Nadu and passes through Madurai via the hill resort of Munnar. Kochi is well connected to other parts of state through various state highways.

Cochin International Airport at Nedumbassery (near Angamali town), 28 km from the city, is the largest airport in Kerala in terms of passengers and number of flights. The airport is well connected by many international & national carriers that operate regular flights to the Middle East and elsewhere in Asia. Many direct chartered services from Europe and the US reach Kochi during tourist seasons. Domestically the airport is well connected to the other main cities in India.

Kochi is well connected to major urban centres in the state as well as to other places through major railway lines namely Thiruvananthapuram – Palakkad railway line via Kottayam and Thiruvananthapuram – Kozhikode. Kochi has a good network of inland waterway system consisting of backwaters, canals and lagoons. National waterway No. 3 connecting Kollam and Kottappuram pass through the region.

5.2 PHYSICAL FEATURES

(i) Topography

Being a coastal district majority of the Kochi region is within the low land regions of the state. The average altitude towards the eastern fringes is about 7.5 m above MSL, and towards the west the altitude is less than one metre on an average. The whole of the land slopes gradually from east to west. The flat terrain of the central city with the low altitude interspersed with a network of canal system provide link to the backwaters. The main canals are navigable for small and medium crafts. The secondary canals used to serve as natural drainage canals in the city for flood waters, but today they are in an advanced stage of deterioration through silting and waste dumping and fail to serve their purpose. The effects of inadequate drainage become visible and real with flooding and water logging of low lying areas during rainy season.

The terrain features have adverse influence on the sewerage and drainage system of the area. Percolation of effluent from septic tank and dispersion trenches pollute the ground water. Commercial wastes are mostly directed to open surface drains. To ensure ruling gradient the drains have to be deepened often below the sea level and the sewage has to be regularly pumped to its outfall regions for disposal. The outfall regions are again the back waters. The

back waters further take the load of effluents from the industry, most of which are located in the water fronts and river side. The continued effects of all these factors result in the abuse of water courses, environmental deterioration and public health hazards.

(ii) Soil type

The soil of the planning region can be broadly classified into two categories viz. alluvial and lateritic. The lateritic soil covers the eastern portion of the area. The soil is porous and well drained and hence suited for all garden works. On removal of the top soil, laterite is present as a homogeneous mass which can be cut as building blocks. The alluvial soil is the characteristic type seen over the remaining part of the city. It has been formed from the deposition and consolidation of river discharge laden with fine silt and clay. Soil exploration has revealed that this deposit is present even to a depth of about 50 metre from the sea level. This fact presents the unique foundation engineering problems of this area.

(iii) Climate, Rainfall and Water Bodies

The annual variation of temperature in the Kochi region is between 22^0 C and 32^0 C and a more or less uniform temperature exists throughout the year. Because of the nearness to the sea and due to the large area of backwaters in the region, the humidity is high all round the year. Kochi has a tropical climate with intense solar radiation and abundant precipitation.

Kochi region experiences only two major seasons, namely the dry season and the wet season, as in all other places in Kerala. The wet season is usually associated with the months in which the south-west and north-east monsoon occur. The north-east monsoon commences in October and continues till November. The rain fall varies from 1500 mm to 2000 mm during south west monsoon and 400 to 700 mm during the north-east monsoon. The maximum annual rainfall in the region is around 3000 mm. Heavy showers during the monsoons over the whole of the state, sustains a system of rivers and estuaries originating from the Western Ghats. These rivers transport the sediments from high lands and mid lands to the plains and discharge them into Arabian Sea. The interaction between the river discharge and the tidal forces has helped the sediment deposition, there by directly influencing the creation of lagoon system and land forms of Kochi.

The characteristic physical feature of Kochi is the expanse of backwaters and low lying wet lands. The backwaters of Kochi form part of the Vembanad water basin of the Central Kerala. This, together with a number of canals provides the cheapest means of transportation, especially for bulk goods to and from the city. However due to misuse these canals are not adequately used as waterways for transport. These water bodies are often made to contribute to environmental degradation due to waste dumping and other misuses.

The backwaters are rich in their marine foods and hence form the means of livelihood for a large portion of the population. Further, it presents great potential for recreation. The wet

lands are formed by the gradual leaching of dry land into the flood basins of the watercourse, canals and estuaries. They remain covered by water during rainy seasons, but in summer they partially dry up and become suitable for paddy cultivation. With spiraling labour cost and decreasing size of holdings, presently they are mostly left uncultivated. More often, they are used for pisciculture by bunding and in filling by water from the back water. Potential of converting the paddy fields and marshy lands into urban land has also led to indiscriminate filling of such area in recent times; often creating possibilities of flooding and water logging in adjoining areas.

5.3 URBANIZATION IN KOCHI - A COMPARISON WITH THE NATIONAL AND STATE SCENARIO

Census 2001 recognises 27.78 percent of the population of India as urban (Out of India's population of 102.70 crore, 28.54 crore live in urban areas). Considering the rapid urbanization in India, it is estimated that by 2050 about 50 percent of India's population may be living in urban areas. During the last three decades India has witnessed significant increase in the population of its metropolitan cities. There are 35 million plus cities in India as per the Census 2001.

The State of Kerala accommodates only 2.90% of the urban population of India. However, Kerala has witnessed steady growth in the urbanization. The urban content of the State's population which was only 15.11 % in 1961 has risen to 25.97% in 2001. The urban population of 82.67 lakh (2001) is accommodated in 159 urban areas comprising of 60 statutory towns and 99 census towns.

A peculiar phenomenon of the urbanization trend in Kerala is that a major percentage of this urban population is within 17 urban agglomerations (UA). Kochi UA has the most number of constituent units (25) with Kannur in the second place with 16 constituent units and Kozhikode in the third position with 14 constituent units. All the other UAs have only 10 or less than ten constituent units.

Table 5.1 : Urban Areas in Kerala and Ernakulam district

Category of town	Kerala		Ernakulam	
	1991	2001	1991	2001
Statutory towns	65	60	12	9
Census towns	132	99	16	16
Total	**197**	**159**	**28**	**25**

A remarkable feature of urbanization is that though the urban content of the State's population is only 25.97%, Ernakulam is the most urbanized district in the state in terms of absolute number of urban population (14.77 lakhs) and the percentage of urban to total district population (47.56 %) as per 2001 census. The distribution of towns by size, class and population in the State shows that there are 7 Class 1 towns with a population over 100,000 (one lakh).

A clear demarcation between urban and rural areas is difficult since Kerala has a dispersed settlement pattern. This is clear from the fact that though there are only 60 statutory towns out of the 159 census towns, a good percentage of these census towns are within the 17 urban agglomerations, lying in the peripheral areas of major towns and cities. It was also seen in a study by the Department of Town and Country Planning that more than 100 panchayats satisfy more than 75% of the criteria for urban as per the Census (the three fold criteria specified by Census of India).

Fig. 5.1 Growth of towns in Kerala from 1901 to 2001

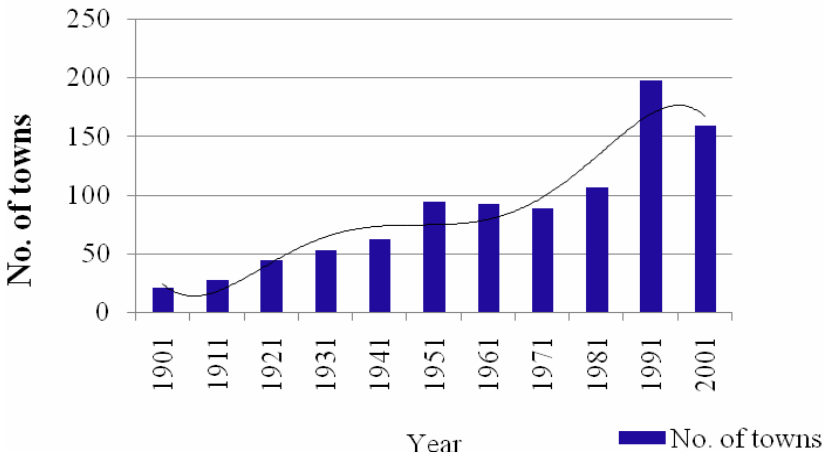


Table 5.2 : Urbanization trend – comparison between India, Kerala and Ernakulam district

Year	**Population** (in lakhs or 1,00,000)								
	India			**Kerala**			**Ernakulam**		
	Total	**Urban**	**% Urban**	**Total**	**Urban**	**% Urban**	**Total**	**Urban**	**% Urban**
1971	5481.60	1091.14	19.91	213.47	34.66	16.24	23.83	6.36	26.69
1981	6833.30	1594.63	23.34	254.54	47.71	18.74	25.35	10.03	39.56
1991	8463.03	2176.11	25.71	290.99	76.80	26.39	28.17	13.73	48.74
2001	10270.15	2853.55	27.78	318.39	82.67	25.97	31.065	14.77	47.56

Table 5.3 : Growth Rate – India, Kerala and Ernakulam district

Geographical unit	1971- 81 (%)		1981- 91 (%)		1991- 2001 (%)	
	Total	Urban	Total	Urban	Total	Urban
India	24.66	46.14	23.85	36.46	21.34	31.13
Kerala State	19.24	37.64	14.32	60.90	9.42	7.64
Ernakulam District	17.18	36.58	11.12	36.92	9.09	7.57

From the table 5.2 it is clear that the percentage of urban population to total population is greater in Ernakulam district than that in any other district in Kerala or in the State as a whole or in India. Ernakulam district is highly urbanized with Kochi UA acting as a magnet attracting economic investments in many sectors.

5.4 ECONOMIC ACTIVITIES IN ERNAKULAM DISTRICT

(1) District wise Gross State Domestic Product

Ernakulam district continues to have the highest income of Rs.27474.62 crore in 2008-09 as against Rs.20782.48 crore in the year 2007-08 registering a growth rate of 14.81 percent. At constant prices (1999-2000) it comes to Rs.19940.60 crore during the year 2008-09 compared to Rs.16338.99 crore during 2007-08. Thiruvananthapuram district stands second with an income of Rs.20745.07 crore in 2008-09 at current prices followed by Thrissur (Rs.18483.03 crore), Kozhikode (Rs.16761.85 crore), Malappuram (Rs.14728.60 crore), and Palakkad (Rs.145793.11 crore). District- wise distribution of gross state domestic product at current prices shows that the lowest income of Rs.3554.59 crore was recorded in Wayanad district at current prices during 2008-09. (*Source: Economic Review, 2009, State Planning Board)*

- **Agricultural Developments**

Production of Rice - During 2008-09, there was increase in area under cultivation of rice by 5327 ha from 2.29 lakh ha in 2007-08 to 2.34 lakh ha; however rice production decreased from 6.42 lakh MT to 5.28 lakh MT, and then increased to 5.89 lakh MT in 2008-09, indicating a 11.74 percent over the previous year. On comparing with the other districts of state during 2008-09, Ernakulam district contributed 4.39 % of the total production of rice in the state using 5.53 % of area of the district for rice cultivation. In terms of productivity per hectare of land, Ernakulam district is way below many other States. The highest production of 3053 kg/ha was recorded in 2008-09 in Alappuzha district, while Kozhikode district had 1390kg/ha. Ernakulam district had a production average of 1998 kg of rice per hectare. *(Source: Economic review, 2009, State Planning Board)*

- **Industrialization**

Medium and Large scale industries - Ernakulum district has the highest number of units - 255 units followed by Thiruvananthapuram and Thrissur district having 90 units each and Wayanad district at the lowest level having 7.

Table 5.4
Medium - Large Scale Industrial Units registered in Kerala, March, 2007

Sl. No.	Districts	Central Sector	State Sector	Co-operative Sector	Joint sector	Private sector	Total units
1	Thiruvananthapuram	2	14	2	4	68	90
2	Kollam	2	7	2	-	20	31
3	Pathanamthitta	-	1	1	1	5	8
4	Alappuzha	-	7	-	3	28	38
5	Kottayam	1	2	2	-	29	34
6	Idukki	-	-	1	1	15	17
7	**Ernakulam**	**12**	**8**	**2**	**4**	**229**	**255**
8	Thrissur	2	8	1	7	49	67
9	Palakkad	2	2	2	6	78	90
10	Malappuram	-	5	1	2	22	30
11	Kozhikode	-	3	1	1	24	29
12	Wayanad	-	-	-	-	7	7
13	Kannur	1	7	5	-	16	29
14	Kasaragod	-	1	1	-	2	4
	Total	22	65	21	29	502	729

Source: Kerala State Industrial Development Corporation (KSIDC, Thiruvananthapuram)

Small scale industries - Small scale industries have emerged as a major determining factor in the growth of economy in terms of employment generation. The sector contributes maximum production for domestic and export markets and produces variety of products ranging from traditional to high tech.

The details of the district wise number of working SSI units, investment, production, employment provided and value of production are given in the Table 5.5 as of March 2009. From the table it is clear that Ernakulum district stood at the highest position in terms of number of units, employment provided, investment and value of production and Wayanad district at the lowest level.

Table 5.5
Working small scale industrial units registered in Kerala - March, 2009

Sl.No.	District	Total No: of SSI units	Investment (Rs. Lakh)	Production (Rs. Lakh)	Employment (Nos)
1	Thiruvananthapuram	22346	52687.77	115317.33	89132
2	Kollam	16716	39814.65	76376.93	78625
3	Pathanamthitta	9392	16773.81	20173.48	24388
4	Alappuzha	18394	51668.26	111903.63	72087
5	Kottayam	20289	64697.26	115068.51	60046
6	Idukki	5519	23691.78	31470.66	18933
7	**Ernakulam**	**26254**	**124366.09**	**429549.65**	**114434**
8	Thrissur	23921	78806.05	134434.60	89530
9	Palakkad	15063	53024.74	73563.66	49298

10	Malappuram	10549	37509.06	75568.17	36728
11	Kozhikode	16406	57220.93	104925.46	60541
12	Wayanad	3001	7843.23	9159.54	10857
13	Kannur	10963	33706.79	69554.88	40185
14	Kasaragod	5568	15039.06	22988.18	26187
	Total	204381	656849.48	1390054.68	770971

Source: Directorate of Industries and Commerce

- **Major Establishments**

(i) Special Economic Zone

A Special Economic Zone (SEZ) is coming at Kakkanad by a joint venture of Cochin Port Trust, Cochin International Airport Limited (CIAL) and Cochin SEZ. Kochi is the only city in India to have three SEZs. These include the Electronic Park at Kalamassery, Cochin SEZ and a port based SEZ. Eleven new SEZs have been approved in the state. In nine out of 11 approved SEZs, the state and central governments are the developers. Of the 11 SEZs six are IT/ITES based SEZs, one each in food processing, biotechnology and electronics and two are port based SEZs. While the Vallarpadam SEZ (port based) consists mainly of the Container Transshipment Terminal and related infrastructure, the Puthuvypeen SEZ (port based) will comprise an LNG Terminal. Two SEZs have been approved in principle, for development by Smart City Infrastructure Pvt. Ltd. and Sutherland Global Service Pvt. Ltd.

(ii) Cochin Special Economic Zone

The Cochin special economic zone (CSEZ) established in 1984 spread over an area of 103 acres located at Kakkanad is one of the seven Special Economic Zones of Central Government. The CSEZ is multi product zone with 98 working units and four under implementation units in sectors as varied as software, hardware, engineering, readymade garments, food processing, rubber products, gem & jewellery, manufacturing and with more than 7800 employees making it the single largest employment destination in the state. Export during 2008-09 was of Rs.11, 549.04 crore as against Rs.4651.40 crore during 2007-08, thereby registering a growth of 148 percent.

Table 5.6 Industry- wise Export Performance of units in CSEZ

Sector	No: of exporting units as on 31.10.09	2006-07 (lakh)	2007-08 (lakh)	2008-09 (lakh)
Electronic Hardware	08	33000	26480	35452
Electronic Software	25	4903	12087	14529
Garments	04	9267	11965	20102
Gem & Jewellery	06	21894	382447	1049148
Plastic & Rubber products	08	4340	2792	2690
Engineering	10	6078	5647	7260
Food & Agro	09	13088	12904	12375
Others	28	11182	10818	13348
Total	**98**	**103752**	**465140**	**1154904**

Source: CSEZ.

(iii) IT Parks

Smart City – Smart city is a planned industry township for information technology and enabled services, media and bio-technology .It is a joint venture between the government of Kerala and Dubai, Technology Electronic Commerce & Media Free Zone Authority (TECOM). Covering 246 acres of land and an estimated built up space of about 8 lakh sq.m; Smart City will be one of India's largest business parks. The project, when completed, will feature an architecture that is an assorted blend of modern and traditional styles with designed landscapes, Smart City will create an infrastructure and environment for knowledge industry companies to grow and flourish. 70% of the built-up space would be developed exclusively for IT related activities. The Kochi project with Rs.1700 crore budget would generate 90,000 jobs and is expected to catapult Kerala to become one of the leading IT destinations in the country.

Info Park –

Info Park is an IT park promoted by the Government of Kerala, located at Kakkanad, Kochi. Info Park is placed in 100 acres campus which is 12 km from the International Airport. It has been growing fast ever since its inception in 2004 and has attracted 29 companies which include IT majors like TCS, Wipro, Affiliated Computer Services, OPI Global, IBS Software Service and US Technologies. Info park campus is divided into SEZ facility zone with 75 acres of land and non-SEZ facility zones. Info Park is the IT landmark in Kochi – Queen of Arabian Sea and commercial hub of Kerala. Its close proximity to the SAFE and SEA-ME-WE-3 cables dropping zone in Kochi make it one of the best connected yet the most economical IT park in the country.

L & T Tech Park –

L &T Tech Park has taken 4 acres of land on lease from Info Park with co-developer status to develop and construct state of the art facilities for IT/ITES companies from India and abroad. Smart Business center (SBC) a true plug and play incubation facility is provided at Info Park. Low rental clubbed with high quality furnishing make the SBC an ideal choice for smart up enterprises.

(iv) Cochin International Airport

Kerala has three airports at Thiruvananthapuram, Kochi and Kozhikode handling both international and domestic flights. Out of the three Thiruvananthapuram and Kozhikode are owned by the Government of India and Kochi is owned by Cochin International Airport Ltd (CIAL), a company set up by GoK with Public Private Participation. Of the three airports, during 2006-07 Kochi airport has recorded the highest number of flights and passengers (international and domestic). During 2008-09, 48.50 percentage of passengers (international and domestic) have been travelled by Kochi airport as against 49.45 percentage in previous year due to the large number of tourist arrivals, Keralities working in gulf and other countries. The details of flights operated and passengers travelled during 2008-09 from the three airports are shown in Table 5.7

Table 5.7
Details of Flights operated & Passengers travelled during 2008-09

Airport	International		National	
	Flights (Nos)	Passengers (Nos)	Flights (Nos)	Passengers (Nos)
Thiruvananthapuram	12974	1473548	9062	481765
Kozhikode	13694	1477955	5411	137122
Kochi	**19047**	**2010114**	**22125**	**1352687**
Total	45715	4961617	36598	1971574

Source: International airports, TVPM, Kozhikode and Kochi

(v) Cochin Harbour

Cochin port, one of India's twelve major ports, is located in Wellington Island. It is an ISO 9001-2000 certified port administered by a Board of Trustees under the Major Port Trust Act 1963. It spreads over 827 hectares. It has a water frontage of 7.5 Km.The Port has traditionally been one of the main economic drivers of the local economy. 97 % of the total volume of traffic from the Cochin Port is accounted by Kerala, though the hinterland of the port spreads to part of Tamilnadu and Karnataka States. As per Asian Development Bank (ADB) projection for G.D.P growth, traffic through Cochin Port could be over two million Twenty Foot Equivalent Units (TEUs) by 2012 and by 2022, it is projected to go up to 3.3 million TEUs.

The total traffic handled by the Port during the year recorded a decrease by 1.66% to 154.94 lakhs tons as against 157.55 lakhs tons handled in the preceding year. During the year foreign cargo traffic increased by 0.88% compared to the preceding year. Coastal cargo traffic decreased by 6.87% from 51.52 lakhs tons to 47.98 lakh tons. Total import traffic handled during the year recorded an increase by 4.24% from 122.64 lakhs tons in the preceding year to 127.84 lakh tons. Total export traffic handled during the year showed a decrease of 22.36% from 34.90 lakh tons in the preceding year to 27.10 lakhs tons.

During the year the tonnage of container cargo handled recorded an increase of 12.21% from 26.34 lakhs tons in the preceding year to 29.52 tons. Exports in containers showed decrease by 8.56% during the year from 12.04 lakhs tons in the preceding year to 11 lakhs tons and import in containers showed an increase by 29.5% during the year to 18.52 lakh tons in the preceding year. Total number of containers handled also showed an increase to 260784 TEUs during the year from 253715 TEUs handled in the preceding year indicating an increase by 2.8%.

During the year 2008-09, 1082 ships called at the port as against 1121 ships in the preceding year registering a decrease of 3.48% in shipping activity. The total number of passengers arrived at and sailed from Cochin Port during the years was 59899 and 62941 respectively as against 61909 and 66647 in the preceding years. The total NRT of ships called at the Port showed an increase of 0.92% during the year over that of the preceding year which is as shown at Table 5.8.

Table 5.8 Number of Ships called at Cochin Port during 2007-08 and 2008-09

Sl. No.	Type of Vessel	No. of Ships		Net Registered Tonnage (NRT)	
		2007-08	2008-09	2007-08	2008-09
1	POL Tanker	352	305	7125849	7007007
2	Colliers	6	6	111741	110460
3	Foodgrain ship	2	0	2529	0
4	Fertilizer ship	4	8	42084	92449
5	General Cargo ship	103	100	530590	552398
6	Containers	350	334	2710308	2376829
7	Cruise ship	43	36	302833	539513
8	Passenger ships and others	261	293	183209	431518
	Total	1121	1082	11009143	11110174

Source: Cochin Port Trust

(vi) Export – Import Trade through Cochin Port

A large share of Kerala's trade is being conducted through the Cochin port. Important export items from Kerala are pepper, cashew, coir and coir products, tea, marine products and spice oils and oleoresins. Software export is also gaining momentum in recent years.

Total value of foreign export through Kochi port increased from Rs.11322.7 crores in 2007-08 to Rs.12828.37 crores in 2008-09 and the quantity of export got decreased from 3490481 MT to 2709952 registering 22.36% decrease compared to 2007-08. The commodity wise export through Cochin port from 2006-07 is shown in Table 5.9

Table 5.9 Commodity- wise export through Cochin Port 2006-07 to 2008-09

Sl.No	Commodity	2006-07		2007-08		2008-09	
		Quantity	Value (crores)	Quantity	Value (crores)	Quantity	Value (crores)
1	Tea	88610	540.67	71472	335.95	68564	378.73
2	Cashew Kernels	68179	1504.94	77458	1480.70	56967	1715.65
3	Sea foods	109207	1448.25	108653	1519.82	90286	1389.62
4	Coir Products	108051	12.36	124213	1308.13	78563	496.97
5	Spices	36732	942.85	70521	1124.60	47985	398.86
6	Coffee	92218	690.21	94386	1381.56	63130	711.67
7	Miscellaneous	2971199	5197.5	2943778	4171.93	2304457	7736.87
	Total	3474196	10336.8	3490481	11322.7	2709952	12828.37

Source: Cochin port trust, Quantity in M.T.

During 2008-09 total import registered through Cochin Port was 12784175 MT which shows an increase of 4.24 % compared to previous year. The details of commodity wise imports through Cochin port are given in the Table 5.10

Table 5.10 Commodity- wise import through Cochin Port 2006-07 to 2008-09

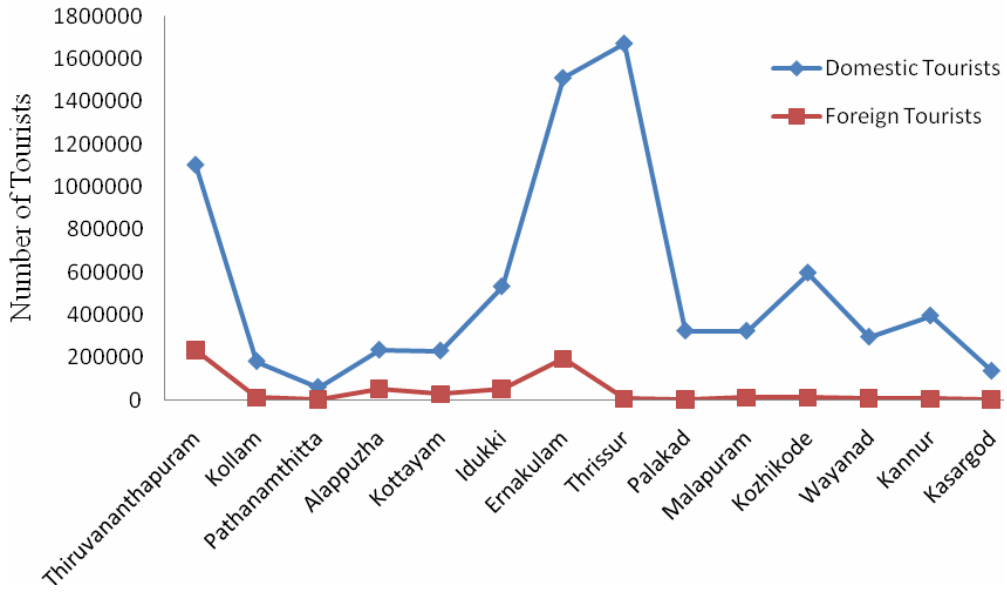
Sl.No	Commodity	2006-07		2007-08		2008-09	
		Quantity	Growth Rate (%)	Quantity	Growth Rate (%)	Quantity	Growth Rate (%)
1	Fertilizers & Raw materials	639533	-12.02	419688	-52.38	569255	35.84
2	Food grains	181366	100.00	0	0.00	0	0.00
3	Iron, Steel & Machinery	339674	10.12	290918	-16.76	192031	-33.99
4	Newsprint	76908	-81.08	97040	20.75	81256	-16.27
5	Cashew nut	339674	7.6	325014	-4.51	314831	-3.13
6	Miscellaneous	10206217	10.82	11131409	8.31	11626802	4.45
	Total	11783372	35.44	12264069	4.08	12784175	4.24

Source: Cochin port trust, Quantity in MT

(vii) Tourism

It is observed that Thiruvananthapuram and Ernakulam lead the other districts of the State in attracting foreign tourists during the last few years. Ernakulam and Thrissur are the leading districts on the basis of domestic tourist arrivals to Kerala. See fig 5.2

Fig 5.2 District wise Tourists arrivals in Kerala during 2008



Source: Department of Tourism, Government of Kerala

The tourism sector happens to be one of the largest foreign exchange earners in the world. The sector is growing at a fast pace, especially in developing countries. The tourism industry is a major contributor to the economy of Kerala State also. It is found that state foreign exchange

during the year 2008 is Rs.3066.52 crore which recorded a growth of 16.11 percent over previous years. The total revenue generated from tourism comes to Rs. 13130 crore, showing increase of 14.84 percent over the last year. Tourism contribution to the state's Gross Domestic Product (GDP) is 7.70 percent. The total employment generated from tourism is around 10 lakh including skilled, semiskilled and unskilled employment. Since Ernakulam stands out highest in the arrival of both foreign and domestic tourists, the major revenue from tourism is from Ernakulam district itself. Medical tourism is also gaining importance in Ernakulam due to the availability of a good number of speciality hospitals in the district.

(viii) Other Major institutions in the district

Cochin University of Science and Technology (CUSAT)

The University was established in 1971 through an act of legislation for the promotion of graduate and post graduate studies and advanced research in applied science, technology, industry, commerce, management education and social sciences.

CUSAT at present has eight (08) international academic linkages. Independent centers have been formed to pursue research in thrust areas. Notable among these centers are Centre for Fish Disease Diagnosis and Management, and Centre for Monsoon studies.

CUSAT is being shortlisted as one among the 5 institutions across the country for up gradation to IIEST by the Ministry of Human Resource Development, Government of India. As of 2007, 18 engineering colleges also have been affiliated to CUSAT University.

Kerala Agricultural University (KAU)

The Kerala Agricultural University is the principal institution in the state providing human resources and technology required for the sustainable development of agriculture encompassing all production activities based on land and water, including crop production, animal husbandry, forestry and fisheries. The university fulfills its obligations and commitments through a network of 36 big and small campuses spread throughout the state consisting of ten colleges, twenty six Research Stations, three Centers of Advanced studies, the Central Training Institute(CTI), the ATIC (Agriculture Technology Information Center), the KAU Press, the Central Library and various other research programmes. The University has a strong technical manpower consisting of 1000 academics and over 800 technical staffs.

The research support for sustainable development of agriculture sector in the state is rendered by Kerala Agricultural University in a participatory mode in close association with research

institutions managed by Indian Council of Agricultural Research, Commodity Boards and Departments of the State and Central Governments.

Central Marine Fisheries Research Institute (CMFRI)

The Central Marine Fisheries Research Institute established by the Government of India under the Ministry of Agriculture in 1947 became a member of the Indian Council of Agricultural Research (ICAR) family in 1967. The headquarters was shifted from Mandapam Camp to Cochin in 1971.

Over the period, the Institute has grown significantly in its size, stature & research infrastructure. Now, it enjoys the status of a premier research organization comparable to any similar institution in the developed countries.

Central Marine Fisheries Research Institute has completed 62 years of service to the fisheries sector of India. Research infrastructure along with highly competent scientific and technical manpower has been the strength behind the Institute's envious growth in this field. Multidisciplinary research approach coupled with state of the art laboratories and research centers have helped to develop the Institute as India's premier fishery research Institute.

(ix) Other Significant Sectors in the district

Mining

Kerala is endowed with a number of deposits such as heavy mineral sand, china clay, iron ore, graphite, bauxite, silica sand, lignite, lime shell, granite etc. However mining activities on large scale are confined mainly to a few minerals such as heavy mineral sand, china clay, silica sand, limestone and graphite. Heavy minerals sand and china clay contribute more than 90 percent of the total value of mineral production in the state. Ernakulam district has contributed Rs.481.12 lakh of the total revenue collected by the Mining and Geology Department. During the year 2008-09, the department collected revenue of Rs.3549.29 lakh. The district wise details are given in the Table 5.11

Table 5.11 Revenue Collection of Mining and Geology Department, 2008-09

Sl. No.	Name of office	Revenue collection (Rs.lakh)		
		Major Mineral	Minor Mineral	Total
1	Thiruvananthapuram	142.47	172.09	314.56
2	Kollam	276.89	143.81	420.70
3	Pathanamthitta	0	181.94	181.94
4	Alapuzha	17.35	25.60	42.95
5	Kottayam	19.87	219.17	239.04
6	Idukki	0	91.98	91.98
7	Ernakulam	0.10	481.02	481.12
8	Thrissur	0	343.55	343.55
9	Palakkad	223.71	175.51	399.22
10	Malapuram	0	317.28	317.28
11	Kozhikode	0.11	215.53	215.64
12	Wayanad	0.16	75.82	75.98
13	Kannur	10.71	158.78	169.49
14	Kasaragod	20.43	127.73	148.16
15	Special office Cherthalai	25.98	0.55	26.53
16	Kerala Mineral Squad (NR)	0	20.71	20.71
17	Kerala Mineral Squad (SR)	0.25	26.75	27.00
18	Directorate	21.23	12.21	33.44
	Total	759.26	2790.03	3549.29

Source: Department of Mining and Geology.

Coastal Pollution

The main driving forces of coastal pollution are pollution owing to population followed by discharge of industrial effluents, indiscriminate use of agricultural chemicals damaging the quality of river water and adding to marine pollution, oil pollution, and air pollution. According to Kerala State Pollution Control Board (KSPCB) in Kerala about 3000 medium and large scale and 2000 small scale industries are discharging effluent directly into saline fresh water bodies. About 104536 m3 of treated effluents per day is being discharged into the backwaters or sea in the coastal zone of the state. On comparing with other districts Ernakulam stands second in the solid waste generation of about 234 tons per day whereas Thiruvananthapuram and Kozhikode stands first. Of the total solid waste generated from state, 14% is from Ernakualm district. In

biodegradable solid wastes Ernakulam stands third generating 77 tons/day. The detailed list of estimated solid waste generation in coastal zone of coastal districts is given in Table 5.12

Table 5.12 Estimated Solid Waste Generation in the Coastal Districts in Kerala

Sl.No	Districts	Solid waste generation (tons/day)	Biodegradable solid waste (tons/day)	BOD load reaching coastal waters (kg/day)
1	Thiruvananthapuram	241	80	13
2	Kollam	196	65	11
3	Kottayam	25	8	1
4	Alappuzha	188	62	10
5	Ernakulam	234	77	13
6	Thrissur	137	45	7
7	Malappuram	122	40	7
8	Kozhikode	241	79	13
9	Kannur	188	62	10
10	Kasaragod	105	35	6
	Total	1677	553	91

Source: KSPCB, 2002

Suchitwa Mission was constituted by the Govt. of Kerala by integrating the Clean Kerala Mission and Kerala Total Sanitation & Health Mission , which acts as the nodal agency of the state for overseeing, advising and supporting the sanitation activities of the urban and rural local governments in the State.

5.5 ADMINISTRATIVE SET UP IN ERNAKULAM DISTRICT

The Ernakulam district is divided both on geographical and functional basis for purposes of general administration. Geographically it is divided into two revenue divisions, six taluks and 117 revenue villages. Functionally the district administration is carried on through these revenue department offices and the various departments of the State Government each of which has a district office at Ernakulam. Revenue Divisional Officer (RDO) is in charge of revenue division, who is assisted by Tahsildars, who are in charge of taluks and Revenue Village Officers, who manage village offices. Revenue map of the district shows the taluks, villages and plot subdivisions within the village as revenue survey numbers.

The District Headquarters, the 'Collectorate' is situated at Kakkanad, Ernakulam and is headed by the District Collector. The District Collector also acts as the district administrator and the various line departments in the State render technical advice to the District Collector through their district offices in matters related to their respective departments. The District Collector is a key functionary of the Government having large powers and responsibilities. The District Collector has mainly the following responsibilities:

i. Revenue Administration
ii. District Land Acquisition Officer
iii. Additional District Magistrate
iv. Development Administrator, with riding control over the various development sectors – coordinating their respective development functions
v. Member Secretary of the District Planning Committee (DPC)

Ernakulam district is comprised of the urban and rural local governments as follows:

One Municipal City Corporation, 8 Municipalities, 117 Grama Panchayats, 15 Block Panchayats and District Panchayat at the district level

Local self Governments –Ernakulam District

District Panchayat	-	Ernakulam District Panchayat
Corporation (1)	-	Kochi Municipal Corporation
Municipalities (8)	-	(1) Aluva (2) Moovattupuza (3) Kothamangalam (4) Kalamassery (5) Tripunithura (6) Parur (7) Perumbavoor (8) Angamaly
Block Panchayats (15)	-	(1) Angamaly (2) Koovappady (3) Edappally (4) Vazhakkulam (5) Parakkadavu (6) Vadavukodu (7) Vyttila (8) Pambakkuda (9) Palluruthy (10) Mulanthuruthy (11) Kothamangalam (12) Moovattupuzha (13) Vypeen (14) Parur, and (15) Alangad

5.6 MAJOR PROJECTS IN THE REGION

The major development projects envisaged by various agencies in and around Kochi city is listed in Table 5.13

Table 5.13 Major Development Projects under consideration in and around Kochi City

Sl. No.	Projects	Local Body
1	International Container Transshipment Terminal	Mulavukkad
2	LNG Regasification Terminal	Elamkunnapuzha
3	International Bunkering Terminal	
4	Ship Repairing Yard	
5	Crude oil storage facilities	
6	International Cruise Terminal	
7	Port based Special Economic Zone	
8	Reclamation for streamlining of flow in the Port Channel for reducing siltation and for future development works	
9	Development Proposals for Cochin International Airport	Nedumbassery
10	Expansion of the existing Chemical Plant	Kalamasserry
11	Expansion of Aluminium Extrusion Plant	
12	Biotechnology Zone	
13	SEZ for electronics	
14	Industrial trade and exhibition centre	
15	Academic zones	
16	Commercial and residential development.	
17	IT township at INFOPARK	Thrikkakara
18	Smart City	
19	Cochin Special Economic Zone	
20	Dredging of navigational channels to increase the draft	Corporation of Kochi
21	Water sports and tourism related operation of tourist vessels Tourist submarine at Kochi, Development of Marina	City area
22	Waste management Facility at Brahmapuram	Vadavucode-Puthenkurisu
23	Petro chemical complex	
24	Setting up of Joint Venture projects at FACT	Eloor
25	NH connectivity to Vallarpadam	
26	Rail connectivity to Vallarpadam	
27	Metro Rail Phase -1	
28	Tourism Village	Kumbalangi
29	Shopping malls and showrooms	Maradu & Edappalli
30	Coastal Highway	

CHAPTER 6

EARLIER PLANNING EFFORTS

6.1 REVIEW OF PLAN DOCUMENTS

There had been awareness and efforts in the direction of planning and providing necessary amenities and services to the population of Kochi since early days. In 1890 there had been a community of merchants to look after the sanitary arrangements of Mattancherry and another community of officials and non-officials to supervise the sanitation and conservancy of Ernakulam. Payment of monthly grant was sanctioned by the Cochin State Government to these communities. In 1896 these communities were superseded by regular sanitary boards. The functions of these boards mainly consisted of keeping the town roads clean and also lighting of streets. In 1909 the Municipal and Sanitary Improvement Regulations was enacted by the then Ruler of Cochin to make adequate provision for the Town Councils for Ernakulam and Mattancherry, vested with powers for planning and administration of their town. For Fort Kochi, the provision of the Madras Town Planning Act of 1920 was applicable as such. After independence, when the Travancore-Cochin State was formed, the Travancore Town Planning Regulation of 1108 (M.E) were made applicable to Mattancherry and Ernakulam towns.

6.1.1 Interim Development Plan for Cochin

A comprehensive approach to the planning of the urban area of Cochin (which later on became Kochi) and its environs was initiated after the Kerala State was reorganized in 1956 and the Department of Town Planning was formed in 1957. Kerala Government accorded sanction to the Department of Town Planning for the preparation of a Development Plan for Cochin Region in 1961. The Department of Town Planning brought out an Interim Development plan for Cochin Region. This was a policy document with plan period 1966-1981. For the purpose of Interim Development Plan, the region was delineated only on an arbitrary basis. Six towns (Municipalities) viz. Ernakulam, Mattanchery, Fort Cochin, Aluva, Perumbavur and Parur and fifty one surrounding panchayats were considered to form the planning region. This region covered an area of 1101.61 sq km and had a population of 11.88 lakhs in 1961.

It was proposed to amalgamate the Municipalities of Ernakulam, Mattancherry and Fort Cochin and to add portions from the surrounding panchayats of Edappally, Vennala, Vyttila,

Cheranellur, Maradu, Palluruthy and Mulavukad into one cohesive urban area. The Corporation of Cochin was formed in the year 1966 on more or less the above lines. The **Central City** or the Urban Core of Cochin Region, as delineated in the Interim Development Plan covered an area of 94.88 sq km (as per 1971 Census) and had a population of 4.39 lakhs (as per 1971 Census).

Three satellite townships were proposed around the Central City at Eloor, Thrikkakara and Ambalamugal to absorb part of future urban population. Eloor and Ambalamugal were proposed to be developed as industrial townships and Thrikkakara as an alternate location for the district administration.

The population of the region was estimated to be 21.40 lakhs in 1981, with an urban component of 12.60 lakhs. The distribution of this urban population within the region was made taking into consideration aspects like (i) the extent of land available in each locality for industrial use and scope for employment in the secondary sector; (ii) the existing infrastructure of each locality and the scope for development; (iii) physical features of the areas facilitating compact developments; and (iv) existing population of each urban area and its growth and the trend of development of each area.

The urban population was proposed to be distributed in the Central City (7.5 lakh), the three municipal towns (Aluva-0.6 lakh, Perumbavur-0.5 lakh and Paravur–0.4 lakh) and 3 townships (Thrikkakara – Kalamassery – 1.6 lakh, Ambalamugal – 1.0 lakh and Eloor – 1 lakh).

The urban peripheral zone was expected to restrain the urban expansion of Cochin in a horizontal direction and to safeguard the independent status of the ring towns. The proposals included roads (bypass to the Central City, radial connections to Thrikkakara and Ambalamugal and strengthening of existing system), commercial centres, housing etc.

The Cochin Town Planning Trust was constituted in 1963 to implement the proposals of the interim plans. The trust launched a number of area development schemes. This was the first organized effort in guiding the planned growth of the city.

6.1.2 Development Plan for Cochin Region, 1976

The Interim Development Plan for Cochin Region, 1966 was subsequently updated in the light of further study and analysis of the growth trends and the Development Plan for Cochin Region was prepared by the Department of Town and Country Planning in 1976. This was a comprehensive policy document to stimulate balanced growth of the region with respect to its

long term need, with the plan period from 1971 to1991. In this Plan, the Region was scientifically delineated.

At first, the primary influence zone of Cochin City was identified by studying six Municipalities considered for the Interim Development Plan and the surrounding seventy panchayats. The towns and Panchayats falling inside the influence zone were identified based on various criteria such as (i) commutation to the Cochin city from the surrounding settlements and towns; (ii) catchment area of colleges; (iii) demand and supply of perishable goods from and to the markets in Cochin City; (iv) location of major industries; (v) development of fishing industry in and around Cochin; (VI) favourable locations in respect of transportation routes; (vii) availability of high tension power lines; (viii) distribution of population and (ix) topography including availability of developable land. Scores were given for each Panchayat and those panchayats which got four or more scores were taken to be included in the primary influence zone of Cochin city, along with Cochin city, Aluva, Parur and Perumbavur towns. There were 38 panchayats included in the primary influence zone.

The primary influence zone was considered for delineating Cochin Region. Three panchayats (Aroor, Ezhupunna and Kodamthuruthu) out of the 38 panchayats identified in the primary influence zone were omitted for the reason that they were outside the district. Eventhough the Panchayats of Vadavukode-PuthenKurisu, Aikeranad, Thiruvankulam, Thiruvaniyyoor, Poothrika, Mulamthuruthy, Amballur, Thrikkakara and Vazhakulam were to be omitted for the reason that these areas were unsuitable for development, Thrikkakara, Vadavukode-Puthenkurisu, Vazhakulam, Thiruvankulam, Mulanthuruthy, Alengad and Kottuvally were included in the region because of other factors such as availability of cheap land for industrial development and contiguity of the region. Thus, the delineated Cochin Region included four towns and Thirty four panchayats with an area of 691.92 sq km and population of 12.48 lakhs as per 1971 census. The population of the region was expected to reach 16.55 lakhs in 1981 and 22.31 lakhs in 1991.

The urban population of the region, as per 1971 census was 6.07 lakhs and was estimated to be 9.87 lakhs in 1981 and 15.04 lakhs in 1991. The rural population of the region was 6.41 lakhs as per 1971 census and was estimated to be 6.68 lakhs in 1981 and 7.27 lakhs in 1991. (Total – 12.48 lakhs as per 1971 Census, 16.55 lakhs in 1981 and 22.31 lakhs in 1991)

The studies for the preparation of Development Plan for Cochin Region revealed that there were three important deviations from the earlier Interim Development Plan.

- The Central City had developed as envisaged in the Interim Development Plan and had grown even beyond the limits proposed

- The progress of development of the satellite towns envisaged in the Interim Development Plan had not been fully realized and instead urban growth points had been developed at other centres viz. Thrippunithura, Njarakkal and Angamali.
- The Municipal Towns of Aluva, Parur and Perumbavur had grown only very slowly and they had also failed to draw away some part of the urban concentration around the Central City.

Physical form of regional development suggested in the Development Plan for Cochin Region was a combination of radial corridor pattern and satellite town concept with rural areas in between urban boundaries. Central city in the selected form included peripheral development around Njarakkal, Eloor, Kalamassery, Thrikkakara, Ambalamugal and Thripunithura.

The Central City was delineated primarily based on the following considerations:

(i) Corporation area and adjoining standard urban area as defined in 1971 census
(ii) Development along traffic corridors
(iii) Industrial developments in the sub urban fringes
(iv) Contiguity of land through the proposed communication system
(v) Viability of urban development.

The Central City, thus delineated, was proposed to be 226.69 sq km (consisting of city area of Cochin, Maradu, Thrippunithura, Thiruvankulam, Vadavukode –Puthenkurisu, Thrikkakara, Kalamassery, Varappuzha, Elamkunnappuzha, Cheranellur, Chellanam, Njarakkal, Mulavukad, Kadungallur and Edathala) with a population of 6.67 lakhs as per 1971 Census and was expected to reach 8.78 lakhs in 1981 and 13.41 lakhs in 1991.

It was proposed that the city would have a peripheral belt to arrest horizontal expansion. To check urban expansion beyond the limits of the Central City, Panchayats bordering the central city were proposed to be declared as 'Urban Peripheral Panchayats' and were proposed to be so developed as to make them strong enough to resist urban expansion into their area. Beyond the urban peripheral zones suggested for the central city, it was proposed to develop the existing urban areas of Paravur, Aluva and Perumbavur to absorb the remaining urban population of the Region during 1981 and 1991. Thus the urban population was proposed to be distributed in Central City and three municipal towns only.

The urban limits of Aluva, Parur and Perumbavur were proposed to be kept unchanged over the plan period. Thus, the total extent of urban limit within the region by 1991 was proposed to be 256.49 sq.km. Perumbavur town was proposed to be developed as a strong counter magnet for Cochin region.

It had been recommended to regroup the remaining 435.43 sq.km of rural areas in the region into 27 viable panchayats and to develop one panchayat centre in each panchayat in a phased manner within the plan period.

Major proposals in the Development Plan for Cochin Region were as follows:

- National Highway with 45 m right of way - NH-47 Bypass road and NH-17 (portions inside region)
- Provincial Highway (Right of Way 36m)
- Sub Regional Roads (Right of Way 30m)
- Intra-city roads of Regional importance (Right of Way 18.30 m)
- Terminal facilities for intra city mass transport through water ways
- Cochin- Alappuzha broad gauge line
- Development of Civil Airport at Poothotta
- Expansion of Cochin Port and allied activities and construction of Super Tanker Berth
- Decentralisation of wholesale trade from Cochin city by developing Aluva, Parur and Perumbavur whole sale trade centres
- Decentralisation of whole sale trade inside Central City from CBD to sub centres to be developed during the plan period
- Development of 27 panchayat centres mainly as distribution and collection centres
- Location of free trade zone in the island groups around Vallarpadam
- Development of major fishing harbours at Vypeen and Mattancherry
- Intensive agricultural development in 435.43 sq.km of rural area within the Region
- 567 acres of land to be acquired and developed for heavy and medium industries in selected locations in sub areas proposed in the Regional Plan
- Forty eight hectares of land to be developed for small scale industries in selected locations distributed over the entire region

For the effective implementation of the proposals in the Development Plan for Cochin Region, the Greater Cochin Development Authority was constituted in 1976 with jurisdiction over the entire Region. GCDA was vested with wide powers to evolve long term programmes for the Region, to identify strategic areas for development and evolve short term action plans for implementation. GCDA initiated implementation of many Detailed Town Planning Schemes and area development projects within the frame work of the Development Plan for Cochin Region.

6.1.3 Structure Plan for Central City, Kochi, 2001

Structure Plan for the Central City of Kochi was prepared by the GCDA, with the technical advice and help of the Department of Town Planning, as per the provisions of the

Town Planning Act 1108 and Madras Town Planning Act 1920 and was sanctioned by Government as per G.O. (Ms) No. 103/91/LAD dated 20.3.1991. This Plan was subsequently varied vide G.O (Ms) 79/99/LAD dated 13th April 1999. This is a Policy Plan for the development of the region with broad land use proposals for the area within the city and the immediate surrounding areas. The Plan period assumed in the Structure Plan was from 1991 to 2001.

Urban expansion during 1971- 81 outgrew the limits of the Central City area delineated in the Development plan for Cochin Region, 1976. Growth trend of settlements of the region was different from what was anticipated and the population growth of rural areas far exceeded that of the urban areas. Hence the suburbs showed higher growth rates than the city proper. The Cochin Urban Agglomeration, as per 1981 census, included the Cochin Corporation, Thripunithura Municipality and census towns of Eloor and Kalamassery and Thrikkakara (Urban OG). In the light of the above, certain modifications were effected in the boundaries of the Central City considering the following norms:

(i) The central city should include the whole of the UA to account for the existing urban spread
(ii) The central city should include census towns contiguous to the urban agglomeration to accommodate potential urban growth
(iii) The central city should include areas intervening between the boundary of UA and census towns satisfying the conditions of growth possibility and viability
(iv) The boundary of the central city should encompass the full administrative boundaries of the constituent local bodies for effective implementation of plan proposals
(v) The central city should necessarily form a compact area wherein developmental efforts could be focused.

In the Structure Plan, the Central City as newly delineated include the Cochin UA (Cochin Corporation, Eloor, Thrippunithura, Kalamassery and Thrikkakara), Census Towns (Mulavukadu and Maradu) and viable panchayats (Njarakkal, Elamkunnappuzha, Cheranelloor, Thiruvankulam and Kadamakkudy) and covered an area of 275.85 sq km with population of 8.55 lakhs as per 1981 census and was estimated to be 10.07 lakhs in 1991 and 11.42 lakhs in 2001. The population of Cochin Region as per 1981 Census was 14.82 lakhs.

The Structure Plan envisages long-term and short-term measures for ensuring the cohesive development of the Central Area. The plan mainly deals with control mechanisms for guiding the future urbanisation and positive actions to be taken up by various development Agencies. The plan calls for concentrated and programmed course of actions among various development agencies functioning within the area as well as healthier interaction of the public and government agencies.

The Structure Plan contains scheme for population distribution and plans for traffic network and land use. The plan for population distribution was aimed towards restricting the urban growth within the boundaries of the Central City and ensuring a balanced distribution of future population within a central city for optimum utilization of urban land consistent with the economics of the land market mechanism and the socio-cultural values of the people.

It was proposed to divide the Central City into seven planning divisions. These divisions were envisaged as more or less self contained settlement of communities with regard to their requirement of work places, residential accommodation, shopping, community facilities and recreation. The details are as follows:

- The Corporation of Cochin was sub divided into three areas.
- The oldest settlement on the western side of the city constituting Fort Cochin and Mattancherry together with Edacochin and Wellington Island formed the first planning division
- Northern side of the city consisting of Pachalam and Edapally zones of the Corporation, a contiguous area with identical planning problem, formed the second planning division.
- The Central Business District (CBD), Panampally Nagar zone and Maradu Panchayat formed the third planning division
- Thrippunithura Municipality and Thiruvankulam Panchayat possessed close interaction in social, economic and physical function, and formed fourth planning division.
- Thrikkakara and Kalamassery Panchayat had similarity of terrain and type of development and hence were identified as fifth planning division.
- The Panchayats of Eloor, Cheranellur and Kadamakkudy formed a homogeneous unit for planning purpose as they had interdependency for transportation, work and community facilities. This formed the sixth planning division.
- The coastal panchayats of Njarakkal and Elamkunnappuzha together with Mulavukadu Panchayat constituted the seventh planning division.

Future population and densities were assigned to the planning divisions based on the holding capacity and future growth trend of each of the divisions. The assigned population formed the basis of working out the plan for each of the divisions. Each of the planning divisions was further sub divided into communities with population ranging from 30000 to 40000. Such a division was meant to facilitate the provision of community needs and services without imbalances in the development of division. Area under each of the planning divisions was divided into well defined zones specifying the land use and density of population. The control of land use and density was to be achieved through zoning regulations.

The density in the core division was kept high because of the restrictions imposed by the services in this area. In the peripheral divisions, the density was assigned low so as to provide space for future planned growth.

The traffic network plan was aimed as arteries of urban mobility. The city level plan proposed the following:

- Eight radial roads (primary distributors), providing direct linkage between the city and major growth centres in the region and environs
  (Cochin-Munambam, Cochin - Parur, Cochin – Alwaye, Cochin – Perumbavur, Cochin-Moovattupuzha, Cochin - Vaikkom, Cochin – Cochin –Alleppey and Cochin – Chellanam) ;
- Three ring roads, to link the radial roads together to achieve inter connection between them at various distances from the centre of the town (Inner ring road – Elamkulam – Kaloor, Kaloor – Perandoor Road forms part of this, Middle ring road – Segment of NH bypass , NH 47 and coastal highway NH-17 formed part of this; and outer ring road – proposed to link directly the industrial zones and other work centres lying in the peripheral areas of the city. This would also open up the sparsely built up land for industrial and housing development); and
- Secondary road network, to ensure accessibility for all parts of the city to the public transportation. This linked to the radial roads and ring roads formed the basic network of development. One major policy in allocating the secondary road network was to ensure that no point in the city is located farther than 1 km walking distance from the bus routes.

Other proposals included improvement of junctions, creation of grade separated foot paths and cycle lanes, allocation of parking space, two central bus stations (one for KSRTC and another for all the private buses to be located close to each other), city service stations, transit stations at interchanges road, rail and water ways wherever they are integrated, truck terminals and proposals for improvement of inland water ways and renovation of canal system.

The land use plan of the Central City was evolved with consideration (i) to make sufficient land available for the prime activities as per space standards; (ii) to achieve a balanced development of the city by decentralizing the work centres related to the population distribution; and (iii) to guide the urban development in an orderly manner by emphasizing the services at different level. The land use plan proposed to accommodate major share of the future land requirement for commercial use in the CBD areas and planned sub centres and community centres, to promote a concentration of activities in specific nodes of the city thereby preventing the proliferation of such activities all over the urban area.

It was proposed to keep the CBD areas and the heavily built up areas of the city for detailed study and area redevelopment in a phased manner. The CBD functions were to be decentralized by initiating 8 planned sub centres in the city. The sub centres were conceived as an integrated facility of commercial, institutional and industrial uses to serve the population of the planning division. For the community needs of the urban population 24 Community Centres, (each serving a population of about 30000 to 40000) were proposed.

The land use plan also proposed for extension of land under industrial use near existing large scale industries, allocation of land for new industrial zones for export production and planned industrial growth. The institutional buildings, offices etc were proposed to be distributed in the CBD area, the sub centre and the administrative complex at Thrikkakara. The community uses were to be distributed in the residential areas and community centres.

The land presently under agriculture was proposed to be retained as a buffer stock and only very low density permitted, but part of land was proposed to be converted into developed land
The major proposals in allocation of land under traffic and transportation were (a) development works of port, airport and railways (b) completion of all roads and bridges in the primary and secondary network designated in the plan and widening of roads at the tertiary level (c) development of traffic terminals (d) development of boat jetties and inter-change points.
Proposal for development of a major city park, a botanical garden, a green strip with parks and specialized recreational activity areas, play grounds and sports fields and community open areas catering to different levels were also included in the Plan.
Government , as per GO(MS)NO.143/07/LSGD dated, TVM, 31st May 2007, have varied 'Part IV, Zoning and Sub division regulations' of the Structure Plan for Central City, Kochi for the purpose of making the zoning regulations compatible to the present development scenario, as an immediate measure, until the scheme is further varied after detailed studies.

6.1.4 Development Plan/Detailed Town Planning Schemes

Seven Development Plans were prepared/being prepared for the entire district including the sanctioned Structure Plan for Central City. Based on the Development Plans, 56 Detailed Town Planning Schemes were prepared/under preparation in the district of which 29 Detailed Town Planning Schemes were sanctioned by the government.

Development Plans for the following areas are under preparation:

- Development Plan for Perumbavoor town;
- Development Plan for Aluva town;

- Development Plan for Angamaly town;
- Development Plan for Parur town; and
- Development Plan for Kalamassery town

Detailed Town Planning Schemes (DTP Schemes)

The main tool for implementation of the development programe is the Detailed Town Planning Schemes. Government had so far sanctioned 26 Detailed Town Planning Schemes within the region. These schemes are under various stages of implementation. Out of these 26 Detailed Town Planning Schemes, only 23 are within the jurisdiction of the GCDA. The DTP schemes prepared in the region can be broadly categorised according to their functions namely:-

(i) Residential Area Development Schemes;
(ii) Commercial Area Development Schemes;
(iii) Road Development Schemes; and
(iv) Composite Area Development Schemes

The GCDA has implemented ten major housing schemes in the area. In the commercial sector, nearly 25,000 sq km of built up commercial space in the various scheme areas were developed by GCDA. The list of sanctioned DTP Schemes in Kochi area is given in Annexure 1.

6.1.5 Vision Document for Kochi, 2002

Steps were taken from 1997 onwards to obtain and consolidate the suggestions and aspirations of different sections of the society with a view to arrive at a vision for the city. Sector wise workshops were held, aspirations of peoples representatives, elected representatives of Municipalities and Panchayats, members of Residents Associations, neighbourhood units, ward committees and grama sabhas were consolidated and a Vision workshop was held in 2002 and arrived at a Vision Document. Various institutions like the Kerala Institute of Local Administration (KILA), Cochin University of Science and Technology (CUSAT), Centre for Earth Science Studies (CESS) and Corporation of Cochin (CoC) held seminars considering the growth potential of the city. In addition to this, the suggestions and proposals derived from the representatives of various sections of society, the recommendations evolved during the workshops and seminars and the studies conducted by various agencies like M/s RITES, NATPAC KRFB, GCDA, Kochi Port trust, KSRBC etc and the papers presented by experts in various fields have been made use of in finalizing the Vision and is as shown below:

'An economically productive, effective and egalitarian metropolis which will provide to all sections of society the desired level of services and attract worldwide attention as a preferred destination for Health care, Heritage, Tourism, IT and Port based services'

6.1.6 City Development Plan (CDP) for Kochi, 2006

City Development Plan (CDP) for Kochi was prepared in 2006 as a prerequisite for accessing financial assistance under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM). JNNURM is a major urban development related program initiated by the Ministry of Urban Development (MoUD) and Ministry of Housing and Urban Poverty Alleviation (MoHUPA), Government of India in 2005. The Mission has a project period of seven years (2005-2012).

JNNURM is a comprehensive Mission which envisages improvements in urban infrastructure components prioritized by the Urban Local Bodies in the CDP, provision of Basic Services to the Urban Poor, improvements in Urban Governance and enables the State and the ULBs to undertake and carry out reforms to ensure better Urban Governance and improved service delivery. Detailed Project Reports (DPRs) are to be prepared for the prioritized infrastructure components identified in the CDP and submit to GoI, to be financed under the Scheme.

JNNURM envisages that the CDP shall be considered as 'Living Document' which mean that the City Government shall refer to the CDP for development priorities, to carry out reforms, for improving Municipal Finance as per the Vision given in the CDP, for expanding the scope of Financial Operation Plan to source funds for the priority development actions etc.

The CDP for Kochi was prepared by the Municipal Corporation of Kochi in 2006 and was approved by the MoUD and MoHUPA. The objective of the CDP is to develop a city development framework for Kochi City and environs. The gaps in service delivery were identified after assessing the present status of the city in respect of demographic & economic growth, infrastructure, services, finance etc. Vision under each sector and strategic framework outlining the goals, strategies, interventions and projects to achieve the vision were prepared so as to bridge the gap between the existing facilities and the future requirements. Sectors were prioritised with due consideration to the National and State Govt. policies and International development trends; short, medium and long-term goals and financial, physical and administrative interventions required were identified and a city investment plan was formulated. The CDP comprises of plans for the identified sectors of development within a period up to the year 2026, outlining the policy framework and investment interventions within a 7 year period to

achieve the vision. Focus was also given in the CDP on urban reforms to be carried out at the State and ULB levels.

Kochi Urban Agglomeration as identified in Census 2001 comprise of Kochi Corporation, Municipalities of Kalamassery, Thrippunithura, Aluva, Angamali and North Paravur, 15 Panchayats and part of 3 Panchayats. The population of Kochi UA as per 2001 Census was 13,55,972 and covers an area of 330.02 sq.km.

For the purpose of delineating the planning area of the CDP, the Central City as per the Structure Plan for Kochi sanctioned by Government was redefined to include the area lying contiguous to the core urban area which have potential for the urban development due to the additional infrastructural inputs already planned and the large scale investments already committed which are likely to increase the urban characteristics and considering the administrative/ geographical boundary. Certain areas on the north & north east portions of the Urban Agglomeration are excluded as these areas show a greater dependency on the secondary urban centers closer to them than to the core city.

The CDP area covers Kochi City, 2 adjoining Municipalities (Thrippunithura and Kalamassery) and 13 contiguous Panchayats (Elamkunnappuzha, Njarakkal, Mulavukadu, Kadamakkudy, Cheranallur, Varappuzha, Eloor, Thiruvankulam, Thrippunithura, Maradu, Kumbalam, Kumbalangi and Chellanam). The population of the CDP area comes to 11.38 lakhs as per 2001 census and is estimated to be 17.52 lakh by 2011, 21.69 lakh by 2021 and 25.29 lakh by 2026 (including migration and floating population).

The CDP had 11 major components on Urban Infrastructure and Governance and Programme on Basic Services to the Urban Poor prioritized for development with a total estimated cost of Rs 10983.45 Crores.

The major observations in the land utilization pattern as per the CDP, Kochi is as follows:

- In spite of restrictions in reclamation of water bodies as per Coastal Zone Regulations, private encroachment of water bodies take place, especially by private properties adjoining water bodies.
- Land under water, paddy and fish farm get converted for construction purposes
- 'Water Sheet' (back waters, rivers, canals, tanks, ponds etc) constituted 23.40 % of the gross CDP area in 1981. This was estimated to be 16.42% in 2006.
- There appears to be considerable shortage of land under parks, Playgrounds, Open Spaces etc. Only area less than 1 % of the area of the city is available as public open spaces and play grounds (including stadia). There is a need for city level parks and playgrounds as well as zonal, community and neighbourhood level open spaces.

CDP recommends emphasis on the following with respect to land utilisation:

Preparation of a Spatial Development Plan for the Greater Kochi Region and Master Plan for the CDP area along with specific zoning regulations and development parameters. Special emphasis is to be given to the following aspects:

- Water front development planning including rehabilitation of encroachers on the public land;
- Land use planning based on sound principles of planning;
- Beautification of specific water front areas - can be taken up directly or on BOT / Public Private Partnership (PPP) basis;
- Water based recreational facility creation (already included as part of tourism);
- Creation of land and water based open space system; and
- Enhancement of the use of waterways for tourism and inland navigation

Priority sectors of development were identified for development based on secondary studies and discussions with stakeholders. In addition to identifying priority project components, the CDP has attempted brief project profiles for each of the projects along with a tentative cost estimate for infrastructure improvement. Details of projects identified in the City Development Plan for Kochi are given in Annexure 2.

Basic Services to the Urban Poor (BSUP)

The CDP has estimated that 34 percent of the people living in the CDP area are in BPL (below poverty line) category and there are 411 slums with 132420 persons living in these slums. Proposals included in the CDP for improving the living conditions of the urban poor are:

- Development of comprehensive database on the urban poor
- Strengthening of the institutions and capacity building to attend to the projects for the urban poor
- Environmental improvement of urban slums
- Providing electricity and street lights
- Providing civic amenities
- Providing dwelling units
- Ensuring social security
- Giving livelihood oriented programmes
- Improving health and education facilities

The total expenditure estimated on the above is Rs 885 crores (Rs 508 Cr. for Kochi City, Rs 49 Cr. each for Municipalities of Thripunithura and Kalamassery and Rs 21 to 22 Cr. for each of the 13 panchayats)

A few of the DPRs got prepared for Kochi were approved and projects costing Rs 558.12 Cr under UIG and projects costing Rs 135.66 Cr under BSUP for Kochi and the towns and Panchayats included in the CDP have been approved (as on 2010).

6.2 REVIEW OF STUDIES

6.2.1 Comprehensive Traffic and Transport Study (CTTS) for Greater Cochin Area, August 2001 by RITES

The study was prepared by Transport department, Government of Kerala with RITES Ltd, a Government of India enterprise in 2001 for Greater Cochin Development Authority (GCDA). The GCDA area includes Goshree Island Development Authority (GIDA) with its suburbs extending up to the satellite towns Angamaly in the North, Thripunithura in the East and Aroor in the South.

A number of traffic surveys have been carried out to assess the socio-economic and traffic characteristics of the resident population and commuter traffic. These include, Road Network Inventory along arterial and major roads, Speed and Delay survey, Classified Traffic Volumes Survey at Screen Lines, Mid Blocks, Intersections and Outer Cordon Points, Pedestrian Survey at selected locations, Parking Survey at identified stretches, Origin and Destination survey at outer cordon points, Household Travel survey, Passenger Occupancy Survey, Terminal surveys (Bus, Rail, IWT, Airport), Bus stop survey, Public Transport Operator Survey, Intermediate Public Transport survey, Level crossing survey, Tourist survey.

The travel data collected through survey for the defined zone system has been used to develop the Lowry land use transport model for the horizon year 2021. The land use transport model has been developed at strategic level, utilizing an aggregated system of traffic zones with compatible transport network for testing development strategies. This model is based on the premise that given the basic employment locations, it is possible to predict population and service employment.

The land use transport model developed comprises of Economic Base Mechanism, Allocation Base Mechanism, and Transport Sub-System. Traditionally four stage transport demand model has been developed. The transport land use model includes two basic employment strategies, two population location strategies and five transport network. Twenty alternative scenarios have been developed by combining the strategies of basic employment, population, and transport network. The land use transport model developed has been used for obtaining the traffic assignments on the proposed network for the horizon years.

Short term Improvement Measures- The data analysis of the traffic surveys has been used to identify the problem areas type and intensity. The following parameters have been taken into consideration for problem identification, Volume Capacity ratio, Degree of congestion,

Congestion index, Parking index, Saturation Capacity of Intersections, PV2 values (Pedestrian volume x Vehicle volume2 during peak hour).

The corridors where the V/C ratio is more than one and the congestion index is high have been selected for improvement schemes under the short-term scheme. A total of 16 junctions have been selected for improvement, out of which 7 junctions are proposed to be provided with automatic signals.

i) Short term improvements like, corridor improvement schemes, intersection improvement schemes, holding areas for buses and LCVs are suggested. These are to be implemented within a period of one to two years. ii) To provide immediate relief from the traffic problems, rapid action plans are proposed. These are simple and immediately implementable measures viz. road markings and signages, area traffic management schemes, parking management and pedestrian facilities which will serve as the precursor of the short term improvements measures.

Medium term Improvement Measures- The transport demand projected by the land use transport model and four stage transport model has been used in formulating the medium term improvement proposals. The 'Shortest Path Assignments' with all 'All or Nothing' assignment procedure has been adopted for assignment of estimated horizon year trip interchanges. The traffic assignments in PCUs have been taken as the basics for formulating the road improvement proposals.

18 new roads and missing links are proposed in the study area at an estimated cost of Rs.180 Crores. To reduce congestion and delays, grade separators/ROB is also proposed. The total estimated cost for the road development proposals works out to Rs.280 Crores in the next ten years.

The Inland Water Transport (IWT) system in the study area comprises of ferries operating from 10 major terminals. The ferries operated by private operators as well as KINCO act as the principal link between the mainland and islands of Vypeen and Vallarpadam.

Two scenarios of the proposed public transport plan have been prepared. In the first scenario, modifications have been made with reference to the changes in the road network and adding the routes from the municipal areas falling in the jurisdiction of the Greater Cochin Development Authority. In another scenario the routes have been reorganized by considering the major terminals in the study area and the routes from each terminal.

To reduce the pollution, the diesel buses have to be changed into CNG buses and also IWT has to be redesigned for the efficient functioning has been proposed in the study area.

Mass Rapid transit system- The rail based mass rapid transport corridors have to be identified to cater to the anticipated travel demand and earmark the reservation of land for the same. The traditional four stage transport model has been developed for projecting the transport demand for the year 2005, 2011 and 2021. Based on the traffic assignments, the MRTs have been identified as, Phase 1: Kalamassery to Tripunithura (23 km), Phase 11: Aluva to Kalamassery (7 km). Economic review has been carried out for Phase 1 of the MRTS network by comparing "with" and "without" the project scenario.

The proposed MRTS is estimated to cost of Rs.1625 crores in Phase 1 at April 1999 prices. The economic internal rate of return is estimated at 24 %. Financial rate of return is estimated as 3% with a fare structure of Rs.7.00 per trip. As per the study undertaken, the project is not viable but it is economically very attractive based on the traffic demand estimation.

6.2.2. Traffic and Transportation System Study for Kochi City, 2007 by NATPAC

A detailed study on traffic and transportation system of Kochi city was carried out by as part of preparation of Development Plan for Kochi. The summary of the Report is as follows:

Travel characteristics

- Detailed studies were carried out to ascertain the intra-city and inter-city travel characteristics of Cochin city
- A total of 2.28 lakh trips were performed by the resident population of Kochi Corporation in 2006. The per capita trip rate was found to be 0.46. Majority of passenger trips (60%) were performed in public buses, followed by 26% in two wheelers and 20% by walk.
- About 1.49 lakh inter-city passenger vehicular trips were performed in the study region on a reference day. The modal split of inter-city vehicular traffic showed that nearly 52% of the total vehicles were two wheelers, followed by 31% of cars, 8.5% of autorikshaws, 6.6% of buses and 1.9% of mini-buses.
- Out of 6.47 lakhs inter-city passengers, 65% of them were traveling in buses followed by 15% in two wheelers, 14% in cars, 4% in autorikshaws and 2% in mini-buses.
- Inter-city goods traffic in the study region was handled by a number of goods vehicles consisting of 11,176 trucks, 8,690 mini-trucks/tempos and 6,262 goods autorikshaws. Goods traffic to the tune of 80,797 metric tonnes were transported to various destinations.
- Bulk of goods vehicles (78%) either originated from or terminated in Kochi City. Only 21 per cent of the total vehicles were found to be bypassing the City.
- The traffic problems in Kochi City were assessed through intensive site investigation coupled with collection of primary and secondary data regarding the traffic characteristics of the city. From the same, a set of indicators for quantifying the traffic problems in Kochi City has been evolved. They are the volume-capacity ratio, Degree of congestion, Congestion index, Parking density and Pedestrian-vehicle conflicts:
- Apart from MG road, Sahodaran Ayyappan road, Chittoor road, Bannerji road and Shanmugam road are the other major travel corridors passing through the city, having acute traffic problems.
- On-street parking of vehicles has been one of the major causative factors for the severe traffic problems of Kochi City.

- Adequate facilities for pedestrians were lacking in almost all major pedestrian intensive locations in the city.
- Most of the intersections along MG road, SA road, Bannerji road and Shanmugam road had high level of vehicular conflicts.
- Consequent to the evaluation of traffic problems and identification of problematic locations in Kochi City, various short term traffic engineering and management measures are proposed to ease the traffic congestion at selected locations within the city.

Traffic projection

- The planning inputs for the Transport Development Plan of Kochi City have been projected for a horizon period of 20 years.
- In the first stage, growth rate method is used to predict the future traffic at all the road stretches to account for normal growth of traffic arising out of population growth, vehicle growth and commercial development.
- In the second stage, additional traffic generated from the developmental projects envisaged at the peripherals of Kochi City like Vallarpadam, Kalamasserry, Kakkanadu, Amabalmugal etc, are estimated. The generated traffic was distributed to various traffic zones in the proportion of existing pattern of inter-city traffic. In the third step, the traffic distributed to various traffic zones were assigned on the road network through the shortest path from the generating zones.

Medium and long term Transport Development Plan

- Medium and long-term transport facilities for Kochi City were planned involving the development of alternative transport development plans taking into account the proposed land use developments.
- The configuration of the existing road network within Kochi city does not reflect any regular form, although, it resembles more or less like grid-iron pattern of network. There are six major corridors in the north-south direction and almost an equal number of east-west corridors.
- The east-west connectivity of the city is hampered to great extent by the railway line and waterways. The east-west connectivity is also hampered by the waterways.
- Most of the available north-south corridors are narrow and are passing through the congested CBD areas.
- Various transport related problems facing the city along with the development plans for the city prepared by various agencies have been taken into account while formulating the long term network development strategy for the city. The development strategy for the city has been prepared giving special emphasis in relocating the heavy traffic

generating facilities and services to the peripherals of the city. In order to reduce the number of private vehicle trips and IPT trips, the development strategy give importance to develop an efficient public transport system for the city.

- Based on the evaluation of the future year traffic loadings on the base year network, alternative network development schemes have been formulated so as to reduce the traffic loadings on routes where the traffic volume exceeded the capacity. All committed road development schemes and the proposed land use development plan for the city were taken into account while formulating the alternative network development plans.

- **Development of grid-iron pattern of network for Kochi City:** The central part of the Kochi city has been developed in a grid iron pattern with roads radiating in north-south and east-west directions, It is proposed to retain the existing grid iron pattern of network for the central area of Kochi by developing the existing roads and also by providing more linkages to newly developed areas. Since acquisition of land is a difficult proposition in the central area, it is proposed to have two-tier road system in a few of the north south and east-west linkages so as to have additional capacity on these links.
- North-south linkages (NS-01 to NS-16) measuring 123.25 km are proposed for development into arterial/sub-arterial standard by widening existing roads, developing missing links and constructing flyovers/two tier roads.
- Also eleven east-west linkages (EW-01 to EW-11) measuring 62.3 km are proposed for developing into arterial/sub-arterial standard by widening the existing roads, developing the missing links and constructing flyovers/two–tier roads.
- Four other linkages were also proposed including links providing connectivity to both North and South railway stations in the City.
- Under the proposed Grid Iron network development plan for Kochi City, there would be 43 kms of 6-lane road, and 4 km of 4-lane road under arterial road category. The roads under sub-arterial category will be 94 kms consisting of 63 km of 4 lane road and 31 kms of 2 lane road. Roads under Collector road category will be 467 kms. With the proposed developments, the share of arterial and sub-arterial roads in the total road network will increase from 11% to 23%.

- **Development of 'Ring and Radial System' network for Kochi Region**: Taking into account the future developments and growth potential of the city, four concentric ring roads – R-01, R-02, R-03 and R-04 – are proposed for Kochi region with 13 inter city and inter regional roads radiating from these ring roads towards the periphery. All the concentric ring roads start from Wellington Island and ends at Vyppin / Vallarpadam and the ring roads spread towards north, east and south of the city.

- **Flyovers/underpass:** In view of the high volume of traffic, it is proposed to have grade separated intersection facilities at 11 locations and rail over bridges at seven locations.

- Apart from widening those bridges, which form part of the proposed road development plan, new bridge need to be constructed near Perandoor along the proposed Vaduthala-Perandoor road as part of east-west linkage.

- **Development of parking infrastructure:** Off-street surface parking, multi-storied parking and automated parking system has been proposed to resolve the parking problems faced by Kochi City.
- Parking on the periphery of the city or activity centers served by transit vehicles have also been proposed to improve the parking supply.

- **Development of pedestrian facilities**: Pedestrian facilities in the form of walkways, marked cross walks and pedestrian over passes/underpasses have been proposed at selected locations.
- Road side appurtenances: Proper road way marking such as pedestrian crossing, traffic lane marking, bus bay marking, stop lines, parking area marking, centre line marking etc are proposed for all the identified road corridors in Kochi city. Similarly, traffic signs are also proposed for major road corridors in Kochi City.

Development Plan for Public Transport System

- After considering various travel and physical factors prevailing in Kochi City and the feature of various transport options available for selection, a combination of different mass transportation systems has been recommended for implementation in Kochi City for various horizon years. The mass transport system proposed for Kochi City comprises of bus transport system, inland water transport system, metro rail system and sub-urban rail system.
- **Metro rail system: Delhi Metro Rail Corporation has prepared a detailed plan for the development of metro rail corridor between Aluva and Petta (25.253 Km), which is in advanced stage of implementation. A total of 24 stations have been proposed by DMRC along the proposed Corridor.**

- **Sub-urban rail system**: A sub-urban rail system for Kochi Region is proposed to be developed by constructing a few new lines and rebuilding the old lines, to improve the service facilities and upgrade the services. The proposed sub-urban rail system comprises of two ring and a series of radial lines.
- By the year of 2025, nearly 139 km of sub-urban railway line has to be newly built, expanding the total length of suburban railway lines within Kochi region to 291 km.

- 56 major terminals are proposed to be developed on the sub-urban rail system including 24 existing terminals. The passenger load expected in various sections of the sub-urban wail system has been worked out for various horizon years.

- **Bus transport system**: It is proposed to develop a bus transport system to serve Kochi City and its environs by complementing and supplementing the metro rail and sub-urban rail systems.
- Based on the passenger demand for bus transport and considering the road network characteristics, a series of circular, link and radial routes have been proposed for city buses. Detailed routing plan for the 10 circular routes, five link routes and 14 radial routes have been worked out. The number of buses required for operation on these routes and the vehicle utilization achieved by these buses have been worked out for various horizon years based on passenger demand, route length and frequency of operation.
- A set of five major terminals and eight mini-terminals (operating terminals) has been proposed for Kochi city for easy and efficient operation of the bus transport system enabling convenient transfer facilities for the traveling public within the system and amongst other transportation systems proposed for Kochi city.
- Also a management plan for operation of bus transport system has been proposed to improve the efficiency of the system.

- **Inland water transport network:** The waterway network in Kochi is more or less of a 'grid iron' pattern, with only a few missing links. If properly developed, the IWT network could meet considerable proportion of transport demand of the city. The development plan for IWT was essentially based on developing this 'grid iron' type of waterway network so that the IWT and other modes of transport could jointly meet the total transport demand of the city. There are eight north-south IWT linkages and four east-west linkages under the proposed IWT network development scheme.
- Based on the travel demand and proposed IWT development plan for Kochi, a number of IWT terminals are proposed to be developed in various parts of the city and at appropriate locations within the region.
- The vessel technology and design depends upon the traffic requirements, waterway conditions, safety and economic aspects. The main problem with operating passenger services on waterways is that fast vessels create an unacceptable high wash, which affects other water users and damages bank installations. Without speed, passenger ferry services become uncompetitive. Considering these aspects, Catamaran vessels has been proposed for Kochi City as a high speed IWT service vessel. Catamaran uses the concept of long thin hulls to reduce both resistance and wash. One thin hull has stability and capacity problems, but by combining two hulls of this type, a suitable hull

with good passenger carrying capacity and low wash and resistance characteristics could be achieved.

- At present there are five agencies involved in the operation of IWT services in Kochi. This results in inadequate and inefficient operation of services. To achieve economy of scale of operation it would be desirable to have a single agency to undertake the entire operation of IWT. Certain incentives for traveling public in the form of telescopic fare rates, composite ticket for multiple journeys, including small distance bus journeys, passenger information system using ITS could help attract more passengers to IWT.
- Based on the setting of the proposed IWT network in the east-west and north-south corridors parallel to the proposed road network, the quantum of traffic that could be diverted to the proposed IWT network has been estimated.

- **Proposed truck terminals**: It is proposed to have four freight terminals in Kochi city which would provide integrated facilitates of highway transport functions, such as, truck parking facility, transit and transshipment facilities for goods, communication, amenities and facilities to crew, transport agency offices, vehicles repairs and maintenance and related activities. It should also act as logistics center for goods warehousing, inter-modal transport, container transport and freight forwarding services etc.
- Apart from the above first class terminals, it is also proposed to have a parking lot for trucks and min-truck at Marine Drive to cater to the goods vehicles using the markets in the locality.

- **Intelligent transportation systems:** Many of the traffic congestion and associated travel delays and environmental pollution prevailing in Kochi City could be reduced considerably by opting to Intelligent Transportation Systems (ITS). The requirement of ITS comes from the problems caused by traffic congestion in Kochi city. The problems could be addressed to a great extent by applying ITS technology which combines information technologies, simulation, real-time control and communications networks
- Considering the recent developments in Kochi city, which is emerging as an IT center of excellence, ITS has a tremendous scope to play, especially in ‘Area Traffic Control System’, ‘Advanced Traveler Information System using GIS’; ‘Parking Guidance and Information System’; and ‘Development of Cordon zones’.

Evaluation of Transport Development Schemes

- As first step towards evaluation of the proposed transport development schemes for Kochi city, the projected traffic were assigned on the existing road network to assess the traffic flow scenario in the ‘do-nothing’ situation and to identify the deficiency of the transport network in catering to the future traffic demand. Accordingly, alternative road network and transportation development plans were formulated. These were tested for their efficiency by assigning the projected traffic on those networks. Subsequently, the

optimal transport network which satisfied the criteria of balanced development of the city with uniform distribution of the projected traffic on the networks in various horizon years was selected.

- **Phasing program:** A phasing program for various development schemes has been prepared. The phasing program has been worked out separately for road, rail, IWT and auxiliary schemes like parking, pedestrian and ITS infrastructures.
- Metro rail has been given the first priority considering the fact that it relieves the severe traffic congestion faced in the main corridors of Kochi City namely Bannerji road, MG road and SA road to a great extent. It is expected that the project for which detailed project report has already been prepared and the Government has approved the same in principle will be commissioned before 2010.
- In the case of city road development schemes, the phasing program has been worked out by taking the visualized traffic congestion measured in terms of volume capacity ratio as a major criteria. Accordingly, five phasing programs have been arrived by considering the v/c ratio for different horizon years in the 'with-project' situation. As per the phasing program, 65 km of road development works need to be taken up in the first phase, followed by 35 km in the second phase, 24 km in the third phase, six km in the fourth phase and 14 km in the final phase within Kochi Corporation limits.
- In the case of regional roads, road network in the immediate vicinity of the city has been given the first preference, followed by roads in the order of their distance from the city center. Accordingly, ring road IV has been given the first preference. In the case of various radial roads, roads linking the district headquarters have been given the first preference, followed by roads connecting taluk head quarters, municipalities and other places in the order.
- Auxiliary road infrastructure like bus bay and terminals, goods terminals, parking and pedestrian facilities, road side appurtenances and ITS are proposed to be taken up along with the development of the respective road schemes.
- Similar to road development schemes, five phasing programs are considered for development of sub-urban rail network in the influence area of Kochi City. The estimated traffic in various horizon years has been taken as the criteria for phasing of the schemes. As per the phasing program, 13.8 km of sub urban network needs to be developed including construction of 5 km of missing link in the first phase, followed by 50 km in the second phase, 85 km in the third phase, 86.6 km in the fourth phase and 55.6 km in the fifth phase.
- Phasing programs have been evolved for IWT development in Kochi City considering the traffic potential. As per the phasing program, 20.2 km of IWT network needs to be developed in the first phase, followed by 11.1 km in the second phase, 10.5 km in the third phase, 70 km in the fourth phase and 71.5 km in the fifth phase.

- **Cost estimate:** Cost estimate for carrying out various infrastructure development schemes have been prepared based on current market rate for various inputs like land acquisition, buildings, civil works etc. The development costs have been worked out separately for road, metro, rail, sub-urban rail, IWT, roadside appurtenances, ITS, parking and pedestrian infrastructure etc. As per preliminary cost estimate, nearly Rs 16,125 crores will be required to carry out various transportation development projects envisaged for Kochi region, of which Rs 6,675 crores need to be earmarked for the city road development, followed by Rs 4,407 crores for regional road development, and Rs 2,162 crores for metro rail project.
- The phasing of investment for various development projects has been made as per phasing program indicated in the earlier section. As per the investment program, the maximum investment of Rs 6,214 crores will be required in the first phase, followed by Rs 4,672 crores in the second phase, Rs 1,135 crores in the third phase, Rs 3,153 crores in the fourth phase and Rs 1,091 crores in the last phase.

- **Proposed implementation plan for Kochi City:** The Kochi Corporation may not be able to mobilize the necessary resources for developing the infrastructure projects proposed in this report. While some of the development schemes like development of bus bays, bus terminals, parking development schemes etc can be entirely left to the private sector, which would be able to generate adequate revenue through the advertising, other development schemes like road widening, IWT development, metro rail etc need to be taken by the Corporation through any of the implementation options like Build-Operate-Transfer (BOT) through public-private partnership, BOT toll based, BOT annuity scheme, Government owned Special Purpose Vehicle (SPV) or through Memorandum of Understanding (MOU) negotiated deal.

- **Pooling of resources for infrastructure development:** Required funds for infrastructure development schemes need to be sourced from diverse resources like grants-in–aid or allocation from the Central Road Fund, and other centrally sponsored schemes like JNNURM, a proportion of the State motor vehicle tax, a special cess on petrol/diesel, government subsidy, parking fee, congestion pricing, advertising revenues, etc. With these diverse resources, the Corporation can set up a Road Fund Board with initial equity participation. The fund has to be used judiciously to solve traffic and transportation problems both for the short term and long term, which require top priority and urgent attention. It can be used to pay off the annuity requirements, initial investment, operating and maintaining cost etc. A proper financial management system should be worked out for managing the road fund.

6.2.3 Detailed Project Report on Kochi Metro Project by DMRC Ltd, 2005

A detailed project report prepared in July 2005 by Delhi Metro Rail Corporation limited for Government of Kerala.

Public transport system is an efficient user of space and energy with reduced level of air and noise pollution. As the population of the city grows, share of public transport, road or rail-based, should increase. Whether public transport system on a corridor in a city should be road based or rail based will depend primarily on the traffic density during peak hours on the corridor. When a corridor traffic density during peak hour's crosses 8000 phpdt provision of rail based mass transport, i.e. metro system can be considered. In Kochi, where road widths are inadequate, this figure may be more than 10,000 persons per hour per direction (phpdt). The projected phpdt in 2011 on Aluva – Petta corridor is 13681.

Greater Kochi area with its present population of 1, 9 million and employment of 7.0 lakh has a travel demand of 14 lakh passenger trips every day with 2.4 lakh trips performed during peak hour. With growing population and mega development plans coming up for the port city the travel demand is expected to grow steeply. With the growing economy and inadequate public transport services the passengers shall shit to private modes which are already evident from the high vehicle ownership trends in the region and road accidents. Therefore road based public transport will not serve the purpose and there is an urgent need to introduce a Light Metro system in the city to provide fast, safe, economic and environment friendly mode for mass movement of passengers. Carrying capacity of Light metro system is up to 25,000 phpdt which can take care of the traffic problems for greater Cochin area for the next 25 years.
The Kochi metro rail project can be taken up based on Build Operate and Transfer (BOT) basis with State - Central Governments participation.

The proposed Aluva- Edapally-Petta MRTS corridor runs southwards from Aluva to Petta via Polinchodu, Companypady, Ambattukaru, Muttom, Appolo Tyre, Jacobite Church, Kalamassery, Pathadi Palam, Edapally Junction, Edapally, Palarivattom, J.L.Nehru stadium, Lissi, Madhav Pharmacy, Maharaja College, Ernakulam south station, GCDA, Fathima church, Elamkulam, Vytilla and Thaikodam covering a distance of 25.253 kms from centre of Aluva station to Petta station.

Major road along the corridor are Banerji road, M.G.Road, M.G.Road to Vytilla, and Vytilla to Petta. Other important roads across the corridor are Masjid road, Perumpavoor Road, Companipady road, Kalamassery road, Cochin university road, Judos avenue road, SRM road, Chitoor road , Jews street, Vishal street, Mullassery canal road, Hospital road, South railway station road, Karshaka road, KP Vallon road, Bye-pass road, Thevarakkvu road and Eroor raods etc.

Stations are located so as to serve major passenger destinations and to enable convenient integration with other modes of transport. A total of 24 stations have been planned along the proposed corridor. 21 stations are proposed to be constructed initially and 3 are future stations. All stations are proposed to be elevated except for Alwaye which is at grade. Average interstation distance is one km, though it varies from 0.50 km to 1.70 km due to landuse and topographic reasons.

Operation Philosophy: The main features are, selecting the most economical frequency of train services to meet sectional capacity requirement during peak hours on most of the sections; economical & optimum train service frequency not only during peak period (2.5 minutes headway) but also during off peak period (15 minutes headway); a short train consists (3 coaches) with high frequency service to be suitably increased to 6 coaches as the transport demand picks up; multi tasking of train operation and maintenance staff.
Traffic demand: Peak hour peak direction traffic demands (PHPDT) for different years are given below.

Corridor	YEAR (phpdt)			
	2011	2015	2020	2025
Aluva - Petta	13681	17663	21065	23621

Train operation plan: The salient features of operation plan are, running of services for 9 hours of the day (5 am to midnight) with a station dwell time of 30 seconds; make up time of 5-10% with 8-12% coasting; scheduled speed of 36 kmph.

Based on the above considerations the train operation plan for (headway and train composition) for years 2011, 2015, 2020, 2025 has been formulated.

Kochi metro has no legal cover of separate legislation now. Metro comes under the definition of Railways and Kochi metro will be a non-Government railway under the Railways act, 1989.So construction of Kochi metro can commence under the railways act. In the mean while a comprehensive metro act to cover all the metros is now with the ministry of urban development, Government of India. If this act is processed and enacted it will give the required legal cover for the Operation and maintenance of Kochi metro. As an alternative MOUD is also examining whether metro systems can get legal cover under the Indian Tramways act, 1886.

M/s RITES in 2001 conducted a ‘Comprehensive study for transport system for Greater Cochin Area’. RITES study recommended provision of LRTS between Alwaye to Thirupunithura as a long term measure, in addition to short term and medium term measures for improvement to road infrastructure. The brief of their study is given below:

The report states that, the rail based mass rapid transport corridors have to be identified to cater the anticipated travel demand and earmarked the reservation of land for the same. The traditional four stage transport model has been developed for projecting the transport demand for the year 2005, 2011 and 2021. Based on the traffic assignments, the MRTs have been identified as, Phase 1: Kalamassery to Tripunithura (23 km), Phase 11: Aluva to Kalamassery (7 km). Economic review has been carried out for Phase 1 of the MRTS network by comparing "with" and "without" the project scenario. Financial analysis for Phase 1 of the proposed system has been done for the following institutional arrangement with a debt equity ratio of 2:1.i) Implementation/operation by government (all equity). ii) By private sector – BOOT model (ROI-16%). iii) Corporate Model (ROI – 8 % p.a).

The proposed MRTS is estimated to cost of Rs.1625 crores in Phase 1 at April 1999 prices. The economic internal rate of return is estimated at 24 %. Financial rate of return is estimated as 3% with a fare structure of Rs.7.00 per trip. As per the study undertaken, the project is not viable but it is economically very attractive based on the traffic demand estimation.

Since land is a scarce commodity in Kochi, the alignment has been so chosen that land requirement is reduced to minimum. Acquisition of private property has also been kept to bare minimum. Land requirement for the Alwaye – Petta corridor is about 25.3347 hectares out which 9.3787 hectares belong to Governement, while the balance 15.9559 hectares has to be acquired from the private land. The summary of land requirement for different components is given below.

Government land	
For maintenance Depot & Construction Depot	2.7874
For stations & sections	6.5913
Total	9.3787 ha
Private land	
For maintenance Depot & Construction Depot	12.8096
For stations & sections	3.1463
Total	15.9559 ha
Grand Total of land to be acquired	**25.3347 hectares**

6.2.4 Environmental study of Corporation of Cochin, 2006

Study on Environment was carried by Centre for Environment and Development in 2006, as part of preparation of Development Plan for Kochi. The major observations and findings are as follows:

- In order to study the land use changes of Cochin Corporation, the land use maps of 1967, 1988 and 2005 were prepared. The study indicated a considerable increase in built up area by way of conversion of the natural vegetation in the land and low lying areas and cultivated areas.

- At present an area of 31.15 sq.km of Cochin Corporation comes under the Coastal Regulation Zone.

- The CRZ – 1 category area of Cochin Corporation is 25.18 sq.km which includes ecologically sensitive areas such as Water bodies, Mangrove areas, areas of outstanding beauty and historical/heritage sites in Fort Cochin and low lying areas and Paddy fields

- An integrated approach for the management of the backwater is required for reducing the impact of degradation and shrinkage of the backwater system.

- There are mangrove areas both under public as well as private ownership, which can be conserved by strict adherence to the rules and by creating awareness. Mangalavanam mangrove area with a core mangrove area of 2.74 ha, situated near the Kerala High Court, is one of the important ecologically sensitive areas in the Cochin City. The City Corporation may take initiative to formulate an action plan as well as regularly monitor the various activities in the area.

- Most of the low lands in the Corporation Area were earlier used for paddy cultivation. These low lands have been facing threat of reclamation.

Cochin is crisscrossed by a network of canals that were earlier used for navigation. Today, these canals have been turned into wastewater drains. The canals show high levels of pollution, clogging due to weeds, disposal of plastics and other wastes, encroachment and filling of many portions of these networks, finally resulting in floods during the monsoon season.

- There are not many polluting industries within the Corporation limits. However, the air pollution caused by some of the neighbouring industries contributes to air pollution within the City.

- Noise levels in the commercial and even in the silence zones were much higher that the prescribed limits, while it was lower in the sole residential zone.

- Water pollution is one of the major environmental problems in many of the urban areas in Kerala. Point sources of pollution occur when harmful substances are emitted directly into a body of water. A non-point source delivers pollutants indirectly through environmental changes.

- Coastal aquifers in this area experience severe degradation of water quality due to various anthropogenic activities. Ground waters present in the shallow aquifers of some of the stations were poor in quality and beyond potable limit as per the standard set by the WHO.

- The Corporation collects around 60% of the wastes which are dumped at land fill sites in Wellington Island, Cheranellur and Brahmapuram. The rest is found scattered on the road sides, drains and canals. Major issues emerging from unplanned waste disposal include ground contamination from on-plot system which could be of serious concern in rainwater harvesting systems and ground water recharge, as well as contamination in open drains and canals caused by the combined flow of sullage and storm water. A total plan for efficient solid waste management shall be developed after a detailed scientific study.

- The conventional sewerage system covers only about 4 km of the city centre. The rest of the places mainly depend upon plot disposal of toilet waste. The overflow of effluent is directed into the drains. It is estimated that 85,000 premises discharge partly digested effluent into the drains along with 80 million litres/day of sludge. The sanitary system of Cochin City, combined with the intrusion of salt water contributes to the degradation of the local water system. A comprehensive sewerage plan for the entire city shall be developed after a detailed study.

- Development of the slums around narrow streets and sides of canals combined with the lack of awareness on hygiene create large scale environmental problems for the Corporation to deal with.

- Management of Solid Wastes and Sewerage system are critical environmental issues associated with high rise buildings and apartments. Separate systems in each building / adjacent buildings for management of solid waste and sewerage shall be implemented.

- The total area of open/green space/park in Cochin City is only 0.65 sq km which is less than 1% of the Corporation area. When compared to many other cities in India, the present allocation for open spaces in Cochin City is far lower that what is required. The maintenance of public space in the City is important because it welcomes diverse social interactions and the exchange of ideas between different members of the community, and for creating a healthy environment.

- Most of the structures in the heritage sites are reasonably protected. As no polluting industries exist in the immediate vicinity of the structures, chances for degradation by air pollution is low. However, a few structures like the David Hall require more care as, once lost, these structures that tell stories of a bygone era cannot be rebuilt. Being one of the tourist attractions in Cochin, a face-lift may be given to these structures keeping their originality intact. The human element in the deterioration of these structures may be strictly monitored and prevented.

- More attention is required for retaining and conserving the natural beauty of the area for which proper management plans shall be evolved.

Strategies for Conservation, development and Management of Natural Resources and preservation of open spaces are proposed in the Report.

CHAPTER 7

MAJOR NATIONAL AND STATE LEVEL POLICIES HAVING BEARING ON URBAN DEVELOPMENT

7.1 National Policy for Inland Water Transport, 2001, Ministry of Shipping, Government of India

The policy identifies Inland Water Transport (IWT) as an economic, fuel efficient and environment friendly mode of transport. The policy aims to support development of an extensive network of rivers, lakes and canal in the country for shipping and navigation to provide efficient network of inland transportation. While the thrust so far has been in developing road and rail sectors, through this policy, Government recognizes the need to actively promote the IWT sector for it to take a reasonable share in the inter-modal mix of inland transport. Under the Inland Water Authority of India Act, 1985,out of the three National Water ways developed so far, the National Waterway no.3 West Coast Canal from Kottapuram to Kollam is in Kerala. These waterways are being developed for shipping and navigation by the Central Government. In order to revive the IWT, the policy recognizes the need for budgetary support for development of IWT sector and gives equal importance to large scale private sector participation, both for creation of infrastructure and for fleet operations. The IWT strategy aims at generating a more pro-active role by various agencies for the development of this sector, by enlarging the scope of the role of Government as a provider, facilitator and regulator and at the same time, offer various concessions to the private sector for their effective participation by way of investment for creation of enhanced IWT infrastructure and fleet operations. The policy supports for accelerated IWT growth by authorizing Inland Water Authority of India (IWAI) to raise bonds and / or enter into joint ventures. It also gives in-principle approval for equity participation by Government / IWAI in BOT projects and levying minimum customs duty on imported equipments and machinery for development of inland water ways. It supports the development of IWT by giving tax exemption to investors in this sector similar to National Highways and by enhancing depreciation rate for inland vessels. Keeping this policy in view, projects have been identified under the traffic and transportation sector to develop the existing waterways in the project area for the purpose of shipping and navigation and also to integrate the waterways to the roadways, railways and airport.

7.2 National Slum Policy 2001

The main objectives of this policy which is prepared by Ministry of Urban Affairs and Employment are, to integrate slum settlements and the communities residing within them into the urban area as a whole by creating awareness amongst the public and in Government of the underlying principles that guide the process of **slum development and improvement** and the options that are available for bringing about the integration; to strengthen the legal and policy framework to facilitate the process of slum development and improvement on a sustainable basis; to establish a framework for involving all stakeholders for the efficient and smooth implementation of Policy objectives.

This policy defines that, all under-serviced settlements, be they unauthorised occupation of land, congested inner-city built up areas, fringe area unauthorised developments, villages within urban areas and in the periphery, irrespective of tenure or ownership or land use, as slum/informal settlement. The criteria for defining a slum/informal settlement have to be considered by economic, social parameters (including health indicators) and physical conditions of that area.

The policy emphasis the ULB for the comprehensive listing and registration of slum dwellers and suitable identity cards shall to be issued to all the houses in the listed slums. After providing the basic services that slum has to be delisted by the ULB's. The ULB has to classify the land status of slums as either Tenable or Untenable in order to determine whether or not regular planned service provision will be undertaken on an in-situ or resettlement basis. Tenure shall be granted to all residents on tenable sites owned or acquired by government. Full property rights shall be granted on resettlement and/or rehabilitation sites. Land acquisition on private lands should be given compensation like monetary contributions, sharing of land, lease of land, allocation of an alternate site etc. In the in-situ upgrading projects, proper layout planning including plot re-alignment and also equalisation of land/share land areas should precede the granting of full property/tenurial rights. These projects should be designated as high density mixed use. A fee should be collected from residents for the sale or transfer of ownership rights based on the following criteria; a plot area up to a maximum of 25sq mts may be granted at a concessional rate; any area in excess of this may be granted at such rates decided by the ULB; plot sizes may be fixed below 25sq mts if mutually agreed by the community and the ULB. The policy emphasis that all States/ULBs shall draw up comprehensive resettlement and relocation guidelines for urban dwellers residing in untenable sites before relocating them. All ULBs also should work to formulate an Integrated Municipal Development Plan. The principle

objective of this plan is to ensure that the ULB has an adequate and sustainable level of infrastructure and services for all its residents and that such infrastructure and services are planned and delivered in an equitable manner. These should be undertaken as a dynamic process which will be updated and reviewed every three years.

The policy suggests improving physical infrastructural developments through, community based approach; Targeting women and children; service delivery on individual household basics; and contracting out. The physical infrastructural components like water supply, sanitation, pedestrian and vehicular access ways, storm water drains, electricity, and solid waste collection can be developed by the above said approaches. The ULBs must build health management capacities to improve service delivery to the poor following the 74th Amendment.

The policy emphasis the ULB's for giving more attention and efforts on increasing the school enrolment at primary level, reducing school drop-out rates particularly for girls and supplementing formal school education with coaching assistance to assist slum children join the formal schooling system. Multi Purpose Community Centres (MPCC) can be used for preschools/ crèches facilities, non formal education classes, adult education, recreational activities etc. And ULBs should discourage child labour through the implementation of penalties and fines and the withdrawal of licences for employers found to be using child labour without making proper provision for education or training. The policy suggests that Municipal Services should be brought under the Consumer Protection Act to monitor quality and reliability of basic infrastructure services delivered at settlement level.

The financing of sustainable slum improvement and services shall include a series of initiatives at central/state/local levels. Some are state financing by creating slum development fund, Municipal Convergence Funding, role of private sector and funding, Institutional Finance, Extending Tax Base, User Charges, Community Cost Sharing and Selling of Land Title.

The policy emphasis that the subsidies could be more clearly focussed on specific components such as roads, drains and other social infrastructure facilities such as pre-school provision, nutrition programmes to children and pregnant women, managing primary health care centre and a host of such other related activities of common benefit or benefiting specific individuals or groups. The capacity building initiatives should be promoted to enable ULBs to effectively carry out slum development in accordance with National Slum Development Policy. This should include skill development, financial administration and management and human resource development. This Policy is committed to a shelter upgradation approach that will enable, support and extend individual and community initiatives for housing provision with the help of ULB's.

Government of India has proposed new initiatives based on this policy which are:

(i) Valmiki-Ambedkar Malin Basti Awas Yojana (VAMBAY):

Incorporating some of the important features being outlined in this policy document a loan cum subsidy central sector scheme is being firmed up for launching soon. As announced by the Hon'ble Prime Minister for Independence Day, 2001 the scheme will be taken up with Central Government Subsidy of Rs 1000 crores and a loan component from HUDCO of Rs 1000 to Rs 2000 crores for construction of 4 lakh dwelling units for slum dwellers. The maximum cost of a dwelling unit to be financed will be Rs 60,000 in the six mega cities, Rs 50,000 in cities with population more than one million and Rs 40,000 in other urban areas. There will be provision for upgradation of existing slum tenements and also for basic amenities like water supply and sanitation.

(ii) Nirmal Bharat Abhiyan – A Sub-component of VAMBAY:

To integrate sanitation as part of the housing development and to achieve cent per cent sanitation coverage in all the state capitals and cities having more than one million population, this sub-component of the above programme is intended to be launched. New individual toilets or conversion of existing toilets into sanitary latrines and community based group toilet scheme in slum areas will be financed under this scheme. Effluents and wastes from such toilets constructed under this scheme will be used for production of manure, vermiculture, biogas etc. In the first year one lakh toilet seats in 10 cities on a demand driven basis with an outlay of Rs 400 crores is being launched soon. The outlay will consist of Rs 200 crores subsidy from Government of India under the Valmiki- Ambedkar Malin Basti Awas Yojana (VAMBAY) and the balance amount as loan from HUDCO. To start with, pilot projects will be initiated in Delhi, Mumbai, Kolkata, Chennai, Hyderabad, Bangalore, Ahmedabad, Chandigarh, Lucknow and Guwahati. The most novel features are – (a) maintenance of community toilet blocks by community based groups elected from among slum dwellers themselves; (b) family pass for each slum household @ Rs 20 per month per family for daily use of such toilets.

Urban India cannot be clean and hygienic if slums continue to proliferate in their present condition. In the slums of KMP area, upgrading in-situ is the preferred strategy, especially where community contributions are involved. Resettlement should be done absolutely as a last resort, only for major infrastructure corridors and at unavoidable purposes. As like housing employment opportunities also has to be given top priority for the urban poor with the help of private agencies, NGO's etc. The proposed central government schemes like VAMBAY and NBA have to be launched in all cities and similar schemes have to be proposed for the upliftment of the slum dwellers.

7.3 National Policy for Urban Street Vendors 2004, Ministry of Urban Development & Poverty Alleviation, Government of India

Street vendors provide valuable services to the urban population while trying to earn a livelihood and it is the duty of the State to protect the right of this segment of population to earn their livelihood. This policy aims to ensure that this important section of the urban population finds recognition for its contribution to society, and is conceived of as a major initiative for urban poverty alleviation.

The overarching objective to be achieved through this policy is to:

- Provide and promote a supportive environment for earning livelihoods to the Street vendors, as well as ensure absence of congestion and maintenance of hygiene in public spaces and streets.
- Street vendors are vulnerable to loss of goods due to natural as well as manmade disturbances that adversely hampers their economic situation. There should be special insurance schemes to cover their products.
- Street vendors should be provided with training to upgrade their technical and business skills so as to increase their income as well as to look for alternatives

All State Governments should ensure that institutional arrangements, legislative frameworks and other necessary actions achieve conformity with the National Policy for Street Vendors. The policy states that a comprehensive survey of street vendors to build an adequate database on street vendors particularly in large and medium cities should be undertaken by the State Governments.

7.4 National Environment Policy 2006, Ministry of Environment & Forest, Government of India

The National Environment Policy lays down that the n**atural heritage sites are to be protected** as they are nature's laboratories for evolution of wild species in response to change in environmental conditions. The Policy calls for adoption of a comprehensive approach to Integrated Coastal Management by addressing linkages between coastal areas, wetlands, and river systems, in relevant policies, regulation, & programs and preparation & implementation of action plans for major cities for addressing water pollution, comprising regulatory systems relying on a appropriate combination of fiats and incentive based instruments, projects implemented through public agencies as well as public-private partnerships for treatment, reuse, and recycle where applicable, of sewage and wastewater from municipal and industrial sources, before final discharge to water bodies. The Policy also states that integrated regional development plans should be drawn up, with participation of the local community, to shift polluting activities or render them much less polluting, to treat waste streams, to review transportation options, and adopt building norms which maintain the overall heritage ambience of the area. With this view, the Government of Kerala has initiated actions to formulate

Regulations for ensuring and promoting conservation of natural heritage, heritage buildings and precincts. To enable such regulations attempts are being made to list the heritage structures and sites in the state.

7.5 National Urban Transport Policy, 2006
Ministry of Urban Development, Government of India

The main vision of this policy which is prepared by Ministry of Urban Development, is to recognize that people occupy centre-stage in our cities and all plans would be for their common benefit and well being; to make our cities the most liveable in the world and enable them to become the “engines of economic growth” that power India’s development in the 21st century; to allow our cities to evolve into an urban form that is best suited for the unique geography of their locations and is best placed to support the main social and economic activities that take place in the city.

The objective of this policy is to ensure safe, affordable, quick, comfortable, reliable and sustainable access for the growing number of city residents to jobs, education, recreation and such other needs within our cities. This is sought to be achieved by incorporating urban transportation as an important parameter at the urban planning stage rather than being a consequential requirement; encouraging integrated land use and transport planning in all cities so that travel distances are minimized and access to livelihoods, education, and other social needs, especially for the marginal segments of the urban population is improved; improving access of business to markets and the various factors of production; Bringing about a more equitable allocation of road space with people, rather than vehicles, as its main focus; encourage greater use of public transport and non motorized modes by offering Central financial assistance for this purpose; enabling the establishment of quality focused multi-modal public transport systems that are well integrated, providing seamless travel across modes; establishing effective regulatory and enforcement mechanisms that allow a level playing field for all operators of transport services and enhanced safety for the transport system users; establishing institutional mechanisms for enhanced coordination in the planning and management of transport systems; introducing Intelligent Transport Systems for traffic management; addressing concerns of road safety and trauma response; reducing pollution levels through changes in travelling practices, better enforcement, stricter norms, technological improvements, etc; building capacity (institutional and manpower) to plan for sustainable urban transport and establishing knowledge management system that would service the needs of all urban transport professionals, such as planners, researchers, teachers, students, etc; Promoting the use of cleaner technologies; raising finances, through innovative mechanisms that tap land as a resource, for investments in urban transport infrastructure; associating the private sector in activities where their strengths can be beneficially tapped; taking up pilot projects that demonstrate the potential of possible best practices in sustainable urban transport.

The policy suggests every city to identify potential corridors for future development and then establish a transport system that would encourage growth around itself. Road space can be achieved by reserving lanes and corridors exclusively for public transport and non-motorized modes of travel. Similarly dedicated lanes could be reserved for vehicles that carry more than three persons (High Occupancy Vehicle Lanes). The policy also encourages, using public transport systems which occupies less road space and causes less pollution per passenger-km than personal vehicles. According to fare two different levels of services can be given, a basic service, with subsidized fares and a premium service, with no subsidy which is of high quality but charges higher fares.

To promote investments in transportation sector, the Central Government would, provide 50% of the cost of preparing comprehensive city transport plans and detailed project reports; offer equity participation and/or viability gap funding to the extent of 20% of the capital cost of public transport systems; offer 50% of the cost of project development whenever such projects are sought to be taken up through public-private partnerships, so that a sound basis for attracting private partners can be established. The remaining cost of such project development would have to come from the city development authority/State government and a project developer.

The modern technologies like, BRTS, elevated sky bus and monorail systems, electric trolley buses, etc can also be used in public transportation system. The policy encourages the use of non-motorized modes which are environmentally friendly and have to be given their due share in the transport system of a city. Segregation of access paths for bicycles and pedestrians, coupled with safe bicycle parking places, would contribute towards increasing the use of non-motorized modes.

The policy suggest the state governments to amend building bye laws more strictly in all million plus cities so that adequate parking space is available for all residents / users of such buildings. Multi-level parking complexes should be made a mandatory requirement in all city centres that have several high rise commercial complexes which can be achieved through public private participation.

The capacity building has to be addressed at two levels, institutional level and individual level. At institutional level, institute of Urban Transport, an existing institute under the purview of the Ministry of Urban Development would be strengthened. At the individual level, a major exercise of training and skill development of the public officials and other public functionaries would be taken up to make such officials aware of the nuances of urban transport planning and the specific issues involved in managing city transport.

The policy encourages the use of clear technologies like CNG buses which is adopted in public transport in Delhi, electric trolley buses, electric cars and two wheelers which reduces

vehicular pollution to a great extent. The policy suggests the National Urban Renewal Mission to give more priority to urban transportation issues.

Keeping this policy in view, projects like proposal of multi level parking at various nodes, new roads and widening of existing roads have been identified under the urban transportation sector to develop the existing conditions of the KMP area. The modern technologies like BRTS which is successfully adopted in Delhi and Ahmadabad can be proposed and the metro rail which is already under proposal has to be launched to meet the demand of the fast growing urbanization of Cochin. Relative characteristics of available public transport technologies is given in Annexure 4.

7.6 National Urban Housing and Habitat Policy, 2007

The core focus of National Urban Housing and Habitat Policy 2007 prepared by the Ministry of Urban Affairs and Employment is provision of "Affordable Housing For All" with special emphasis on vulnerable sections of society such as Scheduled Castes/Scheduled Tribes, Backward Classes, Minorities and the urban poor. The policy intends to promote sustainable development of habitat in the country with a view to ensuring equitable supply of land, shelter and services at affordable prices to all sections of society.

The policy aims at, Urban planning; Affordable housing; Increase flow of Funds; Spatial Incentives; Increase Supply of Land; Special Provision for SC/ST/OBC/Minorities/Disabled; Special Provision for Women; Employment Generation; Public-Private Partnerships; Management Information System and Healthy environment.

The Policy seeks to enhance the spotlight on 'habitat' with a 'Regional Planning approach' as well as further deepen the role of Government as a 'facilitator' and 'regulator 'and also to develop innovative financial instruments like development of Mortgage Backed Securitization Market (RMBS) and Secondary Mortgage Market in the housing sector. It also seeks to attract Foreign Direct Investment (FDI) in areas like integrated development of housing, new township development and SEZs.

The policy states that the Central Government will encourage and support the States to prepare a State Urban Housing and Habitat Policy and also a State Urban Housing & Habitat Action Plan. These State/UT level Policy and Action Plan should provide a road map pertaining to institutional, legal, regulatory and financial initiatives in relation to (i) supply of land (ii) modification of Acts/Bye-laws (iii) promotion of cost effective building materials and technologies with a view to bringing down the cost of EWS/LIG houses (iv) infrastructure development and (v) in situ slum development. Further, the action plan should make specific provision for use of information technology for planning, Management Information System and online e-connectivity in a time bound manner. Development of a Mass Rapid Transit System (MRTS) at the sub-

regional level around metropolitan cities and a 'Habitat Infrastructure Action Plan' for all cities with a population of over 1, 00,000 will be encouraged.

The policy encourages promotion of planned and balanced regional growth, creation of sustainable employment opportunities, protection of weaker sections/ vulnerable groups preferably in their present residential location, conservation of urban environment, participatory approach involving all stakeholders like Community Based Organizations (CBOs), Non-Governmental Organizations (NGOs), Self-Help Groups (SHGs), Cooperative sectors, Private sectors in order to synergise community, cooperative and private resources along with Government resources and also it encourages to promote an innovative policy for safeguarding the rights of street vendors.

The ULB has to identify city specific housing shortages and prepare city level Urban Housing & Habitat Action Plans for time bound implementation. Wherever necessary and feasible, ULBs as well as other parastatal would provide viability gap funding especially for EWS/LIG housing and supporting infrastructure so as to ensure better affordability by the poor and financial viability of slum upgradation projects. The state government in consultation with ULB's, has to promote optimal utilization of land by innovative special incentives like 10 to 15 percent of land in every new public/private housing project or 20 to 25 percent of FAR / Floor Space Index (FSI) which is greater will be reserved for EWS/LIG housing through appropriate legal stipulations.

The policy lay special emphasis on the feasibility of a National Shelter Fund to be set up under the control of the National Housing Bank for providing subsidy support to EWS/LIG housing would be examined in consultation with Ministry of Finance. The NHB will act as a refinance institution for the housing sector. Housing and Urban Development Corporation Ltd. (HUDCO) will be directed to observe the aims and objectives listed in its Memorandum of Association and Articles of Association with a view to encouraging EWS/LIG housing. Micro-Finance Institutions (MFIs) would be promoted at State level to expedite the flow of finance to urban poor. The Jawaharlal Nehru Urban Renewal Mission has started to play a vital role both in slum improvement as well as in-situ slum rehabilitation along with Specific Areas of Action provision of security of tenure, affordable housing and basic services to the urban poor. The process for integrating the Valmiki Ambedkar Awas Yojana (VAMBAY) and the environment improvement scheme titled National Slum Development Programme (NSDP) has been undertaken through the Basic Services to the Urban Poor (BSUP) in Mission Cities and Integrated Housing & Slum Development Programme (IHSDP) in Non-Mission cities.

A Monitoring framework at the central level and State/UT level should be set up to periodically review the implementation of the Policy and concomitant Action Plan. At the local level, cities should prepare 15-20 years perspective plans in the form of City Development Plans which take into account the deficiencies in housing and urban infrastructure with special

emphasis on the urban poor and indicate a vision based on various levels of spatial plans Master Plan and Zonal Plans, Metropolitan Plan, District Plan and State/UT based Regional Plan along with an investment plan for their implementation.

The policy states that efforts will be made with the help of public and private agencies to provide good quality training to construction workers preferably women with a view to improving their skills in tandem with technological advancements, induct them at supervisory levels and also develop them as contractors. Also efforts will be made to get States/UTs to enact legislation on the pattern of the Building & Other Construction Workers (Regulation of Employment & Conditions of Service) Act, 1996 of the Central Government with a view to ensuring that adequate measures are undertaken by employers for the occupational health, safety and adequate support services like crèches, toilets and rest room of all workers especially women engaged in construction activities.

The policy gives special attention to housing in coastal areas. Further, adequate mangrove and allied plantations will be promoted in coastal areas especially those which are in high disaster-prone zones to avoid loss to life from natural disaster. This will promote appropriate ecological standards for protecting a healthy environment and providing a better quality of life in human settlements.

The main focus of the policy is to provide shelter to the homeless. Keeping this policy, projects like in-situ slum rehabilitation and development has to be launched in KMP area to address the housing problems with the funding of central schemes like JNNURM, VAMBAY etc. The lost cost techniques in housing construction has to be adopted with the active participation of Research organizations, NGOs and Community Based Organizations (CBOs) to address the demand of housing needs.

7.7 NATIONAL WETLAND CONSERVATION PROGRAMME, 2009

Guidelines prepared by Conservation and Survey Division, Ministry of Environment and Forests, 2009.

Wetlands can be defined as: “lands transitional between terrestrial and aquatic eco-systems where the water table is usually at or near the surface or the land is covered by shallow water”. Ramsar Convention on Wetlands defines wetlands as: “areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres”.

According to the Directory of Asian Wetlands (1989), India has totally 27,403 wetlands, of which 23,444 are inland wetlands and 3,959 are coastal wetlands. Wetlands occupy 18.4% f the

country's area of which 70% is under paddy cultivation. All these wetlands can be classified into different categories on the basis of their origin, vegetation, nutrient status and thermal characteristics. In India, out of an estimated 4.1 m ha (excluding irrigated agricultural lands, rivers, and streams) of wetlands, 1.5 m ha are natural, while 2.6 m ha are manmade. The coastal wetlands occupy an estimated 6,750 sq km, and are largely dominated by mangrove vegetation. The Wildlife Institute of India's survey reveals that they are disappearing at a rate of 2% to 3% every year.

To conserve these wetlands Government of India has been implementing the National Wetlands Conservation Programme (NWCP) in close collaboration with the State/UT Governments since the year 1985-86. Under the programme, 115 wetlands (5 from Kerala) throughout India have been identified till now by the Ministry which require urgent conservation and management interventions.

The programme aims at, **Conservation of wetlands in the country** so as to prevent their further degradation **and ensuring their wise use** for the benefit of local communities and overall conservation of biodiversity.

The objectives of this Programme is, to lay down policy guidelines for conservation and management of wetlands in the country; to provide financial assistance for undertaking intensive conservation measures in the identified wetlands; to monitor implementation of the programme; and to prepare an inventory of Indian wetlands.

Role of Central Government is, to providing financial assistance for implementation of the approved items of the programme; Providing technical expertise and know-how including training of personnel; Issue of detailed guidelines covering all aspects of management; and Evaluation of the interventions made. The role of State Government/UT Administration is that, since the land resources belong to them, they are responsible for management of wetlands and implementation of the NWCP for ensuring their wise-use.

The programme states the minimum area for identification of wetlands should not be less than 100 ha unless it has some exceptional ecological or other significance. The programme defines the Identification of Wetlands of National Importance by five types of criteria's prescribed under the 'Ramsar Convention on wetlands' which are given below:

Sites containing representative, rare or unique wetland types - (i) Criterion 1. If it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.

Criteria based on species and ecological communities - (ii) Criterion 2. If it supports vulnerable, endangered, or critically endangered species; or threatened ecological communities. (iii) Criterion 3. If it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region. (iv) Criterion 4. If it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.

Specific criteria based on water birds - (v) Criterion 5. If it regularly supports 20,000 or more water birds. (vi) Criterion 6. If it regularly supports 1% of the individuals in a population of one species or subspecies of water birds.

Specific criteria based on fish - (vi) Criterion 7. If it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity. (vii) Criterion 8. If it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

Specific criteria based on water/life and culture - (viii) Criterion 9. If it is an important source of food and water resource, increased possibilities for recreation and eco-tourism, improved scenic values, educational opportunities, conservation of cultural heritage (historic or religious sites).
Under NWCP the financial assistance is provided for two components i.e. for implementation of the Management Action Plan for a period of 3-5 years and undertaking research projects. Under the programme, 100% assistance is provided for activities mentioned as 'Admissible items under NWCP'. They are Survey and demarcation; Inventorization; Catchment Area Treatment; Protection Measures; Restoration Measures; Water management; Biodiversity Conservation; Sustainable Resource Development; Weed Control; Pollution Control; Supplementary/Alternate livelihood; Environmental Education and Awareness; Habitat Improvement; Impact Assessment through Concurrent and Terminal Evaluation.

To oversee the Implementation of Programme the central government has formed National Wetlands Committee, Expert Group on Wetlands and Research Advisory Committee on Wetlands at the national level and state government has formed State Steering Committee and State Wetland Conservation Authority at the state level.

In international level the 'Convention on Wetlands' signed in Ramsar, Iran, in 1971, is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

The State government/ULB's in close collaboration with this programme has to take initiative for conservation, protection and wise use of the wetlands of KMP area and as of the state, for the benefit of local communities and conservation of biodiversity.

7.8 Tourism Vision 2025

Government of Kerala formulated Tourism Vision 2025 to serve as a guiding force which will provide a clear vision and direction for optimising the tourism potential of the State in a sustainable manner. The Government has declared tourism as an industry far back in 1986 and offers incentives and concessions to the industry to promote tourism products in the State and to attract private investment.

The objectives of the Vision include the following.

- Make tourism Kerala's core competency sector;
- Generate employment and enhance productivity;
- Promote and market Kerala Tourism products at national and international level thereby making Kerala a premier global tourism destination;
- Define and endorse the role of the Government as a catalyst and facilitator for the growth of tourism industry;
- National tourism related legislations and policies of the Government so that it is tourism friendly and promotes tourism growth;
- Create awareness and tourism consciousness among the people in general and among the taxi drivers, policemen, bus conductors, porters, customs and emigration officers, and others with whom tourists interact in particular thereby removing prejudices and misconceptions and to make Kerala society a tourism friendly society;
- Develop and improve roads, drinking water supply, electricity and power supply, sewage and sanitation systems, signages, transport systems like roads, rail, sea, inland water and air for selected tourist centres;
- Promote sustainable and eco-friendly tourism in the State based on the carrying capacity of the destinations;
- Conserve and preserve the art, culture and heritage of the State;
- Develop and promote new innovative tourism products, lesser-known destinations, art forms, cuisines, monuments and handicrafts;
- Identify, conserve and preserve special tourism zones;
- Develop and promote KITTS, KIHMS and IHMCT into institutions par excellence in India and regulate the syllabi and training facilities of other institutions to maintain quality standards; and
- Involve PRIs and NGOs in the development of tourism infrastructure and tourism awareness.

Tourism Policy for Kerala

State Tourism Policy document 'Tourism Vision 2025' states the vision statement as "To make Kerala, the God's Own Country, an up-market high quality tourist destination through rational utilization of resources with focus on integrated development of infrastructure sector conserving and preserving the heritage and environment and enhancing productivity, income, creating employment opportunities, alleviating poverty thereby making tourism the most important sector for the socio-economic development and environment protection of the State." The focus here is to attract quality tourists by developing quality tourism infrastructure with private sector participation with sustainable development as the key concept.

The objectives of the vision are:

- To make tourism, Kerala's core competency sector;
- To generate employment and enhance productivity;
- To promote and market Kerala Tourism products at national and international level thereby making Kerala as a premier global tourism destination;
- To define and endorse the role of the Government as a catalyst and facilitator for the growth of tourism industry;
- To rationalize tourism related legislations and policies of the Government so that it is tourism friendly and promotes tourism growth;
- To create awareness and tourism consciousness among the people in general and among the taxi drivers, policemen, bus conductors, porters, customs and emigration officers, and others with whom tourists interact thereby removing prejudices and misconceptions and to make Kerala society a tourism friendly society;
- To develop and improve roads, drinking water supply, electricity and power supply, sewage and sanitation systems, signages, transport systems like roads, rail, sea, inland water and air for selected tourist centres;
- To promote sustainable and eco-friendly tourism in the State based on the carrying capacity of the destinations;
- To conserve and preserve the art, culture and heritage of the State;
- To develop and promote new innovative tourism products, lesser-known destinations, art forms, cuisines, monuments and handicrafts;
- To identify, conserve and preserve special tourism zones;

- To develop and promote KITTS, KIHMS and IHMCT into the institutions par excellence in India and regulate the syllabi and training facilities of other institutions to maintain the quality standards; and
- To involve PRIs and NGOs in the development of tourism infrastructure and tourism Awareness

7.9 I.T. Policy for Kerala

The IT Policy has been conceived keeping in view the fact that Information Technology constitutes the primary instrument for facilitating Kerala's emergence as a leading knowledge society in the region. The blueprint for IT development has been formulated in the context of emerging developmental trends that are relevant to the growth strategy of the State:

IT has opened out new channels for service delivery in areas such as e-Governance, education, e-health and information dissemination. IT can serve as the platform for widening the reach of the advances made by the State in domains like health, education, and participatory local governance. Kerala offers fertile ground for the effective utilization of these new technologies; on account of its densely networked communities which possess high awareness and literacy levels, its superior telecom connectivity, and its propensity for quick technology absorption. The objective of the Government is to put in place a package of policy measures and incentives, which will make Kerala one of the most attractive investment destinations in IT. The Policy initiatives delineated in this document comprise a three pronged strategy aimed at:

- Creating an appropriate pro-business, pro-enterprise, legal, regulatory and commercial framework to facilitate the rapid growth of the IT industry in the state;
- Establishing Kerala as a global centre for excellence in Human Resources, through the creation of a large pool of diverse, multi-skilled technically competent manpower in the State; and
- Establishing an internationally competitive business infrastructure and environment for the IT industry in the State, on par with the best facilities and practices worldwide.

Objectives

In line with this broad strategy, the Government has set the following immediate objectives for the promotion of the IT industry in the State.

- To establish Kerala as a leading IT destination in the country within the next five years;
- To provide a nurturing and enabling environment conducive to the vigorous growth of the local IT industry in the State;
- To significantly enhance direct and indirect employment creation in the IT sector;
- To attain a minimum growth level of 100% every year in IT;

- To significantly accelerate the levels of investment inflows including foreign capital into the hardware, software and ITES sectors;
- To aggressively promote the State as the destination of choice for emerging IT business opportunities including IT Enabled Services, new media products and Eservices.
- To establish ITES as the definitive core competence of the State;
- To develop Kochi as an international media and ICT hub; and
- To consolidate and expand the Technopark, Thiruvananthapuram as a leading software and HR Centre in the region.

I.T. Infrastructure

The policy envisages developing IT infrastructure on the following lines.

Government Parks Initiative:

- The city of Kochi will be promoted as an IT hub where facilities offered will match the best available worldwide. A Hi-tech park will be developed here, comprising an area of 200 acres. An IT Corridor connecting the new international airport at Nedumbassery with the city will also be established as part of the larger proposed Special Economic Zone continuum. These facilities shall be developed through Joint Venture partnerships with the private sector and shall endeavour to provide an international business infrastructure and environment at Kochi. Kochi has all the necessary enablers in place including virtually unlimited bandwidth on tap from the VSNL gateway, concentration of quality, technical and non-technical human resources, a cosmopolitan social infrastructure and environment, and excellent air connections. These advantages shall be leveraged to make the city amongst the most preferred IT investment destinations of India.
- The total space availability for IT industry shall be augmented by a minimum of 750,000 sq.ft annually for the next two years. Thereafter, for the next three years a minimum of 1.5 million sq.ft space capacity shall be created annually. These additional capacities will be created through 100% private sector investments as well as Joint Venture projects between the Govt. and the private sector.

- The Technopark, Trivandrum with about 1 million sq. ft of built up area, has established itself as one of the leading IT parks in the country. The campus is now home to several SEI-CMM companies and centres of HR excellence. The IIITM-K, which commenced functioning in the last year and which offers high-end training in emerging technologies is expected to move over to an independent campus shortly. In the second phase of expansion of the park, it is proposed to develop 26 acres with the participation of the private sector.

- The IT Department shall shortly initiate with the help of leading consultants the exercise of preparation of Master Plans for each of the designated IT parks/ zones. These Master Plans shall delineate the blueprint for park development and framework for facilitating private sector participation.

- Govt. shall endeavour to maintain uniform, international quality standards for park infrastructure and services across all State promoted and managed IT parks. A professional Parks' Management team will be set up under the Kerala IT Department for ensuring this.

- Built-up space for IT industry shall be classified under a new category "IT Industry" under the Kerala Building Rules with applicable FAR of 5. This classification shall apply only for newly built-up space that shall be used predominantly (at least 80% of carpet area) for IT software industry for a minimum period of 5 years from the date of first occupation/commissioning.

- Govt. shall proactively encourage and facilitate the development of ancillary social infrastructure in a planned manner including hotels, restaurants, entertainment multiplexes, hospitals, schools, colleges etc within and appurtenant to the IT parks.

Private Parks Scheme:

- To accelerate the process of private sector led IT infrastructure development, Govt. shall, in association with reputed global IT parks' developers/consultants, announce a minimum set of standards to qualify as 'Parks' Standard' certified IT park. Compliance shall be assessed, on formal request, at the pre-construction/design stage and thereafter on project completion. The State IT Parks' Management team shall serve as the nodal agency for compliance assessment and administration of the 'Private IT Parks Scheme'.

- All Parks' standard compliant IT parks shall be entitled to the FAR classification as applicable to IT industry under Kerala Building Rules. For other compliant IT parks that are either entirely for IT hardware industry or for both IT hardware and IT software industry companies, classified under 'Industrial' category of the Kerala Building Rules, additional FAR of 50% shall be permitted (over currently applicable FAR of 1.5).

- The Kerala State Electricity Board, the Kerala Water Authority, and the Office of the Chief Town Planning Authority shall each designate a Nodal Officer who shall facilitate the process of inspection, application processing, and application closure, for their

respective responsibility areas. Response standards shall be announced by these agencies for the fast track clearance process.

- A certified private IT park shall be governed by the same set of industry enabling regulations that are applicable for the State promoted IT parks.

- A private park that qualifies for certification under this scheme shall be promoted by the State Govt. as an integral part of the State's IT Infrastructure provided the promoter of the park so desires.

- The scope of the 'Private IT Parks' scheme shall be restricted to projects that seek to provide a minimum of 50,000 sq. ft per project either through creation of fresh built up space or through conversion of existing space for use by IT industry. Projects less than the 50,000 sq.ft qualifying stipulation shall still have the benefit of FAR provided under point 1 provided they are otherwise compliant with the Parks' standard.

- The Government is aware that rapid change and transformation is the essence of this sector, and acknowledge the need for a dynamically evolving policy that caters to the changing I.T environment. Hence this policy document is envisaged as an evolving blueprint that sets out an indicative roadmap. Government will endeavour to improve upon the components of this policy on the basis of suggestions from stakeholders and the changing requirements of the sector.

7.10 Industrial Policy for Kerala

The policy provides for exploring the scope of developing small scale industries, Traditional Industries, Textiles, Sick Units, Food processing, Biotechnology**,** Infrastructure & Service Sector Industries. Holistic and eco-friendly projects will be encouraged in tourism as the sector has already been accepted as an instrument for generation of foreign exchange, employment, poverty alleviation and sustainable social and economic development. The Government shall endeavour to facilitate notified Special Economic Zones and bring in a special legal dispensation enabling a more liberalized environment within specified industrial parks, estates and notified areas. The waterways in the State shall be developed with the participation of the private sector and made navigable particularly for barge transport.

7.11 Kerala Port Policy

The policy on Ports and Shipping Development announced by the Government of Kerala envisages private participation in building up a wide variety of infrastructure for ports and shipping. The Government will encourage development of special ports and berths for handling

petrol and oil, transshipment ports, multipurpose jetties and passenger terminal by private agencies. The policy also promises promotion of facilities for passenger ships, roll on and roll off vessels, inland terminals and amusement parks besides port based industries including ship yards and dry docks. The tax breaks promised in the industrial policy will be extended for such ventures. Private agencies will be allowed to undertake development of state highways and bridges to minor ports and collect toll to recover their investment. Leasing of existing ports and provision of various services such as loading and pilotage and navigation will also be permitted. The government will take steps to encourage goods transport through waterways to reduce congestion in highways and costs. A Maritime University is proposed to set up for ensuring supply of trained man power.

Objectives of the Government of Kerala Port Policy:

- Kerala shall target a place among the top three marine States of the country in terms of cargo handled in the next ten years;
- Facilitate achievement of optimal multi-model transport and logistic chain outcomes by establishing an efficient and commercially viable transport system. This will be achieved by carrying out co-ordinated development of multi-purpose ports, transhipment bunks, inland water ways, coastal shipping inland terminal cargo handling and storage facilities, railways and road linkages;
- Promote port based and Maritime Industries;
- Ensure protection of environment and coastal zones; and
- Promote establishment of passenger terminals and marinas.

7.12 People Centred Service Delivery Policy for Kerala

The Service Delivery Policy approved by the Government is intended to establish the mode and manner in which services are delivered to citizens. In a broad sense it covers the whole range of interface between Government and the people and the whole gamut of the interaction between people and their Government. The objective of the Policy is to provide a systematic approach to ensure that adequate level of public services of prescribed quality are provided by the various departments and implementing agencies in the State and Local Self Governments of Kerala. The public services include civic services like water supply and sanitation, welfare services like social security, human development services like health, nutrition and education and basic minimum services like housing. In addition, Government and Local Governments provide several regulatory and administrative services. It is hoped that a Service Delivery Policy will help develop and put service standards in place which would enable citizens, policy makers and service providers to track service performance and take corrective measures.

7.13 Kerala Conservation of Paddy land and Wetland Act, 2008

The main focus of this act is to conserve the paddy land and wetland and to restrict the conversion or reclamation thereby to promote growth in the agricultural sector and to sustain the ecological system, in the State of Kerala. This act states that, the owner, occupier or the person in custody of any paddy land shall not undertake any activity for the conversion or reclamation of such paddy land except in accordance with the provisions of this Act and also to the cultivation of any intermediary crops that are cultivated without changing the ecological nature of that paddy land or the strengthening of the outer bunds for protecting the cultivation. This also states that, the wetlands of the State shall be maintained as such and there shall be a total prohibition on reclamation and removal of sand of such wetland.

As per the act there will be a state level committee, district level committee and a local level monitoring committee in each Panchayat or Municipality, for the purpose of monitoring the implementation of the provisions of this Act. In the local level committee the mayor of the gram panchayat/municipality/corporation will be the president or chairman of the committee. The Agricultural Officer shall be the convener of the Committee and the reporting officer to the divisional revenue officer regarding any violation of the provisions of this act. The members are agricultural officers, village officers and three representatives of farmers nominated by panchayat/municipality/corporation, in the area under their jurisdiction. The term of office of the non-official members of the Local Level Monitoring Committee shall be three years from the date of its constitution. The quorum for a meeting of the Committee shall be three.

Powers of the committee is, to recommend to the State Level Committee or District Level Authorised Committee, for the reclamation of paddy land for public purpose or for construction of residential building for the owner of the paddy land. Provided he shall not recommend for filling of paddy land of more than ten cents in a Panchayat or five cents in a Municipality/Corporation, for the construction of residential building for the owner of the paddy land; to inspect, to examine and to intervene the paddy lands within the jurisdiction of the Committee.

The Act states that, the committee has powers to direct the holder of any paddy land which is uncultivated and left fallow, to cultivate it by himself or through any other person of his choice, with paddy or any other intermediary crops under the provisions of this Act. The committee may request the holder to grant permission in writing, to cultivate the said paddy land through the Panchayat in case of any practical difficulties in cultivating the land. The right to cultivate such paddy land shall be given in the following order of priority (i),Padasekhara Samithis or Joint Farmers Societies (ii) Self Help Groups (iii) The Kudumbasree Units functioning in the Grama Panchayat/Municipality where the paddy land is situated.

Any officer of the Revenue Department not below the rank of a Revenue Divisional Officer or any officer authorized by the Government in this behalf or any police officer not below

the rank of a Sub-Inspector, may enter and search any premises and seize any vessel, vehicle or any other conveyance or machinery used or deemed to have been used for any activity in contravention of the provisions of this Act, and a report regarding such seizure shall be given to the Collector having jurisdiction over that area within forty eight hours of such seizure. The appeal can be done against confiscation within thirty days. The district collector has power to restore the original position of any paddy land reclaimed violating the provisions of this Act.

As per the act any person who, in violation of the provisions of this act converts or reclaims any paddy land or wet land, shall on conviction, be punishable with imprisonment for a term which may extend to two years but shall not be less than six months and with fine which may extend to Rupees One lakh but shall not be less than fifty thousand rupees. As for a company, every person who was committed, was in charge of, and was responsible to the company for the conduct of the business, shall be liable to be proceeded against and punished. The act emphasis that the paddy land and wetland of KMP area which are “green lungs of a city “has to be conserved to promote the agricultural sector and ecological system in the state.

7.14 Kerala Road Development Policy, 2009 – 2021

Prepared by Public Works Department, Government of Kerala with the objectives to, Develop a sustainable road network which would meet the traffic requirement of the future; Maintain the road network at a desirable serviceability level all through the life of the road; Mobilise market resources along with increased generation of internal resources for joint development of road projects (Construction / Maintenance) with private participation; Adopt better standards and specifications in design and construction of roads; Enhance quality of road network with a view to reduce the transportation, Vehicle Operating Costs (VOC) and maintenance costs; Professionally manage highways assets and resources; Ensure road safety and mitigate ribbon development; Mitigate negative environmental impacts and provide safeguards; Acquire land with better Resettlement and Rehabilitation policies; Adopt innovative and improved methods of road construction and maintenance; Provide quicker access to essential services, thereby improving the quality of life in rural areas; Improve the functional capability of roads (Speed, Safety); Improve Inter modal Connectivity (Water – Air – Road); Improve Industrial Connectivity; Improve access to Major and Minor Pilgrim and Tourist Centres; Improve Urban links and access Roads to Highways; Improvement of quality of construction through Quality Control Mechanism.

The proposed road development policy outlines the objectives and the actions to be taken under various aspects such as, planning development and maintenance works, funding and resource mobilization, project implementation, land acquisition, management and control of assets, institutional requirements, information dissemination and transparency. PWD handles two types of road development works. One is concerned with improvements to existing roads

while the other relates to new developments. The policy has framed two phases (2009-11 & 2011- 2021) of 22 action plans for the road development in the state.

Kerala PWD manages eight National Highways totaling 1524 Kms, all of which is progressively being widened to two/four lane width by the MORTH/NHAI. Kerala PWD also has 4650 kms of State Highways of which about 90 percent is of single or intermediate lane width. Government of Kerala has initiated the Kerala State Transport Project (KSTP) in June 2002 to improve 1600km of state road network and 77km of Inland Water Transport (IWT).

The government has allocated an amount of Rs 2420 crores in the State's Tenth plan for road development. Of this, Rs 2270 crores was for PWD (R&B) and Rs. 150 crores for PWD (NH). The State's Eleventh Plan reiterates the need for continuing the state road improvement program and has allocated Rs. 1619 crores for the purpose.

Action 1: In cooperation with the NHAI/MoRTH, the PWD (NH) shall develop and improve the NH network in the state.

Action 2: In keeping with the Eleventh Plan strategies and the road development requirements, the following shall be achieved over the period 2009-21. a) All state highways shall be designed and converted into two lane carriageway with paved shoulders and the pavement shall be strengthened appropriately. b) Based on needs, about 10 percent of the State Highways shall be further upgraded into 4 lane divided carriageway. c) All MDRs shall be improved to have a single lane carriageway with hard shoulders and the pavement shall be strengthened appropriately. d) Based on needs, about 10 percent of the MDRs shall be further upgraded into two lane carriageway with hard shoulders. e) IRC standards and MoRTH specifications shall be adopted for the design and implementation of these road improvement projects. Appropriate measures for regulating direct access from roadside properties shall be incorporated in the designs. f) Standard right of way shall be acquired as part of this program. g) Preparation of projects for prioritizing and phasing the road improvement shall be initiated immediately and completed by 2011. h) Implementation of projects shall be initiated as and when the projects are approved and completed by 2021.

The estimated outlay required for achieving the road improvement is as given below,

Component	Total		2009-11		2011-21	
	Kms	Cost*	kms	Cost*	kms	Cost*
Two laning of SH	3000	18,000	500	3,000	2500	15,000
Four laning of SH	400	2,000	50	250	350	1,750
Improvements to MDR	18000	18,000	2,000	2,000	16,000	16,000
Two laning of MDR	1000	2,000	100	200	900	1,800
Total	22400	40,000	2,650	5,450	19,750	34,550

Action 3: To address the problems encountered on urban links, the following shall be achieved by 2021. a) Bypasses shall be provided to all urban agglomerations with a population of over 1 lakh. b) Where ever bypasses are provided, the existing urban links shall be transferred to the Urban Local Body for their subsequent improvement and maintenance. c) Project preparation

works shall be initiated for all the 15 locations and completed by 2011 d) Project shall be implemented and completed by 2021.
The estimated outlay required for provision of bypasses to urban agglomerations is as given in table below,

Component	Total		2009-11		2011-21	
	Nos	Cost*	Nos	Cost*	Nos	Cost*
Bypasses to urban areas	15	750	5	250	10	500

Action 4: Initiation and implementation of the following new road projects shall be undertaken over the period 2009-21. a) Development of the North-South road transport corridor. This has the potential for private sector participation. Extent of private participation needs to be ascertained by a techno-economic feasibility study and this shall be initiated immediately. b) Development of missing links and improvement of existing roads along the Hill Highway c) Development of Coastal Roads d) Project preparation work for identification and prioritization of new roads shall be initiated immediately and completed by 2011 e) New roads shall be implemented and completed by 2021.

The estimated outlay required for the development of new roads is as given in table below,

Component	Total		2009-11		2011-21	
	Kms	Cost*	kms	Cost*	kms	Cost*
Development of the N-S road transport corridor	600	10,000	-	-	600	10,000
Development of missing links along Hill Highway	300	1,500	50	250	250	1,250
Development of missing links along the Coastal Road	300	900	50	150	250	750
Total cost of new road corridors	1,200	12,400	100	400	1,500	12,000

Action 5: The following shall be the road maintenance action programs: a) All PWD roads shall be maintained as per IRC standards. b) Maintenance plans and programs shall be formulated on the basis of RMMS c) Priority shall be given to make the RMMS fully functional by 2010 d) Backlog of maintenance works shall be brought down to zero by the year 2021 e) Performance based maintenance contract shall be adopted as a preferred procedure for road maintenance programs
The estimated outlay required for achieving the maintenance of PWD roads is as given in table below,

Component	Total		2009-11		2011-21	
	Kms	Cost*	kms	Cost*	kms	Cost*
Maintenance of SHs	4,200	2,100	-	-	4,200	2,100
Maintenance of MDRs	19,000	3,800	-	-	19,000	3,800
Total	23,200	5,900			23,200	5,900

Considering the action plans envisaged for the period 2009-21, total of about Rs. 53,150 crores is the fund requirement in the immediate and medium term which is as given below,

Component	Fund Requirement (Rs. Crores)		
	Total	2009-11	2011-21
Improvement to existing roads	40,000	5,450	34,550
Bypasses to urban agglomerations	750	250	500
New road corridors	12,400	400	12,000
Total	53,150	6,100	47,050
Average Annual Requirement		3,050	4,705

Action 6: The Government shall amend the KRF Act to enable KRF to function and operate as an autonomous financial institution.

The policy states some of the potential sources available for mobilizing additional funds which are given in the table below,

Sl. No.	Additional Source of revenue	Amount Rs. Crores/year
1	User fees (Toll)	100
2	10 % Additional allocation from MV Registration fee	30
3	Development Revenue Sharing	150
4	State Cess on fuel	200
5	Traffic fines	20
6	Charges for locating Utility and services within ROW	40
7	Other sources	10
Total		550

If the annual revenue of KRF is enhanced to Rs. 550 crores per annum as in the table, this amount could be used to leverage borrowings from the market to the extent of Rs. 1500 crores. The Government should encourage KRF to associate with infrastructure funding agencies such as LIC, HUDCO, ADB, JBIC and IBRD to source additional funds for development and maintenance of road infrastructure in the state.

Action 7: With quite a few potential sources available for mobilizing additional resources, the Government shall enact necessary legislation to tap these sources and facilitate the implementation of the road development plan. At the same time, the Government shall put in place a procedure that ensures automatic transfer of these funds from the consolidated fund of the Government of Kerala to the KRF.

Action 8: Design and development of the north-south transport corridor has the potential for private sector participation. The Government shall initiate a techno-economic feasibility study to identify the corridor alignment and the financial viability of the project and understand the extent of private participation that would be possible and the conditions under which this would be acceptable to both the Government and the private sector The government will ensure that any such private sector projects will be just and fair for the road users whilst allowing the investors to have an economically viable project..

Action 9: Government shall ensure that sufficient funds are allocated in the budget for road maintenance.

Action 10: All road development projects undertaken as part of this road development policy shall adopt the fast track land acquisition process and the Government shall notify these accordingly.

Action 11: The Government shall accord approval to the revised PWD manual so that the revised bid documents and procurement processes could be adopted as soon as possible and electronic procurement shall become the norm

Action 12: PWD shall identify appropriate institutions which can provide training on project management techniques to the engineering staff and the training programs shall be initiated immediately.

Action 13: The KHRI shall be made autonomous and upgraded to the standards of CSIR laboratories and subsequently shall be authorized to provide the Quality Audit of road works under implementation.

Action 14: The minimum eligibility criteria for Contractors to register with the PWD for undertaking road development and maintenance works would be to provide proof of their having undergone a training program which certifies their familiarity with the IRC and MoRTH standards and specifications.

Action 15: Adoption of mechanized construction procedures supplemented with finished work measurement should become the standard procedure for approval and payments.

Action 16: The following shall be achieved as part of the Asset Management functions: a) Priority shall be given to fully establish and operate the RMMS within the next 12 months. Towards this, all the necessary data shall be collected and compiled for the entire PWD road network and associated planning software tools shall be acquired and operationalized. b) Using the RMMS, PWD's planning wing shall prepare the prioritized list of missing links and the program of implementation in the short term and these should be implemented by 2021. c) Land use planning shall be used as a tool to regulate and control traffic generation so that intersections, access roads, parking lots, road widening requirements, ribbon development etc could be managed more effectively. d) Standard right of way (ROW) shall be acquired and established as part of this road development program.

Action 17: The Government shall frame the rules for the Highway Protection Act and shall ensure effective enforcement by providing support to the Highway Authority in terms of manpower and funds for the removal of encroachments, regulate and control access and to co-ordinate activities with other agencies.

Action 18: Use of low axle weight but heavy haul multi-axle trucks which are more fuel-efficient shall be monitored and enforced by the Highway Authority.

Action 19: The education and training needs identified under the ISAP of KSTP shall be implemented on a priority basis and a training needs assessment in the context of these road development policy requirements shall be initiated.

Action 20: An autonomous Highway Development Authority shall be established within the PWD to implement the road development plan.

Action 21: The KHRI shall be made autonomous and adequately strengthened to handle additional functions such as organizing and conducting education and training programs and undertaking quality audits on a continuing basis.

Action 22: The HDA shall ensure that the projects and programs are taken through a process of public consultation and such information is available for public access through electronic media.

The implementation of the road development policy will usher in a wide range of benefits. Some of the major benefits anticipated are:

(a) With the possible expenditure of upto Rs. 4,000 crores per annum over the next 12 years, road building materials and equipments industry is likely to generate of over 1 lakh jobs per year; (b) Improved roads will reduce vehicle operating costs of all road users; (c) Improved road infrastructure would facilitate development of lands for residential, commercial and semipublic uses which is required for accommodating the anticipated urban growth in Kerala.

Abbreviations:

BOT	-	Build Operate and Transfer	MDR	-	Major District Roads
GIS	-	Geographic Information System	MORTH	-	Ministry of Road Transport and Highways
HAD	-	Highway Development Authority	NH	-	National Highways
IRC	-	Indian Road Congress	NHAI	-	National Highway Authority of India
ISAP	-	Institutional Strengthening Action Plan	PWD	-	Public Works Department
IWT	-	Inland Water Transport	PWD (R & B)	-	Public Works Department (Roads & Bridges)
KHRI	-	Kerala Highway Research Institute	R & R	-	Resettlement and Rehabilitation
KRFB	-	Kerala Road Fund Board	RBDCK	-	Roads and Bridges Development Corporation of Kerala
KSEB	-	Kerala State Electricity Board	RMMS	-	Road Maintenance and Management System
KSTP	-	Kerala State Transport Project	SH	-	State Highways
KSUDP	-	Kerala Sustainable Urban Development Project	VOC	-	Vehicle Operating Costs

CHAPTER 8
DELINEATION OF PLANNING AREA

8.1 Planning area in the context of a wider region

The immediate primary influence area of Kochi city, which is the Kochi City region, is identified as the planning area; and a secondary influence area beyond the planning area limits is considered as a wider influence region for the purposes of the Plan. This wider region may even transcend the limits of Ernakulam district boundary.

8.2 Influence area of Kochi City

8.2.1 Wider influence region around Kochi City:

Kochi city exerts a powerful economic influence extending over a much larger area than its corporate limits. As the focal point of an extensive regional network of transport and communication, Kochi is the nerve centre of a large urban agglomeration. Growth around the city of Kochi has been mostly guided by the important regional road connectivity.

Cochin Port extends its influence to the whole of Kerala and parts of neighboring states. The super specialty hospitals of Kochi attract people from across the state and even from abroad. Commercial activities of the city get customers from the State as a whole. The Cochin Port and the urban complex, which envelops it along with the backwaters and the lagoons, has become a distinct land mark of the west coast of India. Further the International Airport at Nedumbassery developed on PPP basis, the establishment of the Transshipment Terminal at Vallarpadam, the export processing units that have got established in the city periphery, are some of the factors which further add to the development of the region.

The secondary influence of the city region has spread to adjacent districts also. The National Highway (NH 47) passing through the North – South corridor has contributed much to the spread of developmental activities to nearby districts like Alappuzha and Thrissur. Towards the south the influence area extends up to Cherthala in Alappuzha district (along the NH 47 to Thiruvananthapuram) and towards north the influence has been along Aluva - Angamaly corridor up to Thrissur. Refer Map 8.1. A study on floating population in the city conducted in February 2007 (NATPAC) shows that the quantum of floating population that the city accommodates is as much as 46% of the resident population and that 37% of this is from other districts. 65% of the population visited Kochi for work or work related purposes. The influence of

the city is thus found to extend even beyond the district boundaries up to Thrissur in the north, Thodupuzha in the east and Alappuzha in the south

Map 8.1

Thus on a broader perspective, it could be stated that the wider influence region of Kochi may extend up to Thrissur on the north, Perumabavur on the north-east , North Parur and Kodungallur on the north west , Vadavukode – Puthenkurisu (Kolencherry) and Muvattupuzha-Kothamangalam on the east, Vaikom and Kottayam on the south-east and Alappuzha on the south.

8.2.2 Immediate Primary influence Area (Planning Area) of Kochi City

8.2.2.1. The primary influence zone identified in the previous Plans and the concept of Central city

The primary influence zone of Kochi was delineated as the Greater Cochin Region, in the Development Plan for Cochin Region, 1976 and included the Corporation of Kochi, 6 Municipalities and thirty three Panchayats. Refer Map 8.2. (Details of local bodies included in the Greater Cochin Region identified in the Development Plan for Cochin Region is given in Annexure 5). The urban core of this Region thus identified was delineated as the Central City and included Corporation of Kochi and fourteen other Panchayats and had an area of 226.69 sq km . The urban population was proposed to be distributed in the Central City and the three Municipal towns of North Paravur, Aluva and Perumbavur. The details of local bodies included in the Central City identified in the Development Plan for Cochin Region is shown in Table 8.1 below.

Table 8.1 : Details of Local bodies included in the Central City as identified in the Development Plan for Cochin Region, 1976

Sl. No	Name of local body	Gross area in sq.km	Population 1971 census*
1	Cochin Corporation	94.88	4,39,066
2	Maradu	10.93	22,528
3	Thrippunithura	14.86	17,766
4	Thiruvankulam	10.40	11,550
5	Vadaukode Puthenkurisu	12.95	8,360
6	Thrikkakara	15.67	18,255
7	Kalamassery	16.92	21,210
8	Varappuzha	13.08	35,040
9	Elamkunnappuzha	11.52	36,358
10	Cheranellur	1.02	4,824
11	Chellanam	6.35	8,540
12	Njarakkal	6.68	18,658
13	Mulavukad	7.30	19,379
14	Kadungallur	3.44	4,064
15	Edathala	0.69	1,173

	Total	226.69	6,66,771

*Source: Development Plan for Cochin Region, 1976 * Comparative analysis with respect to successive Census is not made as only parts of some Panchayats were included in the Central City*

Map 8.2

The urban expansion, however, out grew the limits of Central City during the succeeding decades and the population growth of rural areas far exceeded that of the urban areas. Hence certain modifications were effected in the boundaries of the Central City, in the Structure Plan for Central City, Kochi (Sanctioned by Government within the framework of the Town Planning Legislation in force) so as to include the whole of Urban Agglomeration (UA) as per 1981 Census, census towns contiguous to the Urban Agglomeration and areas intervening between the boundary of UA and Census Towns. It was also considered that the boundary of the Central City should encompass the full administrative boundaries of the constituent local bodies for effective implementation of plan proposals and the central city should necessarily form a compact area wherein developmental efforts could be focused.

The Central City thus delineated in the Structure Plan for Central City, Kochi included the Corporation of Kochi, two Municipalities and ten Panchayats with an area of 275.87 sq.km. Details are shown in Table 8.2 below.

Table 8.2: Area and population details of local bodies included in the Central City as identified in the Structure Plan for Central City , 2001

Sl. No.	Name of local body	**Area (Sq.km)**	**Population 1981 Census**	**Population 2001 Census**
1	Corporation of Kochi	94.88	5,13,249	595575
2	Thripunithura (M)	18.69	43,646	59884
3	Kalamassery (M)	27.01	43,767	63116
4	Maradu	12.35	28,749	41012
5	Thiruvankulam	10.49	15,517	21717
6	Thrikkakkara	27.46	38,318	65984
7	Cheranelloor	10.59	18,381	26316
8	Eloor	21.95	52,528	35573
9	Varappuzha			24524
10	Kadamakkudy	12.92	13,696	15824
11	Mulavukadu	19.27	21,397	22842
12	Elamkunnapuzha	11.66	43,911	50563
13	Njarackal	8.60	21,672	24166
Total		**275.87**	**8,54,831**	10,47,096

However it is seen that the wider influence region identified in the Development Plan for Cochin Region. 1976 and the Structure Plan for Central City, Kochi, 2001 coincided with the boundaries of the Greater Cochin Region. But, as stated under 8.2.1 above, the wider influence

region of Kochi City has transcended the boundaries of Greater Cochin Region and the District as well.

8.2.2.2 Need for re-delineating the Central City identified in the Structure Plan and identifying Kochi City Region as the Planning Area

- The whole of Urban Agglomeration as per 1981 Census was included in the Central City as per the Structure Plan for Central City, Kochi. The Kochi Urban Agglomeration had only 5 constituent local bodies in 1981.

  But this became 19 in 1991 and 26 in 2001 there by showing an expansion of urban area . Refer Map 8.3. Kochi Urban Agglomeration as identified by the Census 2001 comprises of the urban local bodies of Kochi Corporation, 5 municipalities, 15 full panchayats and parts of 4 panchayats (Annexure 6). It extends up to Angamali in the north, Chowara and Edathala in the east, Maradu and Cheriakadavu in the south. The distance from Kochi City to the northern boundary of the Urban Agglomeration is about 35 km.

  The UA identified in the census cover only a portion of the Panchayat in certain cases. The actual contiguity of physical development is not considered as an important factor in defining UA in the Census. But, in order to have a compact development, all the intervening areas are to be simultaneously developed. Considering the urban manageability and the need for addressing the requirements of floating population it is necessary to redelineate the planning area boundary with respect to that of the Structure Plan for Central City, Kochi.

- The population growth in some of the rural areas and municipalities adjacent to the city exceeds that of urban area. The suburban areas showed higher growth rates than the city proper.
- Developable land is available and new projects are coming up in the peripheral areas of Central City identified in the Structure Plan

Map 8.3

8.2.2.3 The Planning Area or Kochi City Region

The following factors were considered for identifying the planning area:

- The area considered as Central City in the Structure Plan is taken in full in the Planning Area.

- Three Panchayats viz. Chellanam, Kumbalam and Kumbalangy lie between the southern side of Kochi Corporation and the District boundary and have potential for development. These Panchayats have major ongoing proposals for extending infrastructure. Due to the geographical location and considering the need for additional inputs to induce physical development in these areas, these three Panchayats are added to the Kochi City Region.

- All or parts of some of the major investments on the anvil are coming up in Vadavukode-Puthenkurisu Panchayat. Smart City, Bhrahmapuram Power Plant, Solid waste treatment plant of Kochi Corporation etc. are some among them. This will have pronounced effect on the development of the city. Moreover there is huge potential for developing heavy industries and land intensive developments in this Panchayat area. This Panchayat is also connected by NH 49 (Kochi – Madurai). This necessitates inclusion of Vadavukode- Puthenkurisu Panchayat in the Planning Area.

- Certain areas on the north and north eastern portion of the Kochi Urban agglomeration 2001 show greater dependency to the secondary urban centres closer to them than to the City which necessitated exclusion of those areas.

- Availability of infrastructure is a major factor for densifying an area. The City Development Plan for Kochi is prepared for an area covering the Central City delineated in the Structure Plan and the three Panchayats of Chellanam, Kumbalam and Kumbalangi. Infrastructure projects envisaged under the City Development Plan are posed for financial assistance under Jawaharlal Nehru National Renewal Mission which is a positive indicator for bringing infrastructure development in these areas.

Considering all the above factors, the Kochi City Region which is the Planning Area is delineated so as to include Kochi Corporation, Thripunithura Municipality, Kalamassery

Municipality and 14 panchayats; altogether encompassing of 369.72 sq. km area as detailed in Table 8.3 and Map 8.4.

Map 8.4

Table 8.3 : Area and population details of proposed Kochi City Region

Sl. No.	Name of Local body	Area (sq. km)	Population as per 2001 Census
1	Corporation of Kochi	94.88	595575
2	Thripunithura Municipality	18.69	59884
3	Kalamassery Municipality	27.00	63116
4	Maradu	12.35	41012
5	Thiruvankulam	10.49	21717
6	Thrikkakkara	27.46	65984
7	Cheranelloor	10.59	26316
8	Eloor	14.21	35573
9	Varapuzha	7.74	24524
10	Kadamakkudy	12.92	15824
11	Mulavukadu	19.27	22842
12	Elamkunnapuzha	14.47*	50563
13	Njarackal	8.6	24166
14	Kumbalam	20.79	27549
15	Kumbalanghi	15.77	26661
16	Chellanam	17.6	36209
17	Vadavukode-Puthenkurisu	36.89	26710
Total		**369.72**	**1164225**

Source: Census, 2001

*Including 2.81 sq.km of accreted land at Puthuvypeen

8.2.2.4 Planning Divisions

The Kochi City and the constituent local bodies of the Kochi City Region will be considered as a single entity for planning purposes. But considering the fact that Kochi city and the constituent units possess distinct potentials for development, in order to utilize these potentials fully and also with a view to relieve Kochi city of the congestion currently being experienced, it is proposed to plan for Kochi City Region identifying different planning divisions as self contained units. The Planning divisions shall be identified in such a manner as to ensure presence of predominant potential for development, physiography, contiguity and homogeneity and each planning division is accessible to mass transit corridors.

The Planning divisions thus identified are as follows (Refer Map 8.5) :

Table 8.4: Details of Planning Divisions

Sl. No.	Constituent area	Specialized Development Potential
1	Fort Kochi and Mattanchery	Heritage and Tourism
2	Wellington Island	Port operations
3	Kochi Main land	Subject to provision of Infrastructure - Commerce, Institutional, Transport related, Recreation
4	Chellanam and Kumbalangy	Fishing, Tourism
5	Maradu, Kumbalam	Residential
6	Thrippunithura, Thiruvankulam	Residential, heritage
7	Vadavucodu-Puthen kurisu	Industries
8	Kalamassery, Thrikkakara	Industries, Commerce, Transport related, IT, Institutional
9	Eloor	Industries, Transport related
10	Cheranallur, Varapuzha	Recreation, water front development
11	Elamkunnapuzha, Mulavukadu, Njarakkal, Kadamakkudy	Port related activities, Fishing related

Map 8.5

CHAPTER 9
DETAILED STUDY AND ANALYSIS OF KOCHI CITY REGION

9.1 DEMOGRAPHY

Emergence of Kochi as the largest city in Kerala

Urban growth in Kochi is not limited to the boundaries of the city alone, since Kochi city and the surrounding areas have been experiencing fast urban growth during the last few decades. The present urban sprawl in Kochi had extended to adjoining contiguous areas of Thripunithura, Eloor, Kalamassery and Thrikkakkara altogether forming Kochi Urban Agglomeration.. Njarakkal town (declassified in the 1981 Census), Mulavucad and Maradu (census towns as per 1981 census) also lie adjoining Kochi, making the city and its immediate environs the largest urban centre of Kerala coast and the second largest on the western coast of India. The population of Kochi Urban Agglomeration was 6.86 lakhs as per Census 1981 and as per Census 1991 the population of Kochi Urban Agglomeration was 11.41 lakhs.

Kochi UA as identified by the Census of India in 2001 comprises of urban local bodies of Kochi Corporation, 5 Municipalities, 15 Panchayat areas in full and 4 Panchayat areas in part. This extends up to Angamaly in the north, Chowara and Edathala in the east and Maradu and Cheriayakadavu in the south. Total population of Kochi Urban Agglomeration is 13.60 lakhs as per 2001 census. (Refer Annexure 6)

It is seen that about 91.80 percent of the total urban population of Ernakulam district comes under Kochi UA as per 2001 census. This is 43.60 percent of total population of the district.

9.1.1 Growth Trend of Population

The state of Kerala situated in the south-west corner of India has a population of 31,838,619 persons (12^{th} in India) with urban population of 8,267,135 (12^{th} in India) and an average density of 819 persons per sq.km (2^{nd} in India) with urban density of 2542 persons per sq.km (16^{th} in India) as per 2001 census. The population of Kerala accounts for 3.1% of the Country's population, while the area accounts for only 1.18% of the total area of the country. It is one of the most densely populated states in the country. More than 25 percent of the population live in urban areas. Demographically the state enjoys a very advanced status with rapidly

declining birth and death rates, low infant mortality and very high literacy and health delivery system.

Ernakulam district has the credit of being the economic nerve centre of the state. It is the industrially advanced and flourishing district of Kerala. Ernakulam district has a population of 30,05,798 persons with an urban population of 14,77,085 and an average density of 1012 persons per sq.km The population of Ernakulam District accounts for 9.75% of the state population, while the area accounts for 7.89% of the state. Urban population of Ernakulam District accounts for 17.87% of the urban population of the state. The percentage of urban population of Ernakulam district as against the state average of 25.96% is very high (49.14%) as per 2001 census. Kochi region encompasses most of the urban centres in the district. The regional population constitutes 58.5% of the district population as per 2001 census. The central city of Kochi which forms the core area of the Kochi region holds 33.72% of the district population as per 2001 census.

The Kochi City Region considered as the Planning area consists of the Kochi city area, two municipal towns and fourteen adjoining panchayats. This is the delineated Central City of Structure Plan together with four more Panchayats viz. Kumbalam, Kumbalangi, Chellanam and Vadavucode-Puthenkurisu. The Kochi City Region has a population of 11,64,225 as per 2001 census. Total area is 36972 ha and the average density of population is 32 persons per ha.

Table 9.1: Area and Population details (in the constituent units) of the Kochi City Region - 1971 to 2001

No	Geographic Unit	Area 2001 (sq km)	1971 Pop.	1981	1991	2001
1	Corporation of Kochi	94.88	439066	513249	564589	595575
2	Thripunithura Municipality	18.69	36593	43646	51078	59884
3	Kalamassery Municipality	27.00	29546	43767	54342	63116
4	Maradu	12.35	22817	28749	34995	41012
5	Thiruvankulam	10.49	13291	15517	18412	21717
6	Thrikkakkara	27.46	26862	38318	51166	65984
7	Cheranelloor	10.59	15135	18381	21407	26316
8	Eloor	14.21	26595	31701	34455	35573
9	Varapuzha	7.74	17798	20627	22514	24524
10	Kadamakkudy	12.92	11831	13696	14668	15824
11	Mulavukadu	19.27	19379	21397	22322	22842
12	Elamkunnapuzha	14.47*	36358	43911	47878	50563
13	Njarackal	8.60	19221	21672	22978	24166
14	Kumbalam	20.79	18636	21678	24143	27549
15	Kumbalanghi	15.77	19489	22376	24601	26661
16	Chellanam	17.60	25025	29536	32978	36209
17	Vadavucode-Puthenkurisu	36.89	19436	23653	26144	26710
Total		**369.72**	**7,97,078**	**9,51,874**	**10,68,670**	**11,64,225**

Source: Census of India

* including 2.81 sq. km of accreted land at Puthuvypeen

Kochi witnessed a rapid population growth during the past 30 years. The average decadal growth in Kochi City area is 7.83% where as the nearby municipal areas registered decadal growth of an average of 18.65% and in the adjoining panchayat areas the average decadal growth was 12.13%. The semi urban areas around the city show high rate of population growth and also fast developing trends. Refer Maps 9.1.1 and 9.1.2

Table 9.2: Trend of Population Growth in the Kochi City Region

Sl. No	Geographic Unit	Area in Sq. Km	Population			Decadal Growth	
			1981	1991	2001	1981-1991	1991-2001
1	Corporation of Kochi	94.88	513249	564589	595575	10.00	5.49
2	Thripunithura Municipality	18.69	43646	51078	59884	17.03	17.24
3	Kalamassery Municipality	27.00	43767	54342	63116	24.16	16.15
4	Maradu	12.35	28749	34995	41012	21.73	17.19
5	Thiruvankulam	10.49	15517	18412	21717	18.66	17.95
6	Thrikkakkara	27.46	38318	51166	65984	33.53	28.96
7	Cheranelloor	10.59	18381	21407	26316	16.46	22.93
8	Eloor	14.21	31701	34455	35573	8.69	3.24
9	Varapuzha	7.74	20627	22514	24524	9.15	8.93
10	Kadamakkudy	12.92	13696	14668	15824	7.10	7.88
11	Mulavukadu	19.27	21397	22322	22842	4.32	2.33
12	Elamkunnapuzha	14.47*	43911	47878	50563	9.03	5.61
13	Njarackal	8.6	21672	22978	24166	6.03	5.17
14	Kumbalam	20.79	21678	24143	27549	11.37	14.11
15	Kumbalanghi	15.77	22376	24601	26661	9.94	8.37
16	Chellanam	17.6	29536	32978	36209	11.65	9.80
17	Vadavucode - Puthenkurisu	36.89	23653	26144	26710	10.53	2.16
Total		**369.72**	**951874**	**1068670**	**1164225**	**12.27**	**8.94**

Source: Census of India

* including 2.81 sq. km of accreted land at Puthuvypeen

Map 9.1.1

Map 9.1.2

9.1.2 Spatial distribution of density of population

The density of population in various parts of the Kochi City Region is shown in Table 9.3 and in Map 9.1.3. The average density of population in the Kochi City Region is 32 persons per hectare (pph). The average population density in Kochi city area is 63 pph. Population growth rate shows a declining trend in the city area during the past three decades where as the suburban areas around the city indicated in the Kochi City Region show a considerable high population growth.

Table 9.3: Spatial distribution of Density of Population – 2001

No	**Geographic Unit**	**Population** 2001	**Area** in ha.	**Density** Per./ha.
1	Corporation of Kochi	595575	9488	63
2	Thripunithura (M)	59884	1869	32
3	Kalamassery (M)	63116	2700	23
4	Maradu	41012	1235	33
5	Thiruvankulam	21717	1049	21
6	Thrikkakkara	65984	2746	24
7	Cheranelloor	26316	1059	25
8	Eloor	35573	1421	25
9	Varapuzha	24524	774	32
10	Kadamakkudy	15824	1292	12
11	Mulavukadu	22842	1927	12
12	Elamkunnapuzha	50563	1447	35
13	Njarackal	24166	860	28
14	Kumbalam	27549	2079	13
15	Kumbalanghi	26661	1577	17
16	Chellanam	36209	1760	21
17	Vadavucode-Puthenkurisu	26710	3689	7
Total		**1164225**	**36972**	**32**

Source: District Census Hand Book, 2001

* including 2.81 sq. km of acreted land at Puthuvypeen

Map 9.1.3

9.1.3 Age Structure

The age structure reveals that the youth and the middle aged population constitute a major portion of total population. This is a sign of healthy social condition having possibility for manpower availability.

Table 9.4: Age Structure- 2001

Age Group	No. of Persons	Percentage
0-4	46942	7.87
5-19	139276	23.35
20-59	349116	58.53
60-79	54518	9.14
80	6621	1.11
Total	**596473**	**100**

Source: Estimation based on District Census Hand Book, 2001

9.1.4 Sex Ratio

Table 9.5: Sex Ratio in Kochi City Region- 2001

Sl. No.	Geographic Unit	Sex Ratio (no of females / 1000 males)			
		1971	1981	1991	2001
1	Corporation of Kochi	951	987	992	1021
2	Thripunithura (M)	1032	1016	1020	1032
3	Kalamassery (M)	889	920	956	977
4	Maradu	998	1010	1001	1020
5	Thiruvankulam	970	994	1004	1016
6	Thrikkakkara	956	993	988	1019
7	Cheranelloor	1002	1000	1018	1014
8	Eloor	852	949	919	1002
9	Varapuzha	-	-	1048	1071
10	Kadamakkudy	1006	995	996	1021
11	Mulavukadu	1002	1009	1026	1050
12	Elamkunnapuzha	1023	1021	1032	1057
13	Njarackal	1034	1062	1054	1078
14	Kumbalam	1019	1010	1016	1043
15	Kumbalanghi	1076	1060	1063	1053
16	Chellanam	1000	1000	1010	1042
17	Vadavucode- Puthenkurisu	933	945	945	987
Kochi City Region (CoC+16 local bodies)		**984**	**998**	**1005**	**1030**

Source: District Census Hand Book, 1971, 1981, 1991, 2001

In 2001, Kochi City area had 290095 males to 295764 females. The Kochi City Region had (2001) a sex ratio of 1030 compared to the state level figure of 1058.

9.1.5 Literacy

The percentage of literates in the State and that in Ernakulam district, Kochi City and in the Kochi City Region is shown in Table 9.6.

Table 9.6: Literacy rate

Geographical Unit	1981	1991	2001
Kerala	70.42	89.81	90.86
Ernakulam District	76.82	92.35	93.2
Ernakulam urban	79.15	93.65	94.66
Kochi corporation	79.58	95.11	95.5
Kochi City Region	**78.73**	**93.23**	**93.79**

Source: District Census Hand Book, 1981, 1991, 2001

Ernakulam district has the unique distinction of being the first district to be declared for attaining 100 percent literacy in the country. There is no wide difference in the literacy rates between males and females and between the rural and urban areas in Kerala. Male literacy rate is 94.2% where as the female literacy rate is 87.7% in Kerala. In the Kochi City Region the average literacy rate is 94.7% and is 95.5% in Kochi city area. Urban male literacy rate is higher compared to 90.9% of urban female literacy

Table 9.7: Literacy rate in the Kochi City Region 1971- 2001

Sl. No	Geographic Unit	1971	1981	1991	2001
1	Corporation of Kochi	69.5	79.58	95.11	95.46
2	Thripunithura Municipality	72.39	80.45	94.34	96.01
3	Kalamassery Municipality	57.21	73.84	91.12	93.18
4	Maradu Panchayat	70.15	77.07	95.09	95.19
5	Thiruvankulam Panchayat	69.63	79.84	94.28	95.41
6	Thrikkakkara Panchayat	52.42	69.58	90.41	92.51
7	Cheranelloor Panchayat	69.38	79.44	95.08	95.35
8	Eloor Panchayat	69.85	91.58	93.55	94.65
9	Varapuzha Panchayat	-	-	93.88	94.39
10	Kadamakkudy Panchayat	72.17	80.59	95.75	94.29
11	Mulavukadu Panchayat	73.81	80.61	95.19	95.68
12	Elamkunnapuzha Panchayat	71.39	80.16	94.26	94.26
13	Njarackal Panchayat	70.12	79.72	95.17	94.76
14	Kumbalam Panchayat	70.78	77.46	94.22	94.67
15	Kumbalanghi Panchayat	65.92	77.43	93.72	93.36
16	Chellanam Panchayat	64.29	75.9	93.47	92.92
17	Vadavucode-Puthenkurisu	64.88	76.48	80.35	82.37

Kochi City Region (CoC+16 local body)	**67.74**	**78.73**	**93.23**	**93.79**

Source: District Census Hand Book, 1971,1981, 1991, 2001

9.1.6 Population Projection

Urban expansion during the past few decades out grew the limits of the central city. The population growth in the rural areas far exceeded that of the urban areas. Hence, the suburbs showed higher growth rate than that of the city. The concept of urban agglomeration takes into account the present urban spread. The constituents of the urban agglomeration satisfy the conditions of urbanization, contiguity and viability.

A survey of the population reveals of the unbalanced distribution of population on urban land, conditioned by physical constraints and inadequacy of services. In order to maximize the land resources and achieve a balanced distribution of population, it is necessary to specify population densities in the different zones of the planning area.

The significant demographic fact about Kochi is that the city lies in Ernakulam District which is the most urbanized region in the state. The percentage of urban population of district (47.56%) is far beyond the urban content of the state (25.96%). The Kochi City Region which forms the core area of the district holds more than one third of the district population.

The population growth has mainly the following components namely:-

(a) Increase by natural growth;
(b) Increase by migration; and
(c) Increase by floating population

From the above components, estimate of future population is decided by natural growth and migration. In a city like Kochi attracting substantial floating population, this needs to be considered to calculate future infrastructure requirements.

For almost all the urban centres in Kerala, the migration component appears to play only a negligible role in the growth of the city. There had been no intensive migration to any of the cities in Kerala mainly due to the following reasons:

- Employment opportunities in the main cities are not sufficient to exert a pulling effect.
- High land values in cities prohibit establishment of residences in cities especially among the middle and low income categories.
- The traditional homestead nature of holdings in the suburban/ rural areas allows fragmentation of property for new house construction activities
- Availability of transport facilities allows daily commutation to the city from the outlying areas and district within a radius of about 100 km

The population characteristic of Kochi is studied based on the above.

In the recent years due to many large scale development projects, especially in the construction sector and information technology, substantial employment opportunities are generated in Kochi and this is a positive factor for migration. However, sharp increase in land values and scarcity of developable land prevent lower and middle income group families from buying land within the city for residential purposes. This has made a good percentage of people to opt for residences in the outskirts of the city. Though the trend reduces migration, it increases floating population in the city.

Population projection in the Kochi City Region has also to take account of the effect of the large scale investment proposals and infrastructure requirements in and around Kochi city. The contributing factors of population growth in the area are mainly the natural increase and the migration from nearby rural areas for trade and employment. Even though the natural growth rate of population does not show exorbitant increase, floating population and migration in Kochi are to be considered while proposing infrastructure requirements. Facility for daily commutation from the region around adds to the increased number of floating population in the city. A transportation study conducted shows that nearly 2.5 lakh of people commute daily to the city thereby increasing the stress on civic infrastructure and congestion on major traffic corridors.

Kochi City Region has higher population growth rate compared to the state average. In the coming two decades it is expected to touch two million mark. Most of the growth is taking place just outside of the Kochi city area but within the Kochi City Region. This coupled with the high level of floating population necessitates integrated planning, development and service delivery.

Population growth from 1981 to 2001 shows a gradual decreasing trend in the city area and in the Kochi City Region

Table 9.8: Population Growth Trends

Geographic Unit	Decadal Growth trend			Decadal Growth Rate (%)		
	1971– 81	81- 91	91 – 2001	71 – 81	81 – 91	91 - 01
Kochi City Region (CoC+16 local bodies)	150579	114305	94989	19.36	12.31	9.11
Corporation of Kochi	74183	51340	30986	16.90	10.00	5.49

Population increase by natural growth:

- Exponential rate of growth is adopted by Expert Committee of Govt. of India on population projection. Hence this method is adopted for determining the increase of population by natural growth in the Kochi City Region. In this method, rate of growth is an influencing factor. Hence local bodies which have higher growth rate for the previous decades shows higher projected population.

- In addition to the natural growth, there will also be **migration** from other areas to the city. The large scale projects already in progress and those envisaged in this area may also considerably influence population increase.

- The rate of migration and floating population assumed for each local body and the final population of Kochi City Region for the year 2031 (including migration and floating population) is as follows :

Table 9.9: Projected Population of Kochi City Region for the year 2031

Sl. No	Name of local body	Population Projected for the year 2031 using Exponential Growth Rate method	Assumed % of migration	Assumed % of floating population	**Projected Population (2031) + Migration + floating population**
1	Corporation of Kochi	737485	10	20	**929541**
2	Thripunithura (M)	113141	10	20	**149346**
3	Kalamasserry (M)	114857	30	20	**179177**
4	Maradu (P)	77367	30	10	**110635**
5	Thiruvankulam (P)	42032	10	20	**55482**
6	Thrikkakara (P)	182500	30	20	**284700**
7	Cheraneloor (P)	39770	nil	20	**47724**
8	Eloor (P)	40418	nil	30	**52543**
9	Varapuzha (P)	34523	30	nil	**44880**
10	Kadamakudy (P)	21432	nil	20	**25718**
11	Mulavukad (P)	25045	nil	20	**30054**
12	Elamkunnapuzha (P)	62897	30	20	**98119**
13	Njarakkal (P)	29564	30	20	**46120**
14	Kumbalam (P)	46707	30	10	**66791**
15	Kumbalangy (P)	36776	nil	20	**44131**
16	Chellanam (P)	52628	nil	20	**63154**
17	Vadavucode-	29100	30	20	**45396**

	Puthencruz (P)				
	Total	1686242			**2273512**

The total population of Kochi City Region by the year 2031, including natural growth, migration and floating population is **22, 73,512**

9.2 ECONOMIC BASE

9.2.1 Occupational pattern

The economic base of a town depends on historical factors, geographic features, available resources, sectors of production operating from the town, growth of service sectors, and capacity of the town to attract further investments. The level of service of infrastructure favor the economic role and the development of the town.

Kochi being a port city, many of the economic activities are interlinked with the port. After the establishment of an all weather natural port in Wellington Island in 1932, trade and commerce which were active in the area since 4th century gained much more importance.

9.2.2 Export and Import

A lion's share of Kerala's trade is being conducted through Cochin Port. It is expected that the volume of export from Kerala will increase on completion of Vallarpadom Container Terminal and the Vizhinjam Port. Important export cargo from Kerala are fish and other marine products, pepper, cashew, coir and coir products, tea, rubber, spice oils and oleoresins. Software export is also gaining momentum in recent years. All the items exported through Cochin Port except cashew kernels and spices registered an increase in quantity. The highest upward trend was seen in tea export.

Kochi is the gateway through which more than 80% of the hill produces of Kerala get exported to other nations. Fishing is also a main activity in the area. The port has induced development of a number of large scale industries in the peripheral areas of the city. Now Puthuvyppu and Vallarpadom are getting prepared to be hectic centres of trade and industry related to Port.

9.2.3 Key Industries

Due to its strategic location, Kochi has long been a centre of trade. For centuries, the city was renowned for its spices, jewellery, apparel and fishing industries. Major industries like Fertilisers and Chemicals Travancore (FACT), Travancore Cochin Chemicals (TCC), Hindustan Machine Tools (HMT), Indian Rare Earths, Premier Tyres (now Apollo Tyres) etc. located in the

adjacent areas of the city have had immense impact on the economy and developments in the city. In recent times, the Cochin Port in its expansion and modernization pace and the tourism industry have also contributed significantly to the local economy. The Shipyard situated within the city limits has been a silent giant contributing substantially to the economic health of the city and the state. While these industries continue to remain strong today, the economy has received a boost from the IT/ITES and financial services. All these have their multiplier effects on trade and commerce and construction industry. As a result, Kochi is witnessing an economic boom.

9.2.4 IT/ITES

The IT/ITES (Information Technology and Information Technology Enabled Services) boom in Kochi is driven by a combination of factors, which include cheaper real estate costs compared to the larger and more mature metros in India; some of India's best communications infrastructure, low labour costs and low attrition rates. These, combined with the Government of Kerala's initiatives to promote IT/ITES within the state have served to make Kochi a very attractive destination for some of India's top technology firms. Wipro, Tata Consultancy Services and Cognizant have an active presence in the city.

9.2.5 Tourism

The natural beauty of Kerala and its coastal backwaters have made it one of the top tourism destinations in the country. The World Travel & Tourism Council has rated Kerala as one of its top three tourist destinations. Approximately 18% of all tourism revenue in the state of Kerala came from Kochi in 2007.

Recognising the importance of tourism to the local economy, city officials have launched initiatives to ensure the continued growth of tourism in Kochi:

- A new, modern airport has been built and is already operational
- The coastal backwaters around Kochi are being further developed to accommodate more tourists
- A new cruise ship terminal is being built in the Port of Cochin

9.2.6 Banking and Financial Sector

Kochi has the proud privilege of being the location of Cochin Stock Exchange (CSE). As the economy of Kochi continues to grow, many firms from the banking, financial services and insurance (BFSI) sector are establishing their presence within the city. Their business is driven

not only by corporate clients and the growing population of the city, but also by Non- Resident Keralites (NRKs) who continue to have financial ties to their home state. Banks such as HSBC, Citibank, ICICI etc. have set up outlets throughout the city, many of which are located in prime areas.

9.2.7 Port Activities

The Port of Cochin is synonymous with the city of Kochi. Located in the Wellington Island, the port has traditionally been one of the main economic drivers of the local economy as well as one of the largest employers in the city. While the Port of Cochin is one of the smallest major ports in India, it is embarking on a modernization project that will enable it to take market share away from competing ports in Gujarat, Maharashtra and Tamilnadu.

9.3 KOCHI TODAY

Kochi, formerly known as Cochin, is recognized as the economic capital of the state of Kerala. For centuries, it has been a centre of trade and commerce due to its strategic location along shipping routes between Europe, Asia and the Middle East.

While the seaport and the industrial developments in Eloor, Kalamassery and Aluva regions continue to be major economic activities in Kochi, the city region has many diversified activities. Information Technology parks and related developments, banking and other financial institutions including Cochin Stock Exchange (CSE) and tourism have grown to become other major dominant economic activities in the city region. These have helped to build the commercial activities as strong magnets attracting customers from far and wide. Government of Kerala has been proactive not only in promoting the city as an attractive leisure and business destination but also in developing the infrastructure required to support such activities. Kochi is quickly transforming into a key IT/ITES hub in South India. The city provides an enviable mix of skilled manpower, low labour & operating costs, attractive real estate options and satisfactory infrastructure. Many of India's leading technology firms have already recognized the competitive advantages that Kochi offers by expanding their operations into the city on a large scale.

A greater corporate presence in the city, and the resulting job opportunities, has led to an increase in real estate development activity in the city and the region around. Newly built malls, hotels, apartment complexes and business parks are transforming the landscape and the urban form of Kochi.

9.4 URBAN FORM & INFRASTRUCTURE

9.4.1 Urban Form

The city of Kochi is located along the central coast of Kerala in Ernakulam district. A collection of small islands, a large peninsula and the mainland collectively make up the modern city of Kochi. Suburban districts and the new Cochin International Airport have recently stretched the boundaries of the greater metropolitan area to the north and the east.

Fort Kochi, located on a peninsula in the southwest corner of the city, is where Portuguese colonists established the first European colony in India during the 16th century. Today this area is mostly a middle-class and upper middle-class residential colony with traces of colonial architecture and urban planning.

Wellington Island, located between the peninsula and the mainland, is where the Port of Cochin is located. Almost the entire island is used for industrial activities by the port and railways. The neighbouring islands of Vypeen, Vallarpadam and Bolgatty are also under the influence of these industrial uses, with some residential and tourism related activities also being developed.

Mahatma Gandhi Road (or M.G. Road) on the mainland is the centre of commercial and retail activity corridor in Kochi. This north-south artery serves as both a 'high street' for the city. Limited space has caused merchants and the corporates to look for space immediately adjacent to the M.G. Road, mostly towards the east. Marine Drive, the prime commercial and residential neighbourhood is along the coast close to the northern end of M.G. Road. Further to the east, National Highway 47 runs parallel to M.G. Road. This vital artery is where many of the new malls are being developed. NH-47, and the parallel Seaport-Airport Road along the east, provides a crucial link to the northeast suburbs and the international airport.

The new I T parks and Special Economic Zones (SEZs) are found in the northeast suburbs of Kalamassery and Kakkanad. A great deal of new residential development is also seen in these areas. Future residential development is slated for development east of the Seaport-Airport road.The Mahatma Gandhi Road, known locally as MG Road, has traditionally been the heart of the commercial activity in the City. Today, MG Road, along with Marine Drive, makes up the major activity centre. Due to lack of available land parcels, very little new development has come up recently. The area in and around Vyttila Junction, Kaloor and Palarivattom Junctions and AKG Road form another important activity centre. Majority of office development activity in

Kochi is at Edappally and Kakkanad which are favoured by the developers due to the availability of large land parcels, good road connectivity (NH-47) and proximity to the Kochi International Airport. The Cochin SEZ, Infopark, Muthoot Technopolis, and Smart City are all located in the area. Within these IT parks and SEZs, large office spaces with facility management services are being offered. This is the hub of IT/ITES activity in Kochi. Companies such as Wipro, Tata Consultancy Services, Cognizant Technology Solutions and Outsource International Partners have all occupied or have developed their own office property here. These developments have in turn promoted commercial and health sector developments in the peripheral zones.

Major Seaport:

The Port of Cochin, one of India's twelve major ports, has ambitious plans for infrastructure development over the next 5 years. In addition to expanding the range of services that can be offered, these infrastructure projects will create economies of scale that will make the port more cost and time competitive with others throughout South and Southeast Asia. The Port of Cochin's intrinsic advantages ensure that it will continue to remain one of India's leading ports. They include:

- A location just 11 nautical miles from a major shipping lane that connects the Middle East to the Far East;
- An all-season port that can handle large vessels;
- Good connectivity to the rest of India by rail, road, air and backwaters;

As the port expands, there will be an increasing amount of industrial activity on Vypin, Vallarpadam and Bolgatty islands. Many of the additional workers that will be hired by the port are to be housed in new residential developments on these same islands. These new workers, along with the Port of Cochin's improved facilities will play a critical part in its plans to increase overall traffic handled and market share within India.

Excellent Air Connectivity:

More than 2.5 million air passengers used Cochin International Airport in 2006–07, making it the 7th busiest airport in India. The airport, built in 1999 as India's first greenfield public-private partnership civil aviation project, ranked 4th in terms of international air passengers. No other airport within India's Emerging Cities ranks as high in both categories.

Cochin International Airport is the only airport in the country besides Mumbai and Delhi that can handle large commercial aircraft such as the Airbus 380 (the largest passenger plane in the world). It has excellent connectivity to other cities within India and has direct international flights. This has served not only to boost tourism within Kochi but has also had a positive impact on the number of companies that have launched operations within the city.

Improved Road Connectivity:

A growing population and an increase in the number of cars per household have worsened the traffic congestion within Kochi. To address this issue, a 30km outer ring road project – the Cochin Seaport-Airport Highway – is being constructed. When fully operational this corridor will connect many of the industrial and commercial zones of Kochi area and reduce the travel time from the sea port to the airport by half. Kochi is well connected to other cities in India via the national highway system. Three national highways (NH-47, NH-17 and NH-49) pass through or near the city. This allows commercial traffic from both the airport and seaport to connect easily to the national grid.

First Rate IT Connectivity:

Kochi's excellent internet connectivity bodes well for the development of the city as an IT/ITES hub. The city is better connected than most cities in India, Such connectivity has helped Kochi in attracting IT & ITES firms.

Technology Parks & SEZs:

Tejomaya Building in Infopark,Kochi

Kochi has been a pioneer in the adoption of SEZs. The Cochin SEZ was one of the first in the country and housed businesses from a variety of industries. After a long break in SEZ development, two new technology-focused SEZs, Info park and Smart City will be completed in the short to medium term in the Kakkanad suburb of Kochi. These will be augmented by facilities such as the Muthoot Techno polis, the Port of Cochin's SEZ, and the KINFRA Information Technology & Electronics Park, which will further boost commercial activity in the city.

The pillars of Kochi's superb infrastructure are its large sea port, modern airport, excellent IT connectivity and technology parks/SEZs

9.4.2 Labour

With a population of 1.5 million inhabitants in its region, Kochi is the largest urban area in Kerala. India's most recent census showed that Kochi's population had grown at an annual

rate of 1.9% (1991–2001). New migrants to the city constitute 7.6% of the overall population, putting it in the same bracket as larger cities such as Mumbai, Delhi and Bangalore.
Due to lack of educational and employment options Kochi residents have traditionally sought opportunities in other Indian states, as well as abroad, most notably in the Middle East. Despite being employed outside of their native city, the residents of Kochi continue to maintain strong ties with families and the community. The money that they repatriate contributes significantly to the local economy.

When one looks at the profile of Kochi residents, contradictions emerge. With a literacy rate of greater than 94%, Kochi residents are among the most literate (educated) Indians. Yet the number of schools and universities are generally considered inadequate. Indeed, only 407 institutes of higher education exist in Kerala, a figure that places it towards the bottom of the list in this category amongst Indian states. This has traditionally driven many of Kerala's bright students to pursue higher education outside of the state.

In the past, lack of employment options had forced many Kochi residents to seek opportunities outside the city. A poor 2% annual employment growth rate has led to an unemployment rate of 27%. Unionized labour has historically been strong in Kochi, due partly to the high number of jobs linked to the Port of Cochin.

The economic resurgence that Kochi has seen in the past five years is sure to improve Kochi's employment figures. While the spice trade, jewellery trade and local seaport have traditionally been the largest employers, IT parks and SEZs are now attracting many new corporate employers to the city. These new technology centres, along with the upgrade to the Port of Cochin, are projected to create over 300,000 new jobs over the next five years, effectively doubling the working population of the city. Many of these jobs will be filled by new migrants to the city, which will create additional demand in the residential sector and boost retail activity within the city.

Business Environment & Governance:

Kochi's economic development is a top priority for the Government of Kerala. While there are persistent concerns about the state's political direction, the government have shown leadership in its development of key infrastructure throughout the city. Important airport, seaport, highway and SEZ projects have been launched and completed throughout the city. These projects have been critical in attracting some of India's leading firms to the city.

9.4.3 Overview of Real Estate Market in Kochi

Compared to India's larger and more mature cities, Kochi has a small commercial real estate market that is still in an early stage of development. However, the city's resurgent

economy is boosting the real estate market and creating new opportunities across all sectors. The city has also among the most transparent real estate markets of India's emerging cities, with levels of transparency comparable to that in Mumbai, Bangalore and Chennai. Quite a large number of real estate developers earlier operating from Bangalore / Chennai have now started making their presence in Kochi. The real estate prices in Kochi have shot up during the last decade.

9.4.4 Work Force Participation

The workforce of Kochi City Region, as available from 2001 census is given in Table 9.16. It shows that only 0.6% of the total main workers are engaged in agricultural labour. Cultivators constitute 0.44% of the workforce and household industry provides work for 2.23%. All the rest, that is 96.73% are counted together as 'other sectors' by the Census of India. This includes all the workers in manufacturing sector, traders, workers in service industries, business and public servants.

Table. 9.12 : Workforce Categorization 2001

Sl. No	Local Body Area	Agricultural Workers	Cultivators	HH industry Workers	Other Workers	Total Main Workers
1	Kochi City	244	210	4592	177143	182189
2	Thrippunithura (M)	126	26	434	17859	18445
3	Kalamasserry (M)	242	83	287	17950	18562
4	Maradu (P)	7	7	166	11625	11805
5	Thiruvankulam (P)	60	19	269	6084	6432
6	Thrikkakara (P)	226	121	320	18645	19312
7	Cheraneloor (P)	14	19	219	7344	7596
8	Eloor (P)	32	38	139	9846	10055
9	Varapuzha (P)	56	68	168	6832	7124
10	Kadamakudy (P)	32	53	75	3959	4119
11	Mulavukad (P)	38	7	45	5931	6021
12	Elamkunnapuzha (P)	150	88	298	14464	15000
13	Njarakkal (P)	103	65	88	6330	6586
14	Kumbalam (P)	131	62	150	7389	7732
15	Kumbalangy (P)	52	80	286	7102	7520
16	Chellanam (P)	154	153	145	10651	11103
17	Vadavucode - Puthencruz (P)	419	436	72	6868	7795
Total		**2086**	**1535**	**7753**	**336022**	**347396**
Percentage to total main workers		**0.6**	**0.44**	**2.23**	**96.73**	**100**

As Kochi is a port based city, the trade and commerce sector gained predominance. The major port based developments proposed -The International Transshipment Terminal, Single Buoy Mooring, LNG Project, Special Economic Zone are sure to boost up Kochi City Region. Large scale IT developments is envisaged in Thrikkakkara and Kalamassery. Port based developments are proposed mainly in Elamkunnappuzha and Mulavukad (Vallarpadom). Industrial developments are concentrated in Eloor. The island panchayats Kumbalangi, Chellanam, Kadamakkudy show potential for tourism development. Thrikkakkkara is the administrative head quarters of the district and it is a sprouting IT hub.

9.4.4.1 Work Participation Rate

The total labour force may be classified into three categories. They are the main workers, the marginal workers who work for less than 6 months per year and the unemployed. According to 2001 census the main workers in the Kochi City Region amount to 29.84% and the marginal workers 4.69% of the total population. See table 9.17. The projected figure of total workers for 2011 is 37.09% for 2021 is 39.61% and for 2026 is 40.87%.

Table 9.13 Main, Marginal and Non Workers – 2001

Sl. No.	Name of Local Body	Main Workers	Marginal Workers	Non Workers	Total Population
1	Kochi Corporation	182189	22136	391250	595575
2	Thrippunithura (M)	18445	2804	38635	59884
3	Kalamasserry (M)	18562	3098	41456	63116
4	Maradu (P)	11805	1764	27443	41012
5	Thiruvankulam (P)	6432	1318	13967	21717
6	Thrikkakara (P)	19312	4132	42540	65984
7	Cheraneloor (P)	7596	1305	17415	26316
8	Eloor (P)	10055	2055	23463	35573
9	Varapuzha (P)	7124	1444	15956	24524
10	Kadamakudy (P)	4119	1414	10291	15824
11	Mulavukad (P)	6021	1745	15076	22842
12	Elamkunnapuzha (P)	15000	2233	33330	50563
13	Njarakkal (P)	6586	1523	16057	24166
14	Kumbalam (P)	7732	2021	17796	27549
15	Kumbalangy (P)	7520	2560	16581	26661
16	Chellanam (P)	11103	1733	23373	36209
17	Vadavucode - Puthencruz (P)	7795	1272	17643	26710
Total		**347396**	**54557**	**762272**	**1164225**
Percentage		**29.84%**	**4.69%**	**65.47%**	**100%**

The ratio of workers to total population and the work participation rate of the local bodies in the Kochi City Region can be compared as in the Table 9.18. It may be noted that the work participation is slowly, but steadily increasing in all the local bodies. In the Panchayats where industrial activity is predominant, women workers are found to be less.

Table 9.14 Work Participation Rate – 1981, 1991 & 2001

Geographic Unit	Male			Female			Total		
	1981	1991	2001	1981	1991	2001	1981	1991	2001
Ernakulam District	46.94	51.5	55.11	16.36	15.38	17.18	31.68	33.44	35.97
Ernakulam (Urban)	45.8	59.16	54.16	12.07	12.73	14.85	28.99	31.61	34.30
Corporation of Cochin	46.29	50.92	54.95	10.79	11.30	14.16	28.66	31.19	34.31
Thrippunithura	46.59	50.92	54.30	16.95	14.98	18.21	31.65	32.78	35.97
Kalamassery	45.26	49.97	52.35	11	12.74	14.92	28.85	31.78	33.85
Maradu	43.58	50.16	54.68	8.56	8.14	11.92	25.98	29.24	33.09
Thiruvankulam	47.13	50.15	54.35	17.9	14.46	17.31	32.57	32.27	35.69
Thrikkakkara	45.49	51.65	53.18	16.55	14.98	18.21	31.07	33.42	35.53
Cheranelloor	42.34	50.25	54.76	8.6	10.09	13.18	25.47	29.99	33.82
Eloor	46.43	49.99	54.54	11.39	10.52	13.58	29.37	31.09	34.04
Varapuzha	**Panchayat Constituted after 1981**								
Kadamakkudy	44.8	50.55	56.26	14.24	13.79	14.12	29.56	32.21	34.97
Mulavukadu	41.41	48.58	55.37	8.72	10.56	13.64	24.99	29.29	33.99
Elamkunnapuzha	42.21	50.48	56.24	8.47	10.46	13.13	25.17	30.15	34.08
Njarackal	42.03	49.10	54.63	8.89	11.87	14.01	25.03	30.00	33.56
Kumbalam	44.32	47.57	55.64	14.26	13.86	16.00	29.22	30.55	35.40
Kumbalanghi	45.58	50.35	57.41	31.81	26.61	19.21	38.49	38.12	37.81
Chellanam	46.76	51.97	58.37	15.07	13.60	13.46	30.92	32.69	35.45
Vadavukode - Puthenkurisu	49.04	20.15	35.01	49.1	11.87	30.00	54.3	13.33	33.95

9.4.4.2 Categorization of main workers

A. Agricultural sector

The agricultural sector (agricultural labourers and cultivators) constitutes 1.04% of the working population of Kochi City Region in 2001. The growth in this sector shows negative trend. Estimated figure of workers in this sector in 2011 is 0.27% and that in 2021 is 0.04%. The fragmentation of land holdings and high wages in agricultural labour discourages the employment stabilization in this sector on one hand. On the other hand spiralling land values encourages the conversion of agricultural land to urban land. Reduction of employment in

agricultural sector is a natural corollary of urban growth. The gainful employment in agricultural sector in the urban area will require not only the conservation of fertile tracts of land for intensive agriculture practice, but also a shift from subsistence crops to crash crops viz. horticulture, flowers, social forest. With deliberate efforts, the employment in agricultural sector is expected to be maintained at 0.04%.

B. Household industry

The proportion of workers in the household industries sector in Kochi City Region is 2.23% which is not high compared to the state figure of 3.60% in 2001. The past trend indicates that this sector is almost stagnant. However, the existence of literate population, low capital and technological requirements, a ready and vast market for a variety of consumer goods and organizations like Kudumbashree are favourable points for generating employment in this sector. A goal of achieving at least the state average employment in this sector will be most desirable. On this assumption the future proportions of workers employed in this sector may be estimated as 2.4% in 2011, 3% in 2021, and 3.2% in 2026.

C. Workers in other categories

The workers in 'other workers' category form the major share of employment in Kochi City Region. 2001 census does not give split up of the different industrial categories of employment in this sector. Existence of vast fishery wealth in the deep waters, continental shelf, lagoons, prospects of developing fish farms in back waters and increasing market demand, present high growth potential for the sector in the Kochi City Region. On the other hand the construction activity is in a booming stage. Hence mining and quarrying sector also shows employment opportunities in this area. In future, this sector will contribute to the economy of this plan area.

Workers in other category comprises of the following.

i. Livestock forestry, fishing, hunting and plantation, orchard and allied activities.
ii. Manufacturing, processing, servicing and repairs other than household industries.
iii. Construction
iv. Trade and commerce
v. Transport, storage and communication
vi. Other services

i. Livestock

Livestock, forestry, fishing, hunting, plantation etc. together with mining and quarrying engaged 6.03% of the total working force in 1991 and this percentage is less than that of 1971 which was 7.16%.

ii. Manufacturing

The manufacturing sector engage 19.88% of the total workers of Kochi City Region in 1991 and this proportion shows a marked decrease over that of 1971 (27.89%) . But the present trend is an upward curve.

iii. **Construction**

The proportion of workers engaged in construction amounts to 9.68% of the population in 1991 against 4.42% in 1971. Though this shows an increasing trend, clearly this cannot be extrapolated to the future. Construction activity is directly linked to economic spurts and can at best be projected based on reasonable estimate of the continuation of this trend. A spurt is occasioned by such factors as sudden influx of personal income, and a disinclination to invest in other sectors. Further mechanization of building industry in future years is likely to reduce the employment. We may hence project the prospective workers in construction to remain at an average value of past decades.

iv. Trade and Commerce

The importance of Kochi as a center for trade and commerce is evident from the fact that while in 1971 only 13.54% of the total working force in the Kochi City Region were employed in trade and commerce, the corresponding figures in 1991 was 19.40%. This is essentially accruing from the trading activities of the Cochin Port. Expansion of the port facilities will give further growth in port trade and will inter alia put increasing demands on warehousing, wholesale centres and retail centres.

v. Transport, Storage & Communication

The employment in traffic and transportation is related to the volume of passengers and goods in different modes. It is directly related to the population, economic activities and their distribution in the city. 12.80% of the working population in 1991 is employed in this sector. The corresponding figure in 1971 was 9.71%. Associated with population growth and economic development, the proportion of workers will show an increasing trend in future.

vi. Other services

Other services form the major category of employment for the central city. In growing cities it can be expected that the service will form a dominant category of employment in the form of professional services, jobs in offices, institutions and administration sales and marketing etc. Data of 2001 however indicates that, while there has been an increase in the employment in all sectors especially in manufacturing, trade

and commerce, the employment in 'other services' has actually decreased. In 1991 the working population in this sector showed a decreasing trend also. That is 22.22% (in 1971 it was 24.38%). This trend has been taken to project the workers of this category. According to 2001 census 96.73% of main workers come under these seven categories.

9.4.4.3 Resource based industries

To evaluate the prospects of growth in resource based industries, the industries have been classified according to the resource base as follows:-

(i) Agro based
(ii) Forest based
(iii) Mineral based
(iv) Chemical based
(v) Metal and Engineering
(vi) Marine
(vii) Miscellaneous

(i) Agro based industries

The agro based industrial units generally show a locational preference to foreshore areas. The principal raw material for majority of these units is coconut. The share of workers in this industrial category has shown a marked decrease during past decades. The fact that it is a low technology, labour intensive industry is an unfavourable point for their location in city. Hence the downward trend observed for this sector will continue in future decades also.

(ii) Forest based industries

The proportion of workers in this sector has shown a gradual increase from 1961. There exists vast resource of timber in the hinterland of the city for profitable exploitation. There is also a ready market for various timber products in the city. These prospects indicate a potential of employment generation in this sector.

(iii) Mineral based industries

The availability of power, ease of transportation by water ways and proximity to the port had helped the setting up of some large scale mineral based industries in this area despite the non-availability of local resources. The investigations to decide availability of oil in Kochi indicates scope for expansion in this sector.

(iv) Chemical based industries

Kochi is the major center of chemical industry in Kerala with major establishments manufacturing a variety of industrial chemicals. The basic infrastructure provided by these factories will continue to generate new ancillary growth and provides additional employment in this area. The proportion of workers hence will continue to be maintained in the future decades also.

(v) Metal and Engineering based industries

The growth trend of this type has been most impressive in the central city. One characteristic feature of this sector is the balanced distribution of large, medium and small scale units. The development of ancillary units is also conspicuous in this type of industry. They are also distributed over the city. Considering past trend, this sector provides vast potential for future employment.

(vi) Marine industries

There exists vast scope for development of industries related to fisheries. The development of marine industries will also give impetus to other allied industrial activities and services.

(vii) Miscellaneous industries

These are generally service industries distributed all over the city. They are related to the needs of the local population and other small scale sector. The proportion of workers in this sector will more or less continue to remain as such in future also. The combined effect of the variation of employment in the different categories of industries, analyzed so far, will be to marginally increase the percentage of workers in the industrial sector in future decades.

According to 2001 census 96.73% of main workers come under these seven categories.

9.4.4.4 Distribution of Workers in Future Decades

Based on the past trend and on analysis of resources, the working forces in the various sectors have been projected for the next two decades. The spatial distribution of the work centres has also been analysed. The future requirement of space for various activities can be worked and the space could be allocated considering this spatial distribution. The projected work force is indicated in Tables 9.19 and 9.20 below.

Table 9.15 : Work participation rates Kochi City Region

	1981	1991	2001	2011 (projected)	2021 (projected)
Total population	952474	1068670	1164225	473972.86	553314
Total workers	276172	337203	401953	1278004.7	1396967
Participation rate	29.00%	31.55%	34.53%	37.08%	39.61%

Table 9.16 : Occupational structure of the Kochi City Region

Sl. No	Category	% of total workers.				
		1981	1991	2001	2011	2021
1	Cultivators	1.22	1.12	0.38	0.26	0.03
2	Agricultural Labourers	3.1	2.85	0.52	0.01	0.01
3	House hold industry workers	1.52	0.67	1.93	2.4	3
4	Other workers total	82.44	89.42	83.6	84.24	83.7
5	Marginal Workers	11.72	5.94	13.57	13.09	13.27
Total		**100**	**100**	**100**	**100**	**100**

9.6 LAND UTILIZATION

The characteristic feature of the land utilization pattern in Kochi is the predominance of water bodies and wetlands. The water body consists of canals and backwaters. These canals and backwaters served the purpose of transportation of men and materials earlier. Nowadays, a numbers of such canals have deteriorated as mere drainage channels. The total area of canals has reduced due to encroachment or siltation. The share of the backwater alone constitutes almost 95% of the water sheet. Vast stretches of this water is navigable, but adjoining the land mass and tiny island, it is very shallow. Unplanned reclamation is likely to affect the ecological balance. In addition, there is restriction in reclamation of water body as per Coastal Regulation Zone (CRZ) Rules except for port related activity. However, encroachment of water bodies continues, especially by those who have their properties adjoining the water bodies. Most of the water bodies lie contiguous to the paddy fields/farms and hence the clear boundary is not visible. The land utilization study shows that the land under water and paddy/fish farm are getting converted to developed land.

Physical, social, political and economic factors have played their decisive roles in the formation of land use pattern in Kochi city. The land forms and the lagoon system contributed to the concentration of economic activities on the water front areas. Ethnic and religious grouping of people dilated the development of distinct residential zones, spatially separated from each other. Political jurisdictions of different authorities were experienced in Kochi and its environs clearly influencing the location of major facilities such as wharfs, public buildings and industries.

The shifting of the capital from Mattancherry to Ernakulam was an important milestone in the development of Kochi. The constitution of the Corporation of Cochin combining the municipal areas of Fort Kochi, Mattancherry and Ernakulam and a few settlements adjoining Ernakulam was another important milestone. Gradually urban expansion outgrew the boundaries of the city. The developments were mainly along the traffic corridors leaving small pockets of undeveloped areas in between. However, the rural urban continuum pattern prevalent in Kerala resulted in non availability of large vacant areas for major organized developments. Hence the urban expansion is contiguous along the arterial corridors resulting in urban sprawl.

The urban growth trends have been analysed based on different parameters like land availability for development, potential for growth in terms of investments already proposed, availability of infrastructural facilities like water supply, sewerage and communication network, environmental quality, population growth rate, density patterns and contiguity to the main city. A combined growth index has to be worked out for each of the local bodies taking into consideration, all the above parameters.

Due to the major projects proposed by Cochin Port, the western island zone is likely to show more urban character and growth. The growth trends indicate the need for spatial allocation of economic activities and proper planning of the Kochi City Region. Analysis of the land utilization and land use pattern assumes importance before allocating major activities.

9.6.1 Significance of the land forms of Kochi City Region

The fundamental significance of the physical features of the planning area can be summarized as follows:-

1. A sizable portion of the gross area is taken up by water sheets, paddy fields and marshy lands thereby reducing the net area available for urban use. The pressure on land hence remains high.

2. The water sheets divide the land mass of the central area. The inadequacy of physical linkages creates restrictions in extending urban services to such islands there by retarding the development in these areas. A system of link roads and bridges connecting these islands is hence warranted to ensure continuity of city growth. Construction of bridges already completed (eg. Vypeen bridge) enhance the city growth to some extent.

3. Economic significance of water course for transportation and pisciculture necessitates effective measures to check the deterioration of this vital asset in Kochi. Water sheets also serve as a permanent open space for the city. Planned development of water fronts and canal system will be economically viable in Kochi. It will also add to the environmental quality of the city.

4. Part of the low lands and the paddy fields could be integrated in the city structure as a green land system for segregating incompatible uses for passive and active recreations, botanical gardens and social forestry. This will provide a much needed public open area for the city.

5. Modifying factors of the hot humid climate of the planning region are the presence of open winds and vegetation. The city building process hence should emphasize these factors by restricting the ground coverage and orienting the streets and the buildings.

9.6.2 Existing land use

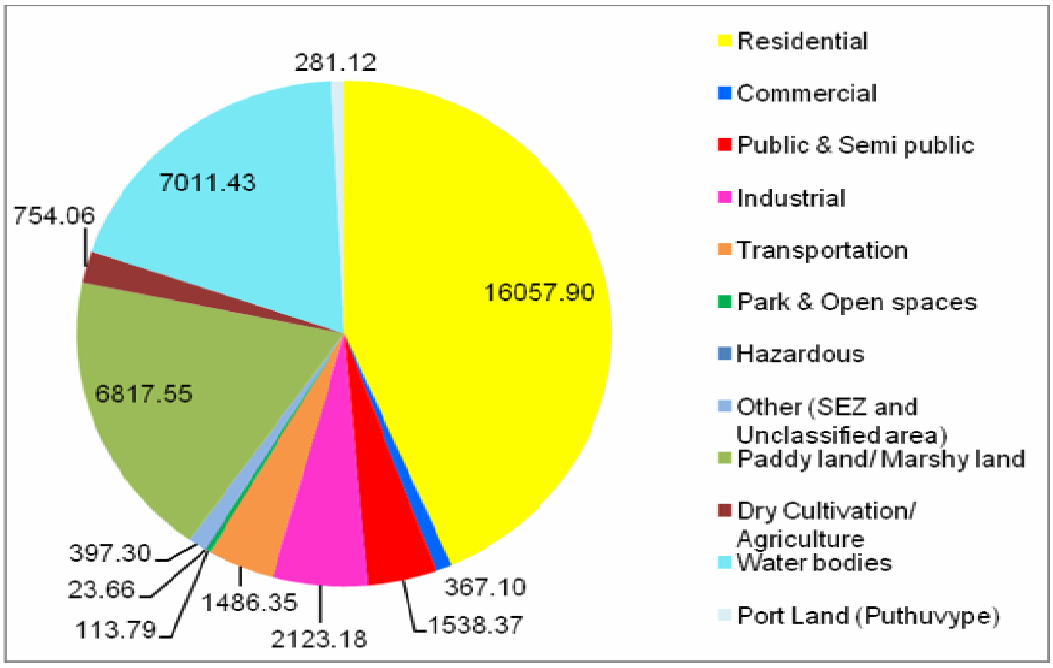
Analysis of the land utilization pattern shows that the areas on the north-eastern and western part of this region vary significantly, as the western part comprises of islands surrounded by water bodies and fragmented by canals and backwaters. The per capita developed land holding is only 117 sq.m in the city and an average of 175 sq.m in the Kochi City Region. The existing land use pattern has resulted from the complex interactions of various factors in the urban structure. Refer Map 9.5.1.

The distribution of land use within the the Kochi City Region as a whole is analysed to understand the salient features of land use distribution. The land use breakup within Kochi City Region is given in Table 9.17. The local body wise details are given in Annexure 7.

Table 9.17: Existing land use of Kochi City Region, 2007 (updated in 2009)

Sl.No	Land Use	Area (Ha)	% to gross area	% to net area
1	Residential	16057.90	43.43	69.39
2	Commercial	367.10	0.99	1.59
3	Public & Semi public	1538.37	4.16	6.65
4	Industrial	2123.18	5.74	9.17
5	Transportation	1486.35	4.02	6.42
6	Park & Open spaces	113.79	0.31	0.49
8	Hazardous	23.66	0.06	0.10
9	Other (SEZ and Unclassified area)	397.30	1.07	1.72
10	Paddy land/ Marshy land	6817.55	18.44	
11	Dry Cultivation/ Agriculture	754.06	2.04	3.26
12	Water bodies	7011.43	18.96	
13	Port Land (Puthuvype)	281.12	0.76	1.21
	Total	36971.81	100.00	

Fig 9.5.1 Existing land use of Kochi City Region, 2007 (Updated in 2009)



9.6.2.1 Water Bodies:

The net dry land available for urban use in the Kochi City Region area amounts to only 62.60 % of the gross land. A characteristic feature of the land use pattern of the Kochi City Region is the predominance of the area under water. The water sheet consists of backwaters, rivers, canals, tanks and ponds and altogether forms 18.96 % of gross land area in 2009. Reclamation of land from water however necessitates identification of strategic areas based on the community needs, study of economic viability based on cost benefit analysis and research on technological feasibility with reference to hydro-dynamic, environmental and ecological impact. Conversion of paddy and wet land shall be effected only based on a comprehensive conservation plan to be formulated for the purpose.

9.6.2.2 Paddy land and Wet land

Due to topographical, climatic and historic reasons, 18.44 % (6817.55 hectares) of the Kochi City Region remains as shallow wet lands that is either paddy or fish farm and marshy. Large portion of this low lying wet lands are left uncultivated in the city and surrounding areas. But in the coastal panchayats the fields are cultivated for single crop and used for prawn farming during rest of the year. These act as open lung space in the city scope now In developing parts of the city, the low lands are getting filled up fast and converted to urban use, both by public and private agencies.

The patented 'Pokkali rice' is being cultivated in the paddy fields, which needs governmental support to be economical. Also, these are breeding grounds for much aqua life. Hence filling up of these areas has to be limited after careful environmental impact assessment.

9.6.2.3 Residential land use:

The city has a very flat terrain with a very gentle slope from East to West. Unlike in other parts of the country, in Kerala, the residential use is widely spread out, intermingling with all other use, making it difficult to clearly demarcate the boundaries of residential area and other uses.

The percentage of residential land to the net dry land is 69.39 % in the Kochi City Region. Considering the existing population (11, 64,225 as per 2001 census) the gross residential density is 32 persons per hectare in the Kochi City Region. The gross residential density of Kochi City is 63 persons per hectare.

From the existing land use map, it may be seen that the residential areas are evenly distributed all over the Kochi City Region. Most of the residential land is built over with isolated single storey buildings in Kochi, except in the central parts of Kochi City. The residential land is mixed with commercial and public uses in its natural development. Apartment housing is a trend, which has come up in Kochi during the last fifteen years. At present this trend is confined to the city and the immediate surroundings viz., Kalamassery, Thrikkakkara, Thrippunithura and Maradu. Changes in the character of land use from residential to commercial use are seen in the Central Business District (CBD) area and slowly this tendency is spreading to the planned residential area as well, mainly near the intersections of important roads. Correspondingly, the residential densities also rise. The city is not yet geared to cope with the increasing density in terms of services like water supply and sewerage. Even if the transformation of land use show higher densities and multi-storied building development, the unplanned residential areas are showing lower densities.

Future land requirement under residential use is to be met by increasing the density of population in the existing residential areas.

9.6.2.4 Commercial land use:

Commercial land use consists of retail and wholesale trade, warehouses and storages, commercial institutions and professional establishments. In the Kochi City alone the percentage of land under commercial use is 2.99 % of the total developed area. But when the total Kochi City Region is considered, the land under commercial use comes 1.59 % of developed area which indicates the commercial significance of Kochi City.

The spatial distribution of commercial land clearly indicates the concentration of this activity in the centre of the city as well as at other nodal points of road intersections. Another feature is the spread of these activities along the roads. The share of commercial land in the city has shown a sudden jump during the last few years due to conversion of other uses to special shopping complexes and shopping malls.

In the future land use proposal, it is necessary to distribute the commercial facility in different planning areas with the twin purpose of preventing ribbon development and reducing the distance from residential zones to the commercial zones. It is also necessary to have a hierarchy of commercial centres catering to different levels of services.

9.6.2.5 Industrial Land Use:

Industrial land use constitutes 9.17 % of the net dry land of the Kochi City Region. All the types of industries, large scale, medium scale and small scale are included in this category. The distribution trends of industrial land show that the lands under large scale industries are concentrated in Eloor-Kalamassery belt and Ambalamugal - Karimugal belt.

The medium scale industries are distributed along the foreshore areas and small scale units are spread all over the city. With the establishment of Goshree bridge connecting the western islands to the main land, large scale industries with capital investment worth more than 15,000 cores are at various stages of implementation at Vallarpadam-Puthuvypeen area. IT industries are concentrated more around Kakkanad, about 8 km from the CBD. About 100 ha of land has been developed for IT and related uses. This development is on an expansion mode.

9.6.2.6 Transportation Use:

Land under transportation use in the Kochi City Region constitutes 6.23% of the net dry land area. In Kochi Corporation it is 6.42 % of the total land area. This includes roads, bus stations, garages, railway installation, dockyard, port areas, jetties and airports. Although the portion of land under this use is comparatively high, it does not bespeak of a good transportation system or a traffic network in the city. The roads are narrow and the streets are irregular lanes. The railway line divides the city into two halves. Inland navigation services are inadequate. Creation of a road network, widening of roads, improvement of terminal facilities and expansion of railway installations will require additional area to be brought under transportation use.

9.6.2.7 Public and Semi-public Use:

Public and semi public use include all administrative, educational, religious, medical, cultural, utility and service installations and land under defense. In the Kochi City Region. 6.65% of the net dry land area comes under this category. 4.69% of the total land area of Kochi Corporation is under public and semi public use. The spatial distribution of this land shows a balanced distribution all over the city. With increased population, land under public and semi public use will have to be increased to accommodate the increased need of community facilities and other public use.

Over the last few decades Kochi has developed, into an established centre of learning and health care. The educational facilities available in Kochi especially for higher education have given Kochi the status of Common Wealth University Centre for learning.

The total number of beds available in the 72 major hospitals spread over Kochi City Region is 6848. In addition, there are ayurvedic and homeopathic hospitals and dispensaries, public health centers, community welfare centers etc. The health facility available in proportion to the total population is much above the existing standards. Kochi acts as a centre of super speciality hospitals and attracts patients from far and wide.

9.6.2.8 Parks, Play Grounds and Open Spaces

There appears to be a conspicuous shortage of land under this category of use since only less than 1% of the area of the city falls under this category. However the vast expanse of water sheet and agricultural land which constitute 39.44 % of the area of Kochi City Region provide the lung space. But their use for passive and active recreation is rather limited. There is need for city level parks and playgrounds as well as zonal, community level and neighborhood level open spaces. Though the percentage of open space is very low, the vast expanse of water bodies make up for this deficiency to an extent. It is imperative to conserve the available water bodies. But a large extent of the waterfronts is private or back or front yards of residences. Thus, the general public has little access to water front.

9.6.3 Analysis of the existing land use study

1. The study of the land forms brings out the increasing pressure of population on the developed land. The unique expanse of the backwaters in the city needs full exploitation for transportation, recreation and water front development.

2. Survey of the population is indicative of the unbalanced distribution of population on urban land, conditioned by physical constraints and inadequacy of services, in order to maximize the land resources and achieve a balanced distribution of population, it is necessary to specify population densities in the different local body areas of the Kochi City Region.

3. Many development projects are being introduced in different parts of Kochi City Region and hence spatial distribution of different activities should be planned in relation to these prime activities.

4. The housing need for the coming decades necessitates planned development of residential area optimizing the cost of services and other social over heads. Sprawl of residential area is to be checked by earmarking future urban land under residential use.

5. The study indicates the need for earmarking sufficient land for community facilities in different parts of the Kochi City Region as per suitable norms. A survey of the open spaces in the Kochi City Region also reveals the lack of public open spaces for the community.

6. The study of the traffic and transportation in the Kochi City Region shows the gap in the traffic network connecting the city with the environs on the one hand and the linking of the different parts of the city on the other. Inadequate width of roads and congested junctions need immediate attention. The creation of an efficient integrated traffic system consisting of roads, rails and water ways and development of the terminal and interchange facilities are essential. There is scope for enhancement of the use of waterways for tourism and inland navigation.

7. A survey of the utilities and services suggests the need for long term measures to extend the utility lines and urban services all over the city in a planned manner depending on the priority of development. Properly planned drainage and sewerage system is necessary for whole of the planning area.

8. An analysis of the existing land use in the light of the future requirements suggests modifications of future land use pattern for achieving an efficient and balanced distribution of activities and ensuring quality of life in urban environment.

9.7 HOUSING

9.6.1 Introduction

Shelter is one of the primary requirements of a human being. The term housing may be used “to cover all the socially accepted ways by which a man acquires a territory for his home, the procedures by which he retains that territory, the price he pays for it and the manner in which the stock of houses is maintained and enlarged”. The qualitative characteristics of the shelter also count in defining housing in relation to the standard of living.

In Kochi City Region, 67.32 % of the developed area is occupied by residential developments. It is the residential use which determines the future living patterns and densities in a community. The increase in population, slow evolution of the single family system and the consequent rise in the number of households result in growing demand for new housing in the Kochi City Region.

9.6.2 Existing housing stock

As per 2001 census there are 2, 53,727 households in the Planning Area. As per Panchayat Level Statistics the housing stock is estimated to be 3, 09,828 units (Table 9.6.1). This reveals an excess of 56,101 units in 2001. Still there is acute shortage of housing manifested in the overcrowding of tenements, sharing of rooms and facilities and the growth of slums. The average size of households in the Kochi City Region was 4.77 in 2001. This is 4.529 persons per household in Kochi Corporation. It is estimated that about 40498 families reside in slums in various parts of the Kochi city alone.

In the Kochi City Region about 8% of the existing stock falls in the category of kutcha construction with inadequate facilities and poor environmental quality. They require alteration, modification or repair to keep them habitable and hence require replacement.

The economic composition of the households in the Kochi City Region reveals that 25% of the households constitute economically weaker section and 35% belong to low income group. The middle income group is 35% and the high income household fall in the marginal 5%.

Table 9.6.1: Houses and households in Kochi City Region-2001

Sl No	Name of local body	No. of House holds	Residential houses according to the type of roof & electrification as per 2001 census			
			Concrete	Tiles/ Asbestos	Thatched & Others	Total
1	Kochi Corporation	1, 31,692	66,281	89,711	10,729	1, 66,721
2	Thrippunithura Municipality	13,925	8,795	6,645	2,787	18,222
3	Kalamassery Municipality	14,206	12,154	436	273	12,863
4	Chellanam	7,423	789	5,564	651	7,004
5	Cheranelloor	5,873	3,593	3,478	537	7,608
6	Elamkunnapuzha	10,828	2,662	7,141	1,660	11,463
7	Eloor	8,245	5,101	5,024	1,027	11,152
8	Kadamakkudy	3,465	820	2,342	255	3,417
9	Kumbalam	6,040	15,551	5,432	683	7,666
10	Kumbalangy	5,699	1,665	3,441	444	5550

11	Maradu	9,123	5,376	3,600	505	9,481
12	Mulavukad	4,976	1,367	3,656	715	5,738
13	Njarakkal	5,276	2,113	4,184	339	6,636
14	Thiruvankulam	5,217	3,110	2,603	1,637	7,350
15	Thrikkakara	14,950	6,456	4,823	1,440	12,719
16	Vadavucode - Puthenkurisu	6,300	4,306	4,591	262	9,159
17	Varapuzha	5,465	2,624	3,843	612	7,079
Total		**2,58,703**	**1, 42,763**	**1, 56,514**	**24,556**	**3,09,828**

9.6.3 Below Poverty Line (BPL) and Slum Housing

Total population below poverty line in Kochi Urban Agglomeration is 34%. 32% of BPL population is now living in slum areas/colonies. The percentage of population below poverty line is higher in the coastal areas, where fishermen constitute a major share of the population. Thripunithura, the capital of the erstwhile kingdom of Kochi has the lowest number of urban poor which is 12% of total population (Table 9.6.2).

Table 9.6.2: BPL Population-2001

Sl. No.	Name of local body	BPL Population 2001
1	Kochi Corporation	1, 32,420
2	Thrippunithura Municipality	9,628
3	Kalamasserry Municipality	16,950
4	Chellanam	-
5	Cheranelloor	1,237
6	Elamkunnapuzha	-
7	Eloor	6,975
8	Kadamakkudy	-
9	Kumbalam	-
10	Kumbalangy	-
11	Maradu	12,648
12	Mulavukad	-
13	Njarakkal	-
14	Thiruvankulam	7,601
15	Thrikkakara	1,602
16	Vadavucode - Puthenkurisu	-
17	Varapuzha	5,769
Total		**1,94,830**

A survey conducted in 2006 reveals that 16,437 households in the planning area live in slums (Table 9.6.3). In addition to the Corporation and 2 municipalities, 2 panchayats, viz. Thiruvankulam and Eloor also have slums. It may be noted that both these are near industrial areas and areas where hectic construction activity is going on.

Table 9.6.3: Details of slums –2006.

Sl. No.	Name of local body	No of HHS	Population	Area covered (Sq. km)
1	Kochi Corporation	12,838	63,324	2.265
2	Thrippunithura Municipality	900	3,862	0.0689
3	Kalamasserry Municipality	2,045	10,145	0.1886
4	Chellanam	-	-	-
5	Cheranelloor	-	-	-
6	Elamkunnapuzha	-	-	-
7	Eloor	130	686	0.0266
8	Kadamakkudy	-	-	-
9	Kumbalam	-	-	-
10	Kumbalangy	-	-	-
11	Maradu	-	-	-
12	Mulavukad	-	-	-
13	Njarakkal	-	-	-
14	Thiruvankulam	524	2,096	0.0812
15	Thrikkakara	-	-	-
16	Vadavucode - Puthenkurisu	-	-	-
17	Varapuzha	-	-	-
Total		**16,437**	**80,113**	**2.6303**

9.6.4 Trends in housing

Traditionally house construction is a private sector activity. But the shortage of housing especially in the lower income and middle income groups has prompted the government to view this as a social obligation. Consequently public housing bodies have been constituted to supplement the house construction.

Affordable housing to the economically weaker sections and low income category through a proper programme of allocation of land, extension of funding assistance and provision of support service is essential. In Kochi city there are 15,000 landless and homeless persons. The government, both central and state has implemented several schemes such as VAMBAY, Janakeeya Bhavana Padhathi, credit cum subsidy under housing etc. for development of weaker sections.

9.6.5 Housing Tenure

The tenure problem of the urban poor in the city is complex in nature. Overcrowded and dilapidated buildings owned by private individuals and trusts are threats to the residents. In many cases the owners of these buildings have no other property and share the premises with slum dwellers. An analysis of the insecurity experienced by the poor clearly suggest the need to specifically target the groups whose vulnerability is increased by the nature of their living environment. These have been identified as the homeless, the landless, various types of tenants and encroachers on government and private land even on the verges of canals and roads.

9.6.6 Housing need of the area

The ideal goal would be to provide a house for every household of right size, type and cost with all appropriate internal and external facilities in a suitable location. For a state like Kerala, this goal cannot be achieved in the near future.

The total housing need for the year 2011, 2021 and 2026 on the basis of projected population and family size, works out to be 3.94 lakh, 4.50 lakh and 4.93lakh units respectively. Deducting the carry over stock of 2001, the housing need in 2011 will be 1.84 lakh units. The house production during 2001-2011 has to cover at least 1,80,000 units so that the back log at the end of the year 2011 can be brought down to 4,000 units. This gives target production of 18,000 units per annum during the year 2001-2011.

The total stock available in 2021 will consist of carryover of 2001 stock (1.87 lakh) plus 1.80 lakh units built in 2001-2011. This will amount to 3.67 lakh units against the total need of 4.50 lakh units leaving a shortage of 0.83 lakh units. The production in 2011-2021 will have to cover these 0.83 lakh units if we aim at wiping out the backlog in housing by 2021. Hence the target production of 2011-2021, will be 8,300 units per annum.

The total housing stock available in 2026 will consists of the sum of the carry over stock of 2001 (1.75 lakh units), 1.80 lakh units built in 2001-2011 and 0.83 lakh unit built in 2011-2021. This will amount to 4.38 lakh units against the total need of 4.93 lakh units, leaving shortage of 0.55 lakh units. The production in 2021-2026 will have to cover this 0.55 lakh units.

The target production of 2021-2026 hence will be 11,000 units per annum. The summary statement of this need is given in table 9.6.4

Table 9.6.4: Summary statement of housing need and targets

Details	**2001**	**2011**	**2021**	**2026**	**Units**
Population	11.64	16.11	18.66	19.58	lakhs
Family size	4.50	4.29	4.15	3.97	Reasons
No. of households (Demand)	2.59	3.94	4.50	4.93	Lakhs
Housing stock of 2001 and carry over to future decades	2.37	2.10	1.87	1.75	lakhs
Anticipated production during 2001-2011 and carry over to 2021-2026	-	1.80	1.80	1.80	Lakhs
Anticipated production during 2011-2021 and carry over to 2026	-	-	0.83	0.83	Lakhs
Anticipated production during 2021-2026	-	-	-	0.55	Lakhs
Total supply	**2.37**	**3.90**	**4.50**	**4.93**	**Lakhs**
Backlog	**0.22**	**0.04**	**0.00**	**0.00**	**Lakhs**

The sky rocketing land price, feeling of security in flats and scarcity of land suitable for house construction are the major factors which leads the people to prefer flats. But many affluent consider investment in flats, as a good investment option that they just buy and lock it. This has given rise to excess number of houses available, than the number of households, where as there are many with no roof over their head.

9.7 TRANSPORTATION

9.7.1 Introduction

Kochi, the commercial and industrial capital of Kerala, with its urban agglomeration is the largest urban centre in the state. The convergence of roads, railways, waterways, airways and the port contributes to the city to make it the most important node in the state for economic development. The Kochi Urban Agglomeration (UA) consist of Corporation of Kochi, 5 Municipalities, 15 panchayaths (in full) and part of 4 panchayaths and has a total population of 13.60 laks in 2001. The UA had 5 constituent local bodies in 1981, 19 in 1991 and 25 in 2001 there by showing a steady and rapid expansion of urban area.

Though the UA is steadily expanding, the dominance of Corporation area as the major centre of economic activities in the region remains unchanged. There are intense commercial activities along the arterial and the sub arterial roads. Many prestigious educational institutions and hospitals are located in the city in addition to the Cochin Shipyard, Naval base, Cochin Port, High Court, Cochin Stock Exchange and the many hotels and restaurants. Most of the IT based and the Heavy Industries in the region are located in and around the city and all of them depend on the city for services. The influence area of Kochi is much wider than its administrative boundaries and the fact that the size of the floating population to the city is as high as 46% of the resident population in the city (NATPAC 2007) provides conclusive evidence for this.

Major urban centres close to Kochi are Thrissur, Kottyam and Alappuzha and are located outside the Ernakulam district at about 75 km, 50 km and 75 km respectively away from the city. There are 6 municipalities in the district of which Kalamasserry is located just 10 km from the city where as Thrippunithura has common boundary with Kochi. In terms of population, facilities and economic activities all the six municipalities are very small compared to Kochi. The dominant role of Kochi over the entire Ernakulam district and beyond is thus very obvious.

With the implementation of major projects like Vallarpadam Transshipment Container Terminal, LNG Terminal at Puthuvype, Single Buoy Mooring offshore project by KRL, Petro Chemical Complex by GAIL, Smart City at Kakkanad, Marina for Tourism Promotion at Mulavukad, KINFRA Export Promotion Industrial Park at Kakkanad etc, the travel demand and infrastructure requirements of the city, are expected to considerably increase in the coming years.

As the transportation sector is a vital component of any city, planning of transportation infrastructure commensurating with the increased travel demand and vehicle population is an essential requirement. To plan for the same, it is imperative that necessary planning inputs like inventory of existing road network, vehicle ownership, traffic volume, travel characteristics, capacity utilization of roads, rail, waterways and other transport system, future traffic scenario etc are assessed in a scientific manner.

In 2005, Corporation of Cochin engaged National Transportation Planning and Research Centre (NATPAC), Trivandrum to carry out a detailed study of existing transportation system of the city and to propose long-term traffic and transportation plan for the city. Major findings of the study are summarized in the following sections.

9.7.2 Characteristics of Transport Network

Kochi city is served by four dominant modes of transport viz. road, rail, water and air. Of these, road network has a wide presence throughout the city due to its penetration into every

nook and corner of the city and suitability to all terrain conditions. In the case of rail network, it has a limited but dominating influence. Air network has its usual supplementary role, while waterways are mostly confined to western side of the city.

9.7.2.1 Road network

The road transport network of Kochi City is shown in Map 9.7.1. The total length of roads in Kochi City (except the roads belonging to Kochi Naval Base in ward No.26) is 614 Km. The city has a road density of 1.03 km/1000 population and 6.47 km/sq km of surface area.

The roads in the city are classified as arterial, sub-arterial, collector and local streets, based on the following definition.

Arterial streets:This system of streets, along with expressways where they exist, serves as the principal network for through traffic flows. Significant intra-urban travel, such as, between central business district and outlying residential areas or between major suburban centers takes place on this system. The arterial streets are generally divided highways with full or partial access control. Parking, loading and unloading activities are usually restricted and regulated. Pedestrians are allowed to cross only at intersections.

Sub-arterial streets: These are functionally similar to arterial streets but with somewhat lower level of travel mobility. Their spacing may vary from about 0.5 km in the central business district to 3-5 km in the sub-urban fringes.

Collector streets: The function of collector streets is to collect traffic from local streets and feed to the arterial and sub-arterial streets and vice versa. These may be located in residential neighborhoods, business areas and industrial areas. Normally, full access is slowed on these streets from abutting properties. There are few parking restrictions except during the peak hours.

Local Streets: These are intended primarily to provide access to abutting property and normally do not carry large volumes of traffic. Majority of trips in urban areas originate from or terminate on these streets. Depending on the predominant use of the adjoining land they allow unrestricted parking and pedestrian movements.

Map 9.7.1

9.7.2.1.1 Classification of roads

The share of arterial roads in the total road network in the city is only 2.75 per cent whereas that of sub-arterial roads is around nine per cent. Local streets formed the big chunk of the road network in the city. Distribution of roads in Kochi city according to their functional classification is given in **Table 9.7.1.**

Table 9.7.1
Distribution of road network in Kochi city according to functional classification

Sl.No	Type of road	Length (km)	Percentage
1	Arterial road	16.900	2.75
2	Sub-arterial road	53.000	8.63
3	Collector street	151.400	24.66
4	Local streets	392.665	63.96
	Total	**613.965**	**100.00**

The road network in Kochi city is maintained by two agencies namely Kochi Corporation and Public Works Department (PWD). Of the total length of 614 km of road network, major portion (88%) of the roads in the city are under the control of Kochi Corporation and the remaining 12% are maintained by PWD.

9.7.2.1.2. Right-of-way

53 % of the total roads in Kochi city have a right of way less than 5m and are of local street category. 35 % of roads have a right of way ranging from 5 to 10m; 8% of the roads are of sub-arterial category and have 8 % ROW ranging from 10 to 20 m. Hardly one per cent of the roads (5.939 Km) of the roads in Kochi city have right of way more than 40 meters. Distribution of right-of-way available for roads in Kochi city is given in **Table 9.7.2.**

Table 9.7.2
Distribution of road network in Kochi City according to right-of-way

	Right of way (m)	Road length (km)	Percentage
1	< 5	325.604	53
2	5 – 10	214.887	35
3	10 – 20	49.117	8
4	20 – 30	18.418	3
5	>40	5.939	1
	Total	**613.965**	**100**

9.7.2.1.3 Carriageway width

16.3% of the roads have less than 3m carriageway, while 56.6% have single lane carriageway of 3.5m, 13.2% have intermediate lane of 5.5m, 8.5% have two lanes, 0.70% have three lanes (10m) and 4.7% have carriageway more than four lanes. **Table 9.7.3** gives the distribution of road network of Kochi city according to availability of carriageway.

Table 9.7.3
Distribution of road network in Kochi city according to availability of carriageway

Sl. No	Carriage way width	Road length (km)	Percentage
1	Less than single lane	100.125	16.3
2	Single lane	347.680	56.6
3	Intermediate lane	81.295	13.2
4	Two lane	52.355	8.5
5	Three lane	4.050	0.7
6	>Four lane	28.460	4.7
	Total	**613.965**	**100**

9.7.2.1.4 Availability of footpath and drainage

The availability of roadside appurtenances is necessary for the smooth flow of traffic including pedestrian traffic. It is observed from the road inventory surveys that only 6% of the road network in Kochi city has footpath on both sides of the road and 87.5% of the roads network had drainage facility. However, only 8% of these roads were having covered drainage.

9.7.2.1.5 Bridges, ROBs, culverts and level crossings

There are 26 bridges, 10 ROBs, 122 culverts and eight level crossings existing on major roads in Kochi city.

9.7.2.2 Rail Network

Rail transport system caters mainly to the needs of inter-city passenger and goods traffic. Kochi city is connected to major urban centers in the state as well as to the up-country destinations through two major railway lines. They are the Thiruvanathapuram-Thrissur railway line via Kottayam and the railway line from Eranakulam to Kayamkulam via Alappuzha. The total railway track length within the City limit is 28 Km.

9.7.2.2.1 Details of railway stations

At present, Kochi City has the benefit of two major railway stations viz., Eranakulam Town (North), and Eranakulam Junction (South). Of these two stations, Eranakulam South is the most frequently used, as maximum number of trains touch this Station. Eranakulam South station handles about 65% of traffic generated from the city and the rest is handled by Eranakulam North station.

9.7.2.2.2 Passenger and goods movement

A large number of inter-city passengers travel to and from the city from South and North Railway stations in Kochi City. The passenger traffic during the year 2005 was estimated from the sales of daily and season tickets sold from these two Railway stations in Kochi City. It was found that about 51.91 lakh passenger trips were originated from the South and North Railway Stations, of which the share of South railway station was 66 per cent.

The goods traffic in Kochi is handled at Ernakulam Goods Yard and at Kalamasserry Good shed. The data collected from the above stations showed that on an average about 86 MT and 518 MT of goods were handled at the Goods Shed at Eranakulam and Kalamasserry.

9.7.2.2.3. Railway Over bridges and level crossings

The Thiruvananthapuram-Thrissur railway line passes through the heart of Kochi city dividing it into two parts. The older parts of the city are located on the western side of the railway track, while new developments are in the eastern side of the railway line. Four major Railway Over bridges (ROB) located at various parts of the city provide uninterrupted flow of traffic between western and eastern parts of the City. These ROBs are:

(i) North Railway Station on the Bannerji road
(ii) Near Manorama Junction on Sahodaran Ayyappan road
(iii) Near Kathrikadavu on Kaloor-Kadavanthara road
(iv) NH-47A Kundanoor-Thevara bridge

There are a number of railway level crossings within the city, which remain as major bottlenecks to the free flow of vehicular traffic along certain travel corridors. Frequent gate closures at these level crossings result in traffic hold ups and under utilization of these corridors. Of these, eight level crossings are located along major travel corridors and are listed bellow:

(i) Edappally on NH-17
(ii) Pulleppady on Pulleppady-Kathrikadavu road,

(iii) Ravipuram on Panampilly Nagar road to Chittoor road,
(iv) Pachalam on Chittoor road
(v) Vaduthala on Chittoor road
(vi) Ponnurunny on Thammanam-Vyttila road and
(vii) Atlantis on Panampilly Nagar to MG road.

ROB at Pulleppady on Thammanam – Pulleppady road has been completed now and the one at Edappally level crossing is under construction.

9.7.2.3 Air Transport Network

Kochi is well connected to the rest of the country and other parts of the world by air transport through Cochin International Airport located at Nedumbasserry, nearly 28 km from Eranakulam city. This airport caters to the needs of domestic and international passengers of Kochi and surrounding regions. Another airport located at Willington Island, is under the control of Defense Department.

9.7.2.3.1 Airport terminal

Due to the limitations in the operation of international flights, the erstwhile Kochi airport was shifted from the Willington Island to Nedumbasserry, away from the City. This is the first International Airport in the Country, which was built outside the ambit of the Government of India. The airport is located very close to the three National Highways NH-47, NH-17 and NH-49. The main railway line from Kanyakumari to Delhi is adjacent to the airport and is situated between Aluva and Angamaly Railway stations. The Cochin Port is connected to International Airport by a newly developed link called Airport-Seaport road.

The Kochi International Airport is managed by a group of personnel drawn from the Government Departments, Industries, NRIs, and Financial Institutions. The Airport is suitable for operations of wide-bodied Boeing-747 type of aircraft. The runway is of 3.4 km length with 3,000 ft parallel taxiway and has a premise of 1,300 acres. An International cargo terminal is also functioning with an area of 6,000 sq.m, and is well equipped to handle all type of export and import cargo.

9.7.2.3.2 Details of flights and air passengers

A total of 440 flights are handled by the two terminals namely International and Domestic terminals at the Cochin International Airport in a week (2005). In the domestic terminal, 220 arrivals and departures are handled per week from and to important Cities in India. The daily

operation of the flights varies from 15 to 17. An average of 14,054 domestic passengers arrive and depart weekly from the airport. In the international terminal, at present there are 220 arrivals and departures per week to various destinations outside the Country. An average of 24,430 international passengers arrive and depart weekly from this airport.

9.7.2.3.3 Airport cargo traffic

The data collected from the Airport shows that the Domestic section handled about 300 MT of cargo per year. The cargo handled by the Airport includes General Cargo, Fruits and Vegetables, News Papers and other valuables. About 18,250 MT of cargo was handled by International flights during the year 2005. The Airport authority is planning a full-fledged cargo village. The construction of center for perishable cargo is in full swing and is expected to be commissioned in 2006.

9.7.2.4 Water transport network

9.7.2.4.1 Existing network

Cochin has a good network of inland waterway system consisting of backwaters, canals, lagoons and estuaries **(Map 9.7.2).** There are about 1,100 km of waterways or canals in Cochin City alone. Out of this, about 40 km of rivers and canals are navigable by motorized crafts. National Waterway No.3 connecting Kollam and Kottappuram pass through the region. The waterway network in Cochin is more or less of a 'grid iron' pattern, with only a few missing links. Major canals in Cochin region are shown in **Table 9.7.4**:

Table 9.7.4: Major Canals in Cochin Region

Sl.No.	Name of canal	Length (Km.)
1.	Edappally canal	10.0
2.	Thevara Perandoor thodu	7.5
3.	Chilavannur canal	4.4
4.	Thevara canal	1.5
5.	Market canal	1.0
6.	Mullasserry canal	1.5
7.	Manthara canal	3.5
8.	Rameswaram canal	2.0
9.	Pandarachira canal	3.5
10.	Pashni thodu	1.5
11.	Pallichal thodu	4.0

An inventory of inland waterway canals which are navigable in Cochin City is given in **Annexure 8.**

Map 9.7. 2

9.7.2.4.2 IWT routes

Water transport in Cochin is on the decline due to the construction of bridges connecting islands on the western part of the City. There are very limited passenger boat services operating from Ernakulam jetty and High court jetty. The main routes served by the water transport are Ernakulam–Fort Cochin, Ernakulam–Mulavukadu, Ernakulam-Bolghatty, Ernakulam-Varapuzha, Ernakulam-Mattancherry and Ernakulam–Vyppin. Private boats operate sightseeing trips form Ernakulam, depending on the demand of tourists. KSINC operates one luxury cruise boat 'Sagara Rani' from Ernakulam jetty to cater to the tourists based on demand. The State Water Transport Department (SWTD), Kerala Shipping and Inland Navigation Corporation (KSINC), KSRTC and private operators are providing passenger and cargo boat services to the adjoining islands and industrial centers.

9.7.2.4.3 Passenger movement

Passenger boats are mainly operated from two boat jetties namely High Court jetty and Corporation jetty in the city mainland. From High Court jetty, as many as 89 passenger boat trips are operated to destinations such as Varapuzha, Mulavukadu, Bolgatty and Fort Cochin. From Corporation jetty, passenger boat services numbering 77 are operated to Fort Cochin, Mattancherry and Vyppin Island. It is estimated that about 16,000 passengers are attracted daily to Cochin city by boats from adjoining islands. **Table 9.7.5** gives the details of passenger boat operations from Cochin City.

Table 9.7.5
Details of boat trips operating from Cochin City

Origin		Destination	No. of trips
High court jetty	1	Varapuzha	15
	2	Mulavukadu	22
	3	Bolgatty	31
	4	Fort Cochin	21
		Total	89
Corporation jetty	1	Mattancherry	49
	2	Mulavukadu	2
	3	Vyppin	26
	4	Total	77
		Grand total	166

9.7.2.4.4 Goods movement

Goods transport through waterways are also on the decline due to development of road transport facilities. Goods traffic movements are mainly handled from Murukkupadom jetty and Thevara jetty. There are three oil barges and four water barges operating from Thevara jetty and two water barges operating from Murukkupadam jetty. Other goods movements include 16 barges operating from Thevara to FACT by KSINC.

9.7.2.4.5 Kochi port

Kochi port is an all-weather protected port with midstream mooring facilities in the channels and wharfs on either side of Willington Island facing the channels. It is the only major port in Kerala State with an ISO 9001-2000 certification. Facilities offered by the port are berths for handling cargo and passenger ships, cargo handling equipments, storage accommodation, dry dock, bunkering facilities, fisheries harbor, etc. Passenger ships are operated to Lakshadweep Islands from the Kochi Port. The entrance of Kochi Port is through the Cochin Gut between the peninsular headland Vyppin and Fort Kochi. 1,126 ships called at this port in 2004-05 with a net tonnage of 8.18 million. Total traffic handled at this port in 2003-04 was 13.574 million tones, of which 18 per cent of cargo was exports. 314 container vessels were handled at the port in the year 2004-05 with total container traffic of 1.75 million ton. Details of ships called at Cochin Port during 2003-04 and 2004-05 are given in **Table 9.7.6**.

TABLE 9.7.6
No. of ships called at Cochin Port during 2003-04 and 2004-05

Sl. No	Type of Vessel	No. of Ships		Variation (%)	Net Registered Tonnage		Variation (%)
		2003-04	2004-05		2003-04	2004-05	
1.	Container	381	314	-17.6	2,040,622	1,750,841	-14.2
2.	Break Bulk	215	185	-14	363,160	473,816	30.5
3.	Dry Bulk	50	48	-4	390,937	493,425	26.2
4.	Liquid Bulk	264	274	3.8	4,777,028	5,009,877	4.9
5.	Passenger	18	20	11.1	268,146	192,002	-28.4
6.	Others	205	285	39.0	104,016	256,246	146.4
	Total	1,133	1126	-0.6	7,943,909	8,176,207	2.9

Source: Cochin Port Trust

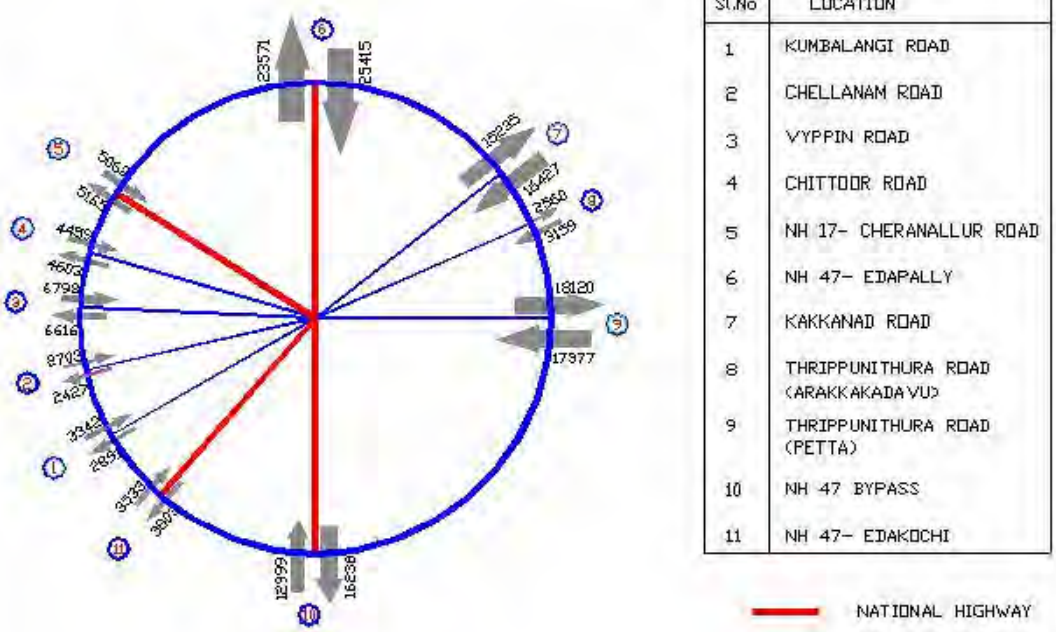
9.7.3 EXISTING TRAFFIC CHARACTERISTICS

The study of existing traffic characteristics of a road network is very important to understand the efficiency at which the system works and the general quality of service offered to road users.

TTS Study of NATPAC, 2006 studied this aspect in detail. Traffic volume count surveys were conducted at outer cordon stations in order to determine the inter-city passenger and goods movement pattern covering *external-internal, internal-external* and *external-external* trips. The study was conducted at the main entry points (MDR, SH and NH) of the city to obtain the intensity of movement and travel characteristics of inter-city passenger and goods traffic. **Map 9.7.3** shows the locations selected for the volume count survey at outer cordon points in Kochi City.

Map 9.7.3

48,986 vehicles entered or exited the City through the survey location at Edappally bridge on NH-47, followed by 35,497 of vehicles through Petta on Thrippunithura road and 31,662 vehicles through Thodu on Kakkanadu road. Fig 9.7.1 depicts the details.



INBOUND AND OUTBOUND VEHICULAR TRAFFIC OBSERVED AT OUTER CORDON LOCATIONS IN KOCHI CITY

Source: NATPAC (2006)

Fig 9.7.1

9.7.3.1 Traffic volume at mid-blocks

Most of the roads in the city carry traffic volume far greater than their carrying capacity. Travel through the CBD area offer a low level of service, and throw up possibilities of accidents and also environmental degradation. Traffic volume survey was carried out at

the mid blocks of major roads in the city road network to assess the capacity utilization of the roads.

The study revealed that the highest traffic volume of 57,357 PCU was observed between Kaloor and Palarivattam on old NH-47. On the major travel corridor of the city namely MG road between Thevara and Madhava Pharmacy, the traffic volume ranged between 23,888 and 34,873 PCU. On the road stretch between Madhava Pharmacy and Edappally Jn, the traffic volume varied from 30,670 PCU at Palarivattam-Edappally stretch to 57,357 PCU at Kaloor-Palarivattam stretch.

Traffic link volume on the NH-17 stretch between Edappally and Cheranalloor was found to be 10,493 PCU.

On NH-49 stretch between Mattancherry Halt and Shanthi Nagar within the city limit, traffic link volume of 13,756 PCU was observed during the 12-hour survey period.

On NH-47 Bypass, the 12 hour traffic link volume was found to be varying from 26,074 PCU on Vyttila -Thykudam section to 35,497 PCU on Palarivattam-Vyttila section.

On Thrippunithura road, the 12-hour traffic link volume was found to be in excess of 34,000 PCU between Petta and Valanjambalam section, whereas the section between Valanjambalam and Pallimukku section recorded link volume of 13,823 PCU.

On the road between BTH Jn and High Court Jn, the traffic volume was 43,244 PCU.

On the Chittoor road, the traffic volume ranged between a low of 6,127 PCU on Vaduthala -Pachalam section to a high of 39,932 PCU on South-Valanjambalam section.

On the Kakkanadu road, the average traffic volume was around 32,000 PCU.

Other roads where traffic volume exceeded 10,000 PCU were Manorama Jn-Panampilly road (21,249 PCU), Kaloor-Kadavanthara road (18,664 PCU), old Railway Station road (12,350 PCU), KP Vallam road (11,337 PCU) and. Vyttila-Palarivattam road (11,276 PCU). **Map 9.7.5** shows the 12-hour traffic volume observed on major links in Kochi city.

Map 9.7.5

Traffic movements at intersections

Capacity of urban roads to a great extent depends upon capacity of intersections. The peak hour traffic volume on major intersections in Kochi city is given in **Table 9.7.7** below.

9.7.3.2 Traffic accumulation at level crossings

Thiruvananthapuram-Thrissur railway line and Eranakulam-Alappuzha railway line pass

Table 9.7.7: Peak hour traffic volume on major intersections in Kochi city

Sl. No	Name	Peak hour	No. of arms	Total junction volume (PCU)	Type of traffic control
1	Palluruthy	08.45 AM to 09.45 AM	3	1,464	UC
2	Thoppumpady	09.15 AM to 10.15 AM	3	2,460	UC
3	Willington Island	09.45 AM to 10.45 AM	4	2,443	UC
4	Thevara	03.00 PM to 04.00 PM	3	3,527	UC
5	Atlantis	09.45 AM to 10.45 AM	3	4,258	UC
6	Ravipuram	10.00 AM to 11.00 AM	4	5,124	P
7	Pallimukku	05.00 PM to 06.00 PM	4	4,847	S
8	Jos	10.45 AM to 11.45 AM	4	5,395	UC
9	Maharaja	11.00 AM to12.00 PM	4	5,386	S
10	Shenoys	11.00 AM to 12.00 PM	4	3,712	S
11	Abad	11.00 AM to 12.00 PM	3	3,574	P
12	Padma	03.00 PM to 04.00 PM	4	4,225	S
13	Madava Pharmacy	03.00 PM to 04.00 PM	3	3,935	P
14	Kacherippady	10.45 AM to 11.45 AM	4	5,621	P
15	North (Town Hall)	09.00 AM to 10.00 AM	3	6,409	[
16	Lissie	09.00 AM to 10.00 AM	4	6,153	UC
17	Stock Exchange	09.00 AM to 10.00 AM	4	6,033	P
18	Kaloor	09.00 AM to 10.00 AM	4	6,326	S
19	Desabhimani	09.00 AM to 10.00 AM	4	4,210	P
20	Palarivattam	05.30 PM to 06.30 PM	4	4,523	P
21	Edappally Bypass	06.00 PM to 07.00 PM	4	7,717	S
22	BTH .	05.00 PM to 06.00 PM	3	2,381	UC
23	Hospital	04.45 PM to 05.45 PM	3	3,394	UC
24	High Court	05.45 PM to 06.45 PM	4	4,680	P
25	KSRTC	03.30 PM to 04.30 PM	4	1,880	UC
26	South	04.45 PM to 05.45 PM	4	4,541	P
27	Valanjambalam	03.45 PM to 04.45 PM	4	4,015	P
28	Manorama	11.00 AM to 12.00 PM	3	6,098	S
29	GCDA	09.00 AM to 10.00 AM	4	4,906	P
30	Kadavanthara	10.00 AM to 11.00 AM	4	3,959	S
31	Vyttila	11.00 AM to 12.00 PM	4	8,721	S
32	Palarivattam Bypass	04.30 PM to 05.30 PM	4	7,356	S
33	Santhi Nagar	05.00 PM to 06.00 PM	4	2,231	UC
34	Kathrikkadavu	05.45 PM to 06.45 PM	4	3,271	UC
35	Thammanam	05.30 PM to 06.30 PM	4	1,607	UC
36	Elamakkara	05.30 PM to 06.30 PM	4	992	UC
37	Kappalandimukku	03.45 PM to 04.45 PM	4	1,278	UC
38	Koovappadam	03.45 PM to 04.45 PM	4	1,199	UC
39	Saudia	10.15 AM to 11.15 AM	3	774	UC

Note: P - Police Control: UC-Uncontrolled : S-Signalized control

through the center of Kochi city. As such, some of the major and minor roads in the city are intersected by these railway lines. These level crossings are found to be a major traffic hurdle for free flow of traffic, due to the frequent closure of railway gates. Long delays were experienced to the vehicles at these level crossings.

Traffic accumulation survey was carried out at all the other major level crossings in the study area from 7AM to 7 PM on a typical working day to determine the train-vehicle conflicts. During the survey, number of trains passing through the level crossing and extent of vehicle accumulation during the closure of railway gate was noted down. The level crossings survey was carried out at the following five locations.

(i) Atlantis (ii) Ponnurunni (iii) Ravipuram (iv) Pachalam and (v) Vaduthala

Table 9.7.8 gives the characteristics of traffic accumulation at level crossings.

Table 9.7.8

Characteristics of traffic accumulation at level crossings in Kochi City

Location	No. of gate	No. of trains		Closure time		Queue length	
		Passenger	Goods	Average	Max	Average	Max
Atlantis	17	14	3	9	15	116	315
Ponnurunni	19	16	3	7	11	62	253
Ravipuram	17	14	3	10	16	19	55
Pachalam	30	27	3	7	15	64	193
Vaduthala	34	31	6	4	9	12	46

Table 9.7.9 gives the category-wise details of vehicles accumulated at level crossings. Category wise analysis of accumulated vehicles at Atlantis shows that two-wheelers (226) were the maximum in this stretch followed by 44 cars and 14 passenger autos.

Table 9.7.9

Category-wise details of vehicles accumulated at level crossings

Location	Maximum accumulation								
	Bus	Mini bus	Car	3-wheel	TW	Truck	Mini truck	Bicycle	Total
Atlantis	0	0	44	26	226	8	0	11	315
Ponnurunni	3	2	46	34	105	2	9	52	253
Pachalam	0	3	27	19	117	5	7	15	193
Ravipuram	0	0	4	7	29	1	3	11	55
Vaduthala	2	0	7	11	19	2	2	3	46

9.7.3.3 Speed and delay characteristics

Speed and delay survey was conducted along the road network by dividing the roads into different sections. Moving car observer method was used to determine the journey speeds and delays. Test runs were conducted on these sections during peak and off-peak periods of the day to determine average journey speed and running speed. The delay, along with duration and causes were also recorded.

9.7.3.3.1 Journey speed

Journey speed is the effective speed of a vehicle between two points and is the distance between two points divided by the total time taken by the vehicle to complete the journey including all delays incurred enroute.

The journey speed characteristics during peak and off-peak periods are presented in **Table 9.7.10** and **Figure 9.7.2**. It can be observed that one third of the total road network in the city have journey speed below 20 Kmph and another one-third between 20-30 kmph during peak hour. However, during off-peak period, one-third of the road network have journey speed below 30kmph, and another one-third between 30-40 kmph.

Table 9.7.10
Distribution of road length by peak and off-peak hour journey speed in Kochi city

Journey Speed (Km/Hr)	Peak period		Off-peak period	
	Road	Percentage	Road	Percentage
<10	7.10	4.37	0	0
10-20	47.45	29.24	14.6	9.00
20-30	53.55	33.00	39.2	24.20
30-40	40.60	25.01	63.3	39.00
40-50	10.80	6.65	34.6	21.30
>50	2.80	1.73	10.6	6.50
Total	**162.3**	**100.00**	**162.3**	**100.00**

Source: NATPAC Traffic Survey, 2005

9.7.3.3.2 Running Speed

Running speed is the average speed maintained by a vehicle over a given course while the vehicle is in motion. It is obtained by dividing the length of the course by the time the vehicle is in motion ie the running time, which excludes that part of the journey when the vehicle suffers delays.

The running speeds are relatively high in the study area-network with 72% have running speed greater than 20 Kmph during peak hour and 72% have running speed greater than 30 Kmph.

9.7.3.3.3 Delays

The analysis of causes of delays reveals that the delays are caused mostly (41%) due to road intersections – highlighting the problem of too many crossroads along the major road network. Congestion (19%), Railway crossings (11.6%) and stopped vehicle (11%) are the other major causes of delays.

9.7.3.4 Parking characteristics

Urbanization and development of the economy has resulted in uncontrolled vehicle growth. Vehicles create demand on parking and hence it is necessary to locate and regulate parking spaces for vehicles. The parking provision can be either designed as on street or off-street. Haphazard street parking becomes a menace resulting in traffic congestion and consequent reduction in capacity.

To assess the parking demand, parking accumulation and parking duration, primary surveys were carried out at the locations where the intensity of parking was very high. The parking survey was carried out at the following six corridors, where parking problems were found to be intense.

i) MG road
ii) Bannerji road
iii) SA road
iv) Shanmughom road
v) Broadway
vi) Market road

9.7.3.4.1 Parking accumulation

It was observed that the highest on-street accumulation takes place on M.G. Road as 880 equivalent car spaces (ECS) followed by Bannerji road (589 ECS) and Sahodaran Ayyappan road (456 ECS). In the case of off-street parking, the highest parking accumulation was along Bannerji road (500 ECS), followed by MG road (494 ECS) and Sahodaran Ayyappan road (409 ECS).

9.7.3.4.2 Parking Duration

The short-term parking is predominant at all corridors. Short term parking of vehicles depends on the category of vehicles and location of parking. It was found that 92-99% of cars and 96 -99% of two wheelers are short duration parkers. The long-term parking of cars was observed mainly along Shanmugham Road (8%), M.G road (6%) and S.A. Road (5%).

9.7.3.5 Pedestrian characteristics

Pedestrians are an important component of road users. In urban areas, a significant proportion of trips are performed by walk. They are the most vulnerable road users in urban areas. The pedestrian facilities such as footpath are encroached by the frontage of the shopkeepers or by vendors. Due to the absence of footpath railings, pedestrian spill over is high, which obstruct the movement of vehicular traffic. Pedestrian surveys were carried out at 30 major intersections and mid blocks, where pedestrian crossings are high.

From the survey, it was observed that peak time and flow of pedestrian traffic are varying for different locations. Based on the analysis of the data, it is found that peak hour pedestrian traffic crossing at major locations ranges from 209 to 2,479 It is also found that peak hour pedestrian traffic is observed high at Menaka (2,479) on Shanmughom road, followed by High court on Shanmughom road (2,183) and Bannerji road (1,330).

9.7.4 Inter-city travel characteristics

9.7.4.1. Inter-city vehicular traffic

9.7.4.1.1 Inflow and outflow of vehicular traffic

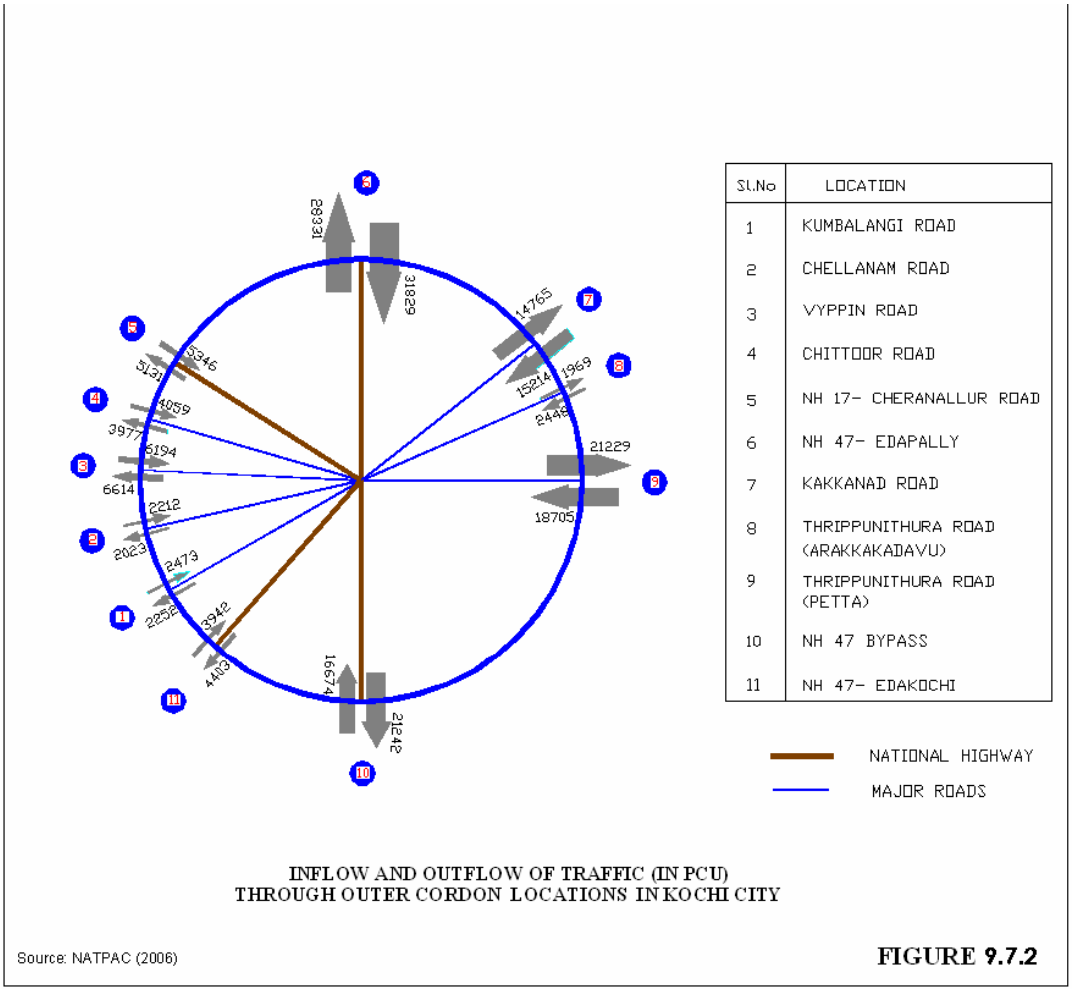
The outer-cordon survey of vehicles entering and exiting Kochi city revealed that during the survey period of 24 hours, a maximum of 60,159 PCU of vehicles either entered or exited the City through the bridge located on NH-47 near Edappally, followed by 39,934 PCU of vehicles along Thrippunithura road near Pettish and 29,979 PCU of vehicles near Thodu on Kakkanadu road. On Palluruthy – Kumbalangi road, 4,678 PCU of vehicles entered or exited through Perumpadappu. Similarly, on Chellanam road, 4,221 PCU of vehicles entered or exited from Corporation boundary. At GIDA Bridge on Vyppin road, 12,807 PCU of vehicles were observed in both directions. From Chittoor side, the vehicular flow was to the tune of 7,999 PCU in both directions were observed near the Chittoor Bridge. On NH-17, near Cheranalloor, 10,477 PCU of vehicles entered/ exited daily. Vehicles from Thrippunithura side, via Arkakkadavu Bridge was observed to be 4,363 PCU in both directions. On NH-bypass at Thykudam bridge, 37,915 PCU of vehicles was observed entering or exiting the City. Similarly, on old NH-47 at Edakochi traffic flow was to the tune of 8,345 PCU in both directions. Distribution of vehicular traffic passing through the eleven outer cordon survey stations in Kochi City is given in **Table 9.7.11.** A schematic presentation of the inbound and outbound traffic in PCU at outer cordon locations is shown in **Figure 9.7.2**

Table 9.7.11

Summary of daily vehicular traffic at outer cordon survey locations in Kochi city

Sl. No.	Name of location	Name of road	Inbound		Outbound		Total	
			No	PCU	No	PCU	No	PCU
1	Perumpadappu	Palluruthy-Kumbalangi road	3,342	2,473	2,891	2,252	6,233	4,725
2	Chellanam	Thoppumpadi to Chellanam road	2,703	2,212	2,427	2,023	5,130	4,234
3	Near GIDA bridge	High court to Vypeen road	6,798	6,194	6,616	6,614	13,414	12,807
4	Near Bridge	Chittur road	4,459	4,059	4,603	3,977	9,062	8,036
5	Near Cheranallur	NH-17	5,062	5,346	5,165	5,131	10,227	10,477
6	Edappally bridge	NH-47 & bypass	25,415	31,829	23,571	28,331	48,986	60,159
7	Near thodu	Kakkanad road	16,427	15,214	15,235	14,765	31,662	29,979
8	Arkkakadavu bridge	Alinchuvadu to Thrippunithura road	3,159	2,448	2,560	1,969	5,720	4,417
9	Petta bridge	Thrippunithura road	17,377	18,705	18,120	21,229	35,497	39,934
10	Thykoodam bridge	NH-bypass	12,999	16,674	16,238	21,242	29,237	37,915
11	Edakochi	NH-47	3,533	3,942	3,803	4,403	7,336	8,345

Source: NATPAC primary survey, December 2005



INFLOW AND OUTFLOW OF TRAFFIC (IN PCU)
THROUGH OUTER CORDON LOCATIONS IN KOCHI CITY

Source: NATPAC (2006)

FIGURE 9.7.2

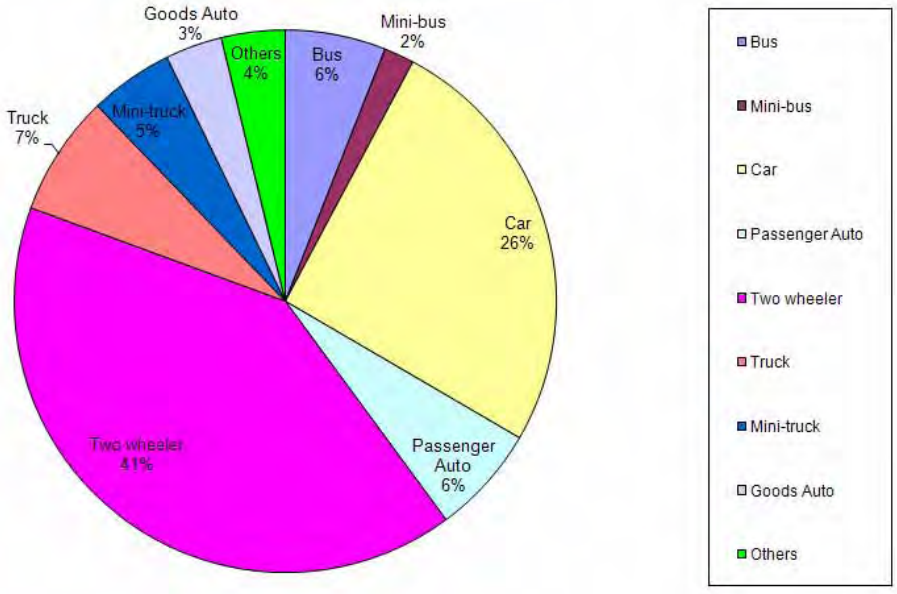
9.7.4.1.2 Modal spilt of vehicular traffic

An analysis of OD survey data was carried out to assess the modal split of vehicular traffic. It could be seen that about 1.49 lakh inter-city vehicular trips were performed in the study region on a reference day. The modal split of inter-city vehicular traffic consists of nearly 52% by two wheelers followed by 31% by cars, 8.5% by auto and 6.6% by bus and 1.9% by mini-bus. Modal spilt of vehicular traffic is shown in **Table 9.7.12**. A pie diagram showing the modal split of vehicular traffic is shown in **Figure 9.7.3.**

Table 9.7.12

Distribution of vehicular trips through outer cordon points according to pattern Of movement in Kochi city

Sl.No.	Pattern of traffic	Vehicle type					Total	
		Two wheeler	Auto	Car	Mini-bus	Bus	No.	Per cent
1	Internal to Internal	594	34	433	65	-	1,126	**0.76**
2	Internal to External	34,169	6,913	21,181	1,293	3,755	67,311	**45.15**
3	External to Internal	38,582	5,409	19,793	775	3,820	68,379	**45.87**
4	External to Extenal	4,122	355	4,827	729	2,234	12,267	**8.23**
	Total	**77,467**	**12,711**	**46,234**	**2,862**	**9,810**	**149,084**	**100.00**
	Percent	**51.96**	**8.53**	**31.01**	**1.92**	**6.58**	**100.00**	



Mode-wise distribution of inter-city road based vehicular traffic in Kochi city

Figure 9.7.3

9.7.4.1.3 Pattern of vehicular traffic

An analysis of pattern of vehicular trips in Kochi city reveals that about eight per cent of the traffic through the outer cordon surveys were bypassable in nature while 46% of the trips were of external to internal and 45% of vehicular trips internal to external. Less than one per cent of the vehicular traffic is found to be of internal to internal traffic.

9.7.4.2 Inter-city passenger traffic

An analysis of OD survey data was carried out to assess the modal split of inter-city passenger traffic as well as the pattern of vehicular traffic whether it is internal-internal, internal-external, external-internal or external-external. The results of the analysis are shown in **Table 9.7.13** and discussed below.

Table 9.7.13

Distribution of passenger trips through outer cordon points according to pattern of movement in Kochi city

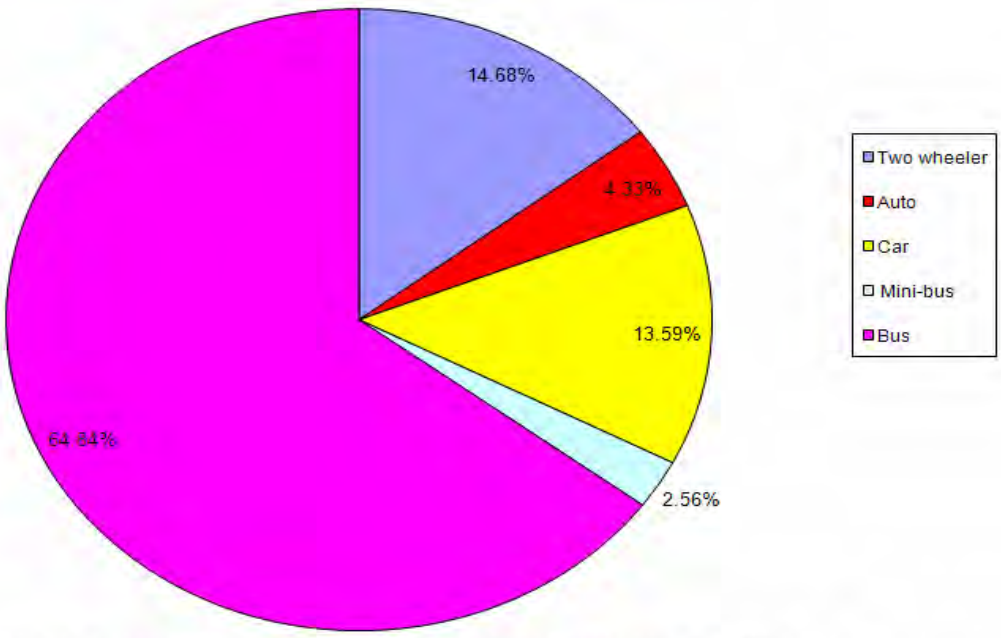
Sl.No.	Pattern of traffic	Vehicle type					Total	
		Two wheeler	Auto	Car	Mini-bus	Bus	No.	Per cent
1	Internal to Internal	908	102	916	413	-	2,339	**0.30**
2	Internal to External	48,055	16,720	46,807	7,680	188,544	307,806	**40.01**
3	External to Internal	58,062	15,241	42,355	5,184	191,770	312,612	**40.64**
4	External to Extenal	5,928	1,233	14,440	6,404	118,493	146,498	**19.04**
	Total	**112,953**	**33,296**	**104,518**	**19,681**	**498,807**	**769,255**	**100.00**
	Percent	**14.68**	**4.33**	**13.59**	**2.56**	**64.84**	**100.00**	

9.7.4.2.1 Modal split of passengers

Buses are the predominant mode of transport in meeting the inter-city passenger demand. The city is directly linked by bus routes to several towns and cities, namely Thrissur, Alappuzha, Guruvayoor, Ankamaly, Kottayam, Perumbavoor, Thrippunithura, Paravoor, Kodungalloor etc.

An analysis of modal split of inter-city passenger traffic reveals that about 65% of passengers were traveling in buses followed by 15% in two wheelers and 14% in cars, 4% in auto and 2% in mini-buses.

A pie diagram showing the modal split of passenger traffic is shown in **Figure 9.7.4**.



Modal split of passenger traffic through outer cordon locations in Kochi City

Fig.9.7.4

9.7.4.2.2 Pattern of passenger traffic

An analysis of movement pattern of passengers through the outer cordon survey locations shows that about 40% each of passenger trips are external to internal trips and internal to external trips respectively and 19% of passengers are through trips, which have no business in the City.

9.7.4.3 Characteristics of inter-city passenger trips

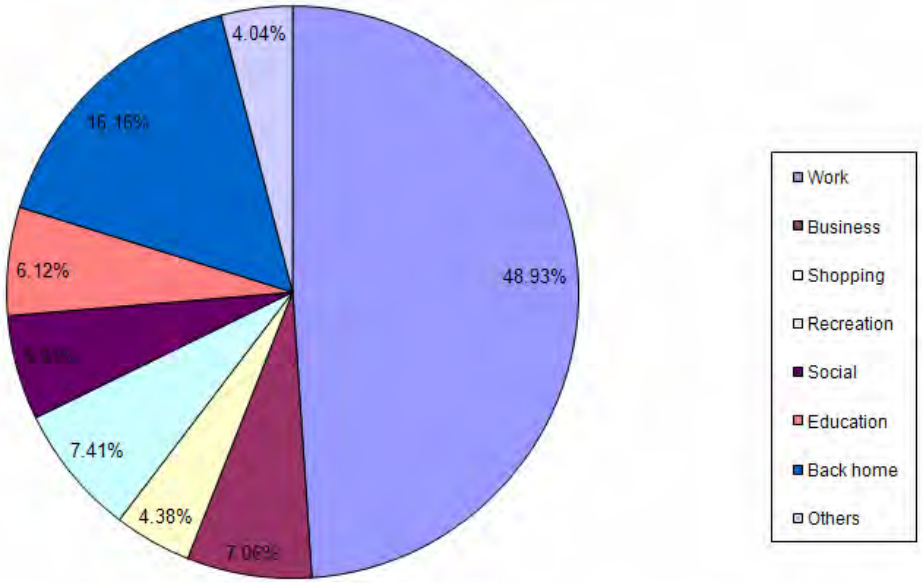
9.7.4.3.1 Purpose of passenger trips

Inter-city trips are broadly classified into eight purposes including work, education etc. In Kochi City, inter-city passenger trips to the tune of 3,76,404 person trips were performed for work purpose. This formed nearly 49% of the total inter-city passenger movement. Detailed analysis of work trips shows that about 2,41,456 passengers traveled in buses followed by 68,323 passengers in two-wheeler and 45,570 passengers in cars. The work trips were followed by 1,24,286 back home trips (16%), recreation trips 57,007 (7.4%), and business trips 54,299 (7%). **Table 9.7.14** gives the mode-wise distribution of inter-city passenger trips through outer cordon points according to purpose of trips in Kochi City. **Figure 9.7.5** illustrates the same by pie diagram.

Table 9.7.14

Distribution of passenger trips through outer cordon points according to purpose

Sl.No.	Purpose	Vehicle type					Total	
		Two wheeler	Auto	Car	Mini-bus	Bus	No.	Per cent
1	Work	58,696	11,862	35,916	6,054	201,929	**314,457**	**40.88**
2	Part of work	9,627	2,589	9,654	550	39,527	**61,947**	**8.05**
3	Personal business	7,518	2,903	11,684	1,690	30,504	**54,299**	**7.06**
4	Shopping	3,752	1,022	3,252	284	25,349	**33,659**	**4.38**
5	Recreation	3,858	2,171	10,509	3,091	37,378	**57,007**	**7.41**
6	Social	5,877	4,129	12,535	5,762	17,185	**45,488**	**5.91**
7	Education	1,476	386	726	635	43,823	**47,046**	**6.12**
8	Back home	18,754	4,944	12,928	444	87,216	**124,286**	**16.16**
9	Serve passenger	745	1,168	2,538	106	430	**4,987**	**0.65**
10	Others	2,651	2,123	4,775	1,066	15,467	**26,082**	**3.39**
	Total (No.)	**112,954**	**33,297**	**104,517**	**19,682**	**498,807**	**769,257**	**100.00**
	Total (%)	**14.68**	**4.33**	**13.59**	**2.56**	**64.84**	**100.00**	

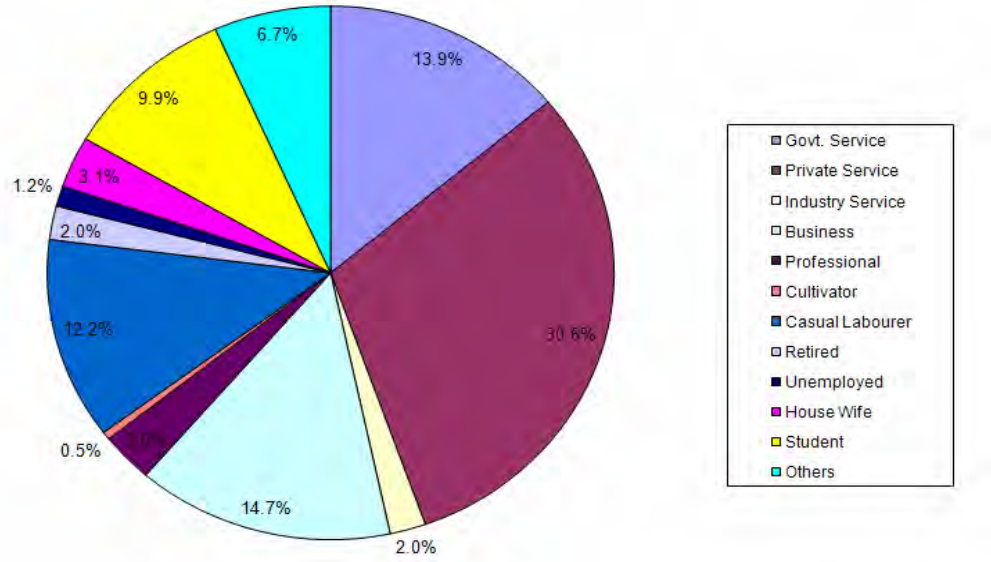


Distribution of passenger trips through outer cordon points according to purpose of trips in Kochi City

Figure 9.7.5

9.7.4.3.2 Occupation of passenger trips

The occupational status of inter-city passengers was ascertained from the O-D survey conducted at outer-cordon points. It has been observed that persons working in the private service constituted the major segment (31 percent) of the inter-city passengers, followed by business people with 15 per cent of the total passengers. Government employees, casual laborers and students constituted 14%, 12% and 10% per cent respectively. **Figure 9.7.6** shows distribution of inter-city passenger trips by road according to occupational status.



Distribution of passenger trips at outer cordon points according to occupation of trip maker in Kochi City

Figure 9.7.6

9.7.4.4 Inter-city goods traffic

The transportation planning of a city has to take into account the impact of both passenger and goods traffic over the road system.

9.7.4.4.1. Modal split of goods traffic

Inter-city goods traffic in the study region was handled by a number of goods vehicles consisting of 11,176 trucks, 8,690 mini-trucks/tempos and 6,262 goods auto. Goods traffic to the tune of 80,797 metric tonnes were transported to various destinations, of which the share of trucks constituted 77.5 % (62,605 MT), followed by mini-trucks 19.4 % (15,688 MT)

and goods autos 3.1% (2,504 MT). The data pertaining to mode wise goods traffic are given in **Table 9.7.15.**.

Table 9.7.15

Modal split of inter-city goods traffic in Kochi City

Sl.	Type of vehicle	No. of	Goods traffic	Percent to
1	Truck	11,176	62,605	77.5
2	Mini-truck	8,690	15,688	19.4
3	Goods auto	6,262	2,504	3.1
	Total	26,128	80,797	100.00

Source: NATPAC Traffic Survey 2006

9.7.4.4.2 Pattern of goods traffic

An analysis of pattern of inter-city goods traffic through Kochi City reveals that bulk of goods vehicles (78%) either originated from or terminated in Kochi city. 21 per cent of the goods vehicles were found to be bypassing the city. In terms of total tonnage carried, only 66 per cent of around 80,000 MT had their origin or destination in Kochi city. Most of remaining vehicles with a tonnage of 26,000 MT (32%) were bypassing the city.

9.7.4.4.3 Commodities transported

Of the 26,108 goods vehicle trips encountered at the outer cordon survey points, nearly one-fourth of the vehicles (6,057) were empty vehicles. In the remaining vehicles, 1,695 goods vehicle carried sand and clay, followed by granite and rubbles (1,610) and vegetables (588). An analysis of the quantities of major commodities carried by goods vehicle shows that earth & gravel (8,587 MT) recorded the highest, followed by sand and clay (7,124 MT) and brick & tiles (4,351 MT). Quantities above 1,000 MT were observed in the case of cement (3,888 MT), Provisions (3,218 MT), Rice and Paddy (2,941 MT), Rubber and plastic goods (2,682 MT), Stationary & paper (2,542 MT), Soda and drinks (2,167 MT), LPG (2,119 MT), other food grains (2,034 MT), Iron and steel (1,993 MT), Chemical and drugs (1903 MT), other petroleum products (1585 MT), Parcel (1,451 MT), Electrical goods (1,223 MT), Spices (1,213 MT), Milk and milk products (1,172 MT), Vegetables (1,137 MT), Cattle feed (1,107 MT), Bamboo and wood (1,111 MT), and Hay (1,049 MT). Other commodities carried were less than 1,000 MT only. Details of distribution of goods vehicle trips through outer cordon points according to commodity and quantity carried in Kochi is given in Annexure 9.

9.7.5 BUS TRANSPORT SYSTEM

Bus Transport System generally plays a vital role in meeting the travel needs of city's population. Kochi City and the neighboring satellite towns mainly depend upon the bus

transport, for meeting the travel demands of majority of the people. Kerala State Road Transport Corporation (KSRTC) and private bus operators jointly provide the bus transport in Kochi city and satellite towns. KSRTC buses mainly ply on major inter-city routes. Private buses are operated from different parts of the city as well as from satellite towns and caters to the travel needs of both intra-city and inter-city passengers.

9.7.5.1 Bus terminals

Except for Kaloor and KSRTC bus station, terminal facilities were not available at any of the places within Kochi city and buses are often parked on the roadside creating traffic problems.

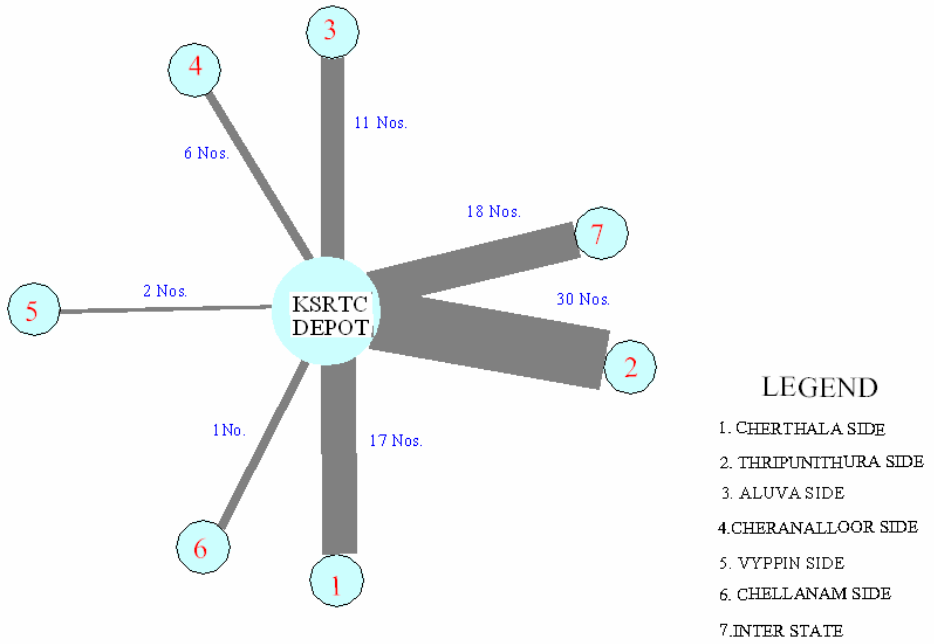
9.7.5.2 KSRTC bus services

KSRTC operated mainly Fast passenger and Super fast services to cater the travel demand of long distance passengers from Alappuzha, Kozhikode, Kottayam, Pathanamthitta and Guruvayoor regions. Ordinary bus services operated from the KSRTC bus station at Kochi to various destinations within the town are very less compared to private buses. The major routes operated by the KSRTC bus station at Kochi are given in **Table 9.7.16.** Desire lines of KSRTC buses operated from Kochi depot are shown in **Figure 9.7.7.**

Table 9.7.16
Number of buses operated to various routes from KSRTC Bus Station in Kochi

Sl. No.	Bus route	No. of ordinary buses	No. of fast passenger/ express buses	Total buses
1	Cherthala side	6	11	17
2	Thripunithura side	13	17	30
3	Aluva side	1	10	11
4	Cheranalloor side	4	2	6
5	Chellanam side	2	0	2
6	GIDA bridge side	1	0	1
7	Inter State		18	18
	Total	**27**	**40**	**85**

Source: KSRTC station, Eranakulam



DESIRE LINES OF KSRTC BUSES OPERATED FROM KOCHI DEPOT

Figure 9.7.7

KSRTC also operates ordinary mofussil buses to northern parts of the City from the bus stand located near Eranakulam Boat Jetty. About 230 trips are operated daily from this bus stand, out of which majority of trips are destined to Guruvayoor, Ponnani and Malappuram directions.

9.7.5.3 Private bus services

Inter-city: Majority of long haul mofussil private buses destined to major destinations in the northern, eastern and southern sides of Kochi City are operated from the Private Bus Terminal at Kaloor. The following are the major private bus routes operated from Kaloor Terminal.

(i) North Paravoor through Cheranalloor
(ii) Cherthala direction through Vyttila
(iii) Thripunithura direction through Vyttila

A total of about 272 buses are operated from this terminal to 24 major routes. Of these, 112 buses are destined to Eramalloor, Poochakkal, Aroorkutty, Keltron Ferry and Cherthala directions. As many as 160 buses are operated towards Thripunithura direction to various destinations such as Piravam, Vaikkam, Thalayolaparambu, Kumali, Thodupuzha, Muvattupuzha, Pattimattam, Koothattukulam, etc. Apart from these buses operated from Kaloor bus terminal, a number of intra-city private buses operated in the city routes also enter the Kaloor bus terminal, enroute to different destinations. The major routes along with the number of private buses operated in these routes from Kaloor bus terminal are given in **Table 9.7.17**

Table 9.7.17
Major routes of inter-city private buses operated from Kaloor bus terminal in Kochi City

Sl.No.	Origin	Major destination	No. of buses	No. of trips
Towards Cherthala direction				
1	Eranakulam	Cherthala, Eramalloor, Poochakkal, Arookutty	85	750
2	Pukkattupady	Eramalloor, Arookutty, Keltron Ferry	12	90
3	Kakkanadu	Eramalloor, Arookutty	15	120
	Sub-total		112	960
Towards Thrippunithura direction				
4	Kakkanadu	Perumbavoor, Vaikkam, Piravam	12	75
5	Eranakulam	Perumbavoor, Piravam, Koothattukulam, Pattimattam, Muvattupuzha, Thalayolaparambu, Kottayam, Thodupuzha	148	744
	Sub-total		**160**	**819**
	Total		**272**	**1,779**

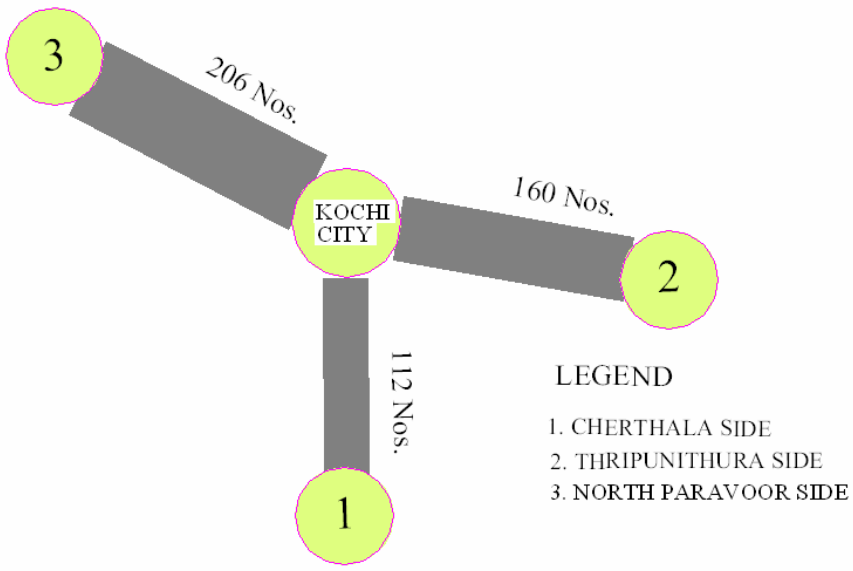
Inter-city buses operated towards northern side of Kochi City are mainly carrying passengers to destinations such as North Paravoor, Munambam, Cherai and Njarakkal. These bus services cater the travel demand of commuters residing in the islands on the north-western parts of Kochi city. With the commissioning of GIDA bridges connecting western islands with the city, the commuters residing in these islands get direct access to the Kochi City. However, private buses entering the mainland through GIDA bridges are terminated near High Court premises in order to reduce the traffic loading on urban streets. The major routes along with the number of inter-city buses operated to the northern side of Kochi city are given in **Table 9.7.18.** Desire lines of inter-city private buses operated in Kochi City are shown in **Figure 9.7.8.**

Table 9.7.18

Major route and trips of inter-city private buses operated on northern side of Kochi City

Sl. No.	Origin	Major destination	No. of buses	No. of trips
1	Eranakulam	North Paravoor (via, Varapuzha & Pathalam)	40	320
2	Eranakulam	North Paravoor (via, Kalamasserry)	2	12
3	Eranakulam	North Paravoor (via,Manjummel)	16	96
4	Eranakulam	North Paravoor (via,Cherai)	96	864
5	Eranakulam	Munambam	29	290
6	Eranakulam	Munambam (via,Paravoor)	6	36
7	Eranakulam	Njarakkal	17	289
	Total		**206**	**1,907**

Source : Private Bus Owners Association, Eranakulam



DESIRE LINES OF INTERCITY PRIVATE BUSES OPERATED FROM KOCHI CITY

Figure 9.7.8

Intra-city: The terminals with a large number of private buses originating and terminating include Aluva, Fort Kochi, Edakochi, Thrippunithura, Vytilla, etc. The route length of the private bus operations varied from 10 Km to 50 Km for the City services. About three fourth of city services operated in Kochi City had route length of more than 20Km. **Table 9.7.19** gives the distribution of route length of Intra-city private bus services operated in Kochi City.

Table 9.7.19
Percentage distribution of route length of intra-city private bus services in Kochi City

Sl.No.	Route length (Km)	Percentage of total
1	10-15	7.4
2	15-20	17.3
3	20-25	18.5
4	25-30	29.6
5	30-40	24.7
6	40-50	2.5
Total		**100.00**

The existing routing pattern of private buses operating as city bus services is indicated in **Map 9.7.6**. The details of private bus routes originating from various terminals in Kochi city along with number of buses and trips on these routes are presented in **Table 9.7.20.**

Map 9.7.6

Table 9.7.20

Details of private city bus routes originating from various Terminals within Kochi city

Sl. No	Route origin	Major destinations	No. of buses	No. of trips
1	Aluva	Fort Kochi, Chottanikkara, Thevara, Edakochi, Panangad, Perumpadappu	260	2,240
2	Fort Kochi	W. Island, Edakochi, Perumpadappu, Kumbalangi, Chellanam	63	1,154
3	Cheranalloor	Chellanam, Perumpadappu, Fort Kochi, Thevara Ferry, Thripunithura	77	750
4	Vyttila	Via, Thammanam, NH bypass Vyttila (circular)	40	800
5	Chittoor	Mattancherry, Edakochi	35	480
6	Edakochi	Fort Kochi, Mattancherry	33	600
7	Kakkanadu	W. Island, Fort Kochi, Thevara Ferry, Perumpadappu	36	444
8	Eloor	Thevara Ferry, Fort Kochi, Mattancherry	30	368
9	Thripunithura	Thripunithura (circular), via Eroor gate	27	324
10	Chittiattukkara	Perumpadappu, Chottanikkara, Fort Kochi	25	238
11	Poothotta	Kakkanadu, Kaloor	15	134
12	Edachira	Fort Kochi, Edakochi	12	136
13	Elamakkara	Fort Kochi, Eloor, Chottanikkara	10	124
15	Mattancherry	Pookkattupadi, Perumpadappu	8	134
16	Puthukkalavattom	Perumanoor, Chottanikkara	7	140
17	Chellanam	Fort Kochi	6	56
18	Kalamasserry	Fort Kochi, Kumbalangi	4	42
19	Nelempathinjimughal	Mattancherry, Poothotta	4	38
20	Manjummel	Fort Kochi, Thevara Ferry	3	32

21	Ponekkara	Fort Kochi	3	32
22	Karimughal	Vyttila	2	36
23	Kothad Ferry	Edakochi, Poothotta	2	24
24	Kumbalangi	Ponekkara	2	26
25	Palamkadavu	University, Puthukalavattom	3	18
26	Pukkattupady	W. Island, Fort Kochi	3	24
27	Thevakkal	Thevara Ferry, W. Island	2	18
28	Thuthiyoor	Thevara Ferry, Fort Kochi	2	24
29	Chottanikkara	Eloor	1	8
30	Marotichuvadu	Panangad	1	8
31	Panangad	Glass Factory	1	10
		Total	**686**	**8,710**

Source: Private Bus Operators Association, Eranakulam

9,7.5.4 Density of buses on major routes

Most of the city bus services operated in Cochin city are getting converged on MG road at some point or other, thus making it the most congested travel corridor. Volume of buses varied along different sections of MG road from 3,000 to 6,000 buses per day. Apart from MG road there are two other important travel corridors in Kochi city, viz, Bannerji road and Sahodaran Ayyappan road, which connects the eastern and western parts of the city. It was found that about 5750 buses pass daily through the Bannerji road. The buses entering the Bannerji road from the Edappally side after passing through the north over bridge splits to Chittoor road and Shanmugham road. Another major entry/exit route for buses to/from the City is through South over bridge on Sahodaran Ayyappan road, which is one of the heavily congested roads in Kochi City. This road carried a daily volume of about 3,500 bus trips. Though the permitted carrying capacity for city buses is 56, during the peak hours, the buses were found over crowded with more than 100 passengers in major travel corridors of the city. Maximum boarding and alighting of bus passengers were observed at Menaka,

Kaloor, Kacheripady and High Court bus stops, which indicated the concentration of office, business complexes and activity centers around these locations.

A major share of the buses operated in Kochi city is having at least one end of the route at the suburbs or at the satellite towns of the city. Thus the origin and destinations of private city buses are scattered both within and outside the City. On the contrary, the mofussil services of KSRTC and private buses are destined to KSRTC bus station and Kaloor private bus terminal respectively. Details of KSRTC and private bus trips operating along major routes in Kochi City is given in **Table 9.7.21**

Table 9.7.21

Details of KSRTC and private bus trips operating on major routes in Kochi

Sl. No.	Name of major route and direction	Inbound (Nos.)		Outbound (Nos.)		Total (Nos)
		KSRTC Buses	Private Buses	KSRTC Buses	Private Buses	
1	Eranakulam - Aluva	282	811	279	863	2235
2	Eranakulam - Kakkanadu	4	513	5	499	1021
3	Eranakulam - Munambam/North	47	399	73	416	935
4	Eranakulam - Vaduthala	6	310	7	321	644
5	Eranakulam - Cheranalloor	127	199	113	222	661
6	Eranakulam - Arkakkadavu	0	58	0	45	103
7	Eranakulam - Thripunithura	248	1053	250	1189	2740
8	Eranakulam - Cherthala	94	449	112	502	1157
9	Eranakulam - Thoppumpady	239	911	255	973	2378
	Total	**761**	**3379**	**810**	**3668**	**8618**

Source: Natpac Survey 2006.

9.7.6 INTERMEDIATE PUBLIC TRANSPORT SYSTEM

Intermediate Public Transport (IPT) system comprises of auto-rickshaw, jeeps, vans and taxis. In cities, IPT modes play an important role in the transportation system of a city. They help to reduce the inadequacy of Public Transportation system to certain extent. They are operated on routes where the public transport modes provided inadequate services. The IPT modes are gradually becoming an important mode of the transport system of Kochi City, as the city is witnessing rapid strides in economic development and hitherto undeveloped areas with limited accessibility for the public transport system are developed and made part of the city.

9.7.6.1 Growth of IPT vehicles

Table 9.7.22 illustrates the growth of Intermediate Public Transport modes in Eranakulam district during 2003-2004. In the year 2004, number of taxis in the region had grown by 11 percent over the previous year. The number of auto rickshaws registered 6% percent growth during the same period. According to 2004 figures, there were 35,511 licensed auto rickshaws and 10,362 taxis in the district. Out of this, about 6,500 taxis and 5,000 auto rickshaws are operating within Kochi City alone. The annual growth of taxis in Eranakulam district shows that it is almost double compared to the growth of taxis in the State.

Table 9.7.22
Growth of intermediate public transport modes in Ernakulam district and Kerala state

Sl. No	Intermediate Public Transport mode	No. of vehicles in		Percentage Increase
		2003	2004	
Eranakulam District				
1	Taxi	9,331	10,362	11.05
2	Auto rickshaw	33,478	35,511	6.07
Kerala State				
1	Taxi	88,070	285,092	6.11
2	Auto rickshaw	285,092	303,092	6.31

Source: Economic Review 2005

9.7.6.2 Operating characteristics

An analysis of the distance operated by the IPT modes in Kochi city revealed that autorickshaws on an average, operated 63 Kilometers daily while taxis operated 74 kilometers daily. The percentage distribution of IPT operators according to distance operated per day is presented in **Table 9.7.23.** 68% of autorickshaws operated up to 75 kms, 14% operated between 76 and 100 km, and 10% operated between 101 and 150 km per day while 8% operated more than 150 km per day. Amongst the taxis, about 56% operated up to 75 km, 15% operated between 76 and 100 km, and 13% operated between 101 and 150 km while 16% operated more than 150 km per day.

Table 9.7.23

Percentage distribution of IPT vehicles according to distance operated per day (including dead Kilometers)

Sl.No.	Distance operated (Km)	Percentage of IPT vehicles	
		Taxi	***Auto rickshaw***
1	Up to 50	31	22
2	51-75	25	46
3	76-100	15	14
4	101-150	13	10
5	>150	16	8
	Total	**100.00**	**100.00**

9.8 INFRASTRUCTURE

9.8.1 Water Supply

The Prime Source of water supply in Kochi City Region is the Periyar River. There are two head works and treatment plants, one at Aluva with a capacity of 225 mld and the other at Chowwara. The total water consumption comprises of domestic and non domestic consumption, including water requirements for industrial, commercial and institutional uses, hospitals, hotels, theatres, gardens etc. To this total consumption unaccounted water which includes requirement for firefighting and appropriate allowances for leakage losses and water treatment plant losses are also added to get the total raw water demand. In Kerala all major

public water supply systems are under the control of Kerala Water Authority (KWA), the public sector undertaking for planning, implementing and maintaining water supply and sewerage schemes for Government of Kerala, formerly known as Public Health Engineering Department (PHED).

Out of the 366.92 sq.km of the planning region 140.58 sq.km is urban area. Remaining 226.34 sq.km distributed in 14 panchayats is rural area. Both urban and rural areas of Kochi City Region have to depend mainly on protected water supply. The total installed capacity of Aluva head works is 225mld and supply area from that plant caters to Kochi Corporation, two Municipalities & 16 panchayats. Supply from Chowara is diverted for rural water supply schemes in surrounding areas. The supply of water for all the local bodies in the KMP area except Thiruvankulam and Vadavukodu-Puthenkurisu is from Periyar river. The per capita consumption is arrived at considering the rural /urban character of the area at that time. Kochi being the industrial and commercial capital of Kerala, the standard of living is high and thereby there is increased use of water. A standard of 200 lpcd is found acceptable for the urban areas and 150 lpcd for rural areas during the year 2001. The estimated water demand of the area served by Aluva head works in the year 2005 was 360 mld, leaving a gap of 135 mld even at present.

Most of the industries in the region have installed their own private water supply schemes in the industrial township. These water supply schemes are not protected since a water purification plant on a limited scale is not economic. FACT draws water from Edamala branch of Periyar. TCC and HIL factories also get water for industries and township requirements from FACT water supply scheme by metered connections. IAC and Apollo Tyres at Kalamassery meet their water requirement from Periyar. Tata Oil Mills, Island Sea Foods, H.M.T, Refinery and University get water from the Kerala Water Authority.

The coastal areas of Kochi are characterized by high density of population and scarcity of good drinking water source. As the ground water sources are saline, coastal people depend mainly on piped water supply and supply through barges and lorries. As the coastal areas lie away from water sources in Periyar, the supplied water does not always reach these coastal areas. Hence the supply is often limited to a few hours a day resulting in long queues waiting for collection of water from public taps located in these areas. The immediate solution is provision of desalination plants of specific capacities in the coastal panchayats. 20 liters of water per family is considered to be the minimum requirement of drinking water per day.

Due to the scarcity of water in high rise buildings (apartments) and for multifamily dwelling units, only one water connection is provided. As a result, they are forced to utilize water distributed in tankers and lorries which is often unhygienic. The source of such water is

either the existing rivers or underground water. The quality and quantity of the underground water is affected by the exploitation of ground water. Additional source of protected water supply for such developments have to be found instead of closing the eyes to such requirements. Special schemes have to be drawn up suitably charging for such concentrated requirements. Alternate strategy is to insist on dual pumping systems and adopting proper treatment for the reuse of water.

Annexure 10 gives details of existing water supply schemes serving the Kochi City Region whereas details of existing treatment plant, over head and ground level tank, pump capacity, pumping main and intake source serving the Kochi City Region and details of Storage tanks in Kochi City Region are shown in **Annexures 11** and **12** respectively

9.8.2 Drainage

Kochi City Region consists of

i. Highly urbanized Kochi corporation area
ii. Two less urbanized municipalities
iii. 14 adjoining panchayats

The topography of Kochi is almost flat. The average altitude towards the eastern fringes is about 7.5m above M.S.L. But towards west, most part of the city is only about 1.00 m above M.S.L. Kochi is characterized by sand bars running in north – south direction with tidal canals in between. In the absence of sufficient wide drains and also because of the general flatness of the terrain, the city is facing acute drainage problems. Several preliminary studies were conducted regarding the drainage of the city, which clearly proved the inadequacy of the primary, secondary and tertiary drains either because of the size, design or maintenance level.

Water related aspects of environment changes drastically due to change in land use. The adverse effects caused due to manmade interventions result in flood, erosion, siltation etc. which will upset the balance of the environment. Such a phenomenon is predominant in the coastal urban areas. In addition to manmade problems, the low lying flat topography, high water table, high intensity of rain etc. also contribute to poor drainage.

In the absence of sewerage, the storm water drains carry sullage and effluent from on-plot excreta disposal systems. This provides ideal environment for mosquito breeding. During dry weather, the flow is stagnant with thick foul smelling liquid of BOD above permissible limits. It is estimated that in Kochi City about 72000 septic tanks discharge to open drains.

The drainage system in the area can be categorized into three levels as:

1. **Primary canals:** – These are major natural canals, which are running in north-south direction and a few natural canals that cut across the sand bars. The primary canals which convey the storm water runoff to the back water system which were once navigable are now highly degraded because of encroachments, waste dumping, silting, weed growth, low maintenance and lack of protective measures. It is found that almost all the tidal canals are in filthy conditions. This is due to the dumping of wastes into the canals and lack of facilities for cleaning them due to inaccessibility of cleaning vehicles and machines. It is necessary that this canal and the shorelines are protected and maintained properly for better living conditions.

2. **Natural and manmade secondary drains**: - Natural secondary drains are the feeder drains/canals of primary canal. The man made secondary drain encompasses major roadside drains, which go beyond the level of area drains. They link with the Primary drains (tidal canals) running in north-south direction.

3. **Area Drains**: **-** The area drains are the drains which discharge the storm water and sullage from a neighborhood to secondary drain. The city has large network of area drains, which act as major storm water receivers. There is no regular pattern for this and lies along small roads and bye lines. The area drains are absent in many of the areas especially in areas with urban proliferation. These drains need immediate attention. These are the primary cause for water logging in the various neighborhoods in the city.

Table 9.8.1 : Canals in Kochi

Sl. No.	Description of item	Quantity (km)	
		Kochi Corporation	Municipalities & Panchayats
1	Total length of the primary canal	77	254
2	Total length of the natural and manmade secondary drains	222	198
3	Total length of area drains	740	489

Source: Irrigation Division, Ernakulam, CoC, Municipalities, Panchayats

The city is facing severe water logging problems. A number of places in the city suffer from water logging due to heavy rainfall in the monsoon. During the period of water logging, normal life and traffic movements of the city gets disrupted. Water logging in some roads persist for few hours whereas that in certain lowlands continues for a few days.

The main reason for water logging in the city are:

1. Flat topography of the area;
2. Clayey nature of the subsoil in most of the area, which prevent water percolation;
3. Lack of adequate slope of the drains and subsidence of the drains;
4. If the rain occurs during high tide time intruding tidal waters prevent the exit of storm water to the main canals;
5. Decreased carrying capacity of the drains due to the heavy silt deposition, discharge of solid waste in the canals and growth of vegetation;
6. Reduction of canal width due to encroachment;
7. Inadequate vent way of the existing bridges and culverts;
8. Low plinth levels of buildings;
9. Missing links in the existing network;
10. Obstruction due to the utility lines such as water mains, power and communication network cables etc crossing the canals and drains;
11. Lack of awareness among the people in maintaining public drains and canals;
12. Tendency of converting canals and water bodies to provide roads, etc.
13. Meandering of the primary canals which slow down the flow;
14. Irregular and inadequate maintenance of drains/canals;
15. Inadequacy of existing cross drainage facilities;
16. Lack of co-ordination among agencies/departments;

9.8.3 Sewerage System

9.8.3.1 Current Scenario

The sewerage system in the Corporation of Kochi is maintained by the Kerala water Authority. The scheme was commissioned in 1970. A comprehensive Sewerage Project for Kochi Corporation was envisaged dividing the Corporation area into four different zones and dividing each zone into different blocks. The scheme as envisaged to cover the entire 94.88 sq.km could not be implemented fully.

9.8.3.2 Coverage

The existing sewerage system covers only 5% of the Kochi Corporation area. An area of 2.5 Sq. Km. in the heart of the city ie. General Hospital area and 1.50 Sq. Km in Gandhi Nagar areas are covered by the existing sewerage system.

9.8.3.3 Sewage Treatment Plant

The Sewage Treatment Plant located at Elamkulam is having a capacity of 4.50 MLD. The plant works in the activated sludge process of Treatment. The plant was commissioned in 1955. The maintenance of the Sewage Treatment Plant at Elamkulam is done by KWA, and the plant is functioning reasonably well.

9.8.3.4 Present Situation & issues

In the absence of a sewerage system, the Kochi City Region depends on on-plot disposal of toilet waste and open surface drain disposal of sullage. High water table, low permeability of soil, and the high density of population have adverse impact on the functioning of on-plot system. Over flow of effluent to drains is common. During summer the BOD in certain open drains in Kochi is alarmingly high. In Kochi, the back waters get polluted receiving this discharge, Periyar is the victim of similar discharge from Aluva and other areas adjacent to this river. This major drinking water source is under threat from various sources of pollution where the contribution of municipal waste water is not negligible.

On-plot disposal systems like Septic tanks and twin pits are affordable options, provided the area is not water logged, soil is permeable and the density of population is less. Such situation is not available in majority of western coastal parts of the Kochi City Region. Many parts of this area get flooded during monsoon, causing not only damage to property but also health hazards due to overflow of sullage mixed with rainwater. During summer the drains will mostly be stagnant with sullage and sewage, making them ideal for mosquito breeding. Besides severe mosquito menace, there is occurrence of water /excreta related diseases like typhoid, gastroenteritis, diarrhea, amoebic dysentery etc.

The major issues emerging out in the above situation are:

- The ground contamination from on-plot systems. The contamination leads to health issues in dense urban pockets in West Kochi.
- The contamination in open drains, canals, back waters and rivers caused by the combined flow of sullage and storm water. Combined drains are often difficult to maintain in a situation as in flat terrain areas of Kochi City Region

Inadequate and improper sewage disposal is a perennial, but mostly neglected problem. Its effects are far reaching and often manifest through epidemics and bad health resulting out of contamination of water, pathogens, mosquito etc. The urban poor are the mostly affected as the provisions for excreta disposal are pits, overhung latrines, overflowing common septic tanks or no system.

9.8.4 Solid Waste Management

Kochi City Region covers corporation of Cochin, two Municipalities and fourteen Panchayats and altogether constitute an area of 366.91sq.km. This area produces about 670 tons of solid waste per day. Out of this, contribution of Kochi Corporation alone is nearly 300t. The generation of solid waste varies from 0.30 kg to 0.58 kg per head per day in the Kochi City Region. The region does not have a scientific management system for solid waste. Some isolated small-scale efforts have been made. Otherwise the solid waste is dumped illegally on road side or in vacant plots and estuarine fringes. This unscientific practice leads to air and water borne diseases.

The density is around 400 kg/m3. The waste is rich in organic content – about 48% and has C/N ratio of 17. Calorific value is low-about 1300kcal/kg. This makes composting a viable option and incineration expensive. Only about 50% is collected and transported from urban areas, while urbanized panchayats have not taken it as an issue needing their attention. The service is inadequate and poor in urban areas in spite of spending about 40% of revenue to meet the O&M expenditure.

Adequate supply of safe drinking water is the prime requirement for human survival. Quality of infrastructure attracts industries and tourists. With its picturesque country side and very comfortable climate, Kochi is an emerging tourist destination. But poor quality of environment can offset all the advantages generated by better infra structure, if we fail to protect the visible and aesthetic aspects of the region.

Health and environmental aspects are not well integrated in the present solid waste management systems and the impact is evident in the urban areas.

The deficiencies leading to this situation are:

- Storage &segregation at source is generally absent
- Communal Storage facilities are inadequate, inappropriate
- Open throwing of waste is common
- Bio-medical waste gets mixed with general waste
- Community involved primary collection is not popular
- Transfer stations are open ,ground level,
- Transport vehicles are inadequate, inappropriate
- Recovery and recycling are not considered as a part of SWM
- Long term, secured disposal sites are not available
- Lack of Community involvement
- Lack of effective Management
- Low Priority, financial constraints

The present pathetic conditions can be, understood from the photographs taken from various places of Kochi. At present the situation is being improved due to the partial commissioning of the Brahmapuram solid waste management plant.

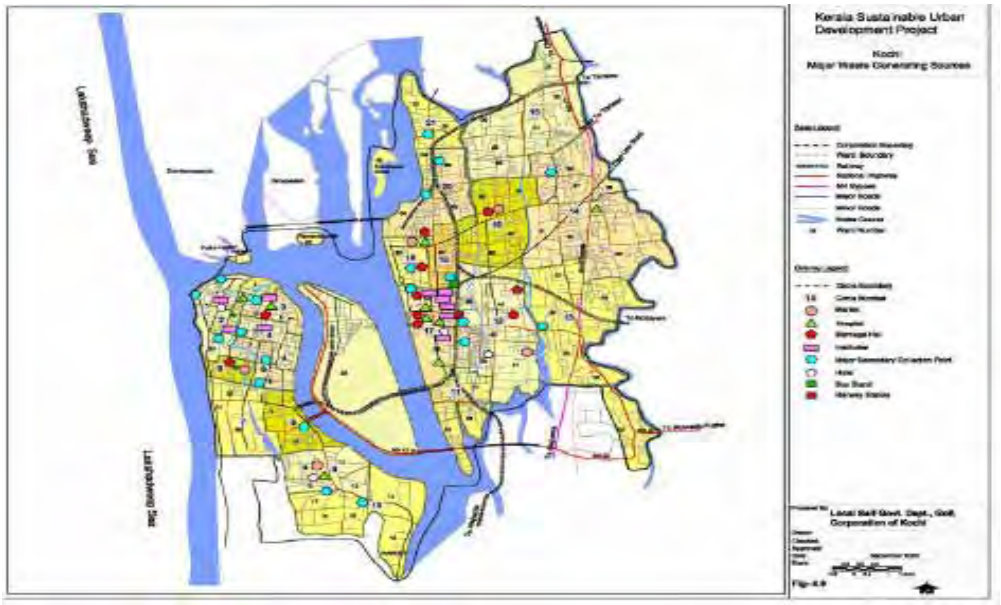
A. Solid Waste Management System in Kochi Corporation.

Health Department (HD) of the Corporation is responsible for sanitation facilities, solid waste management and other public health functions. A Corporation Health Officer (CHO), a medical doctor by qualification, heads the HD. The collection, transportation, disposal of MSW is the responsibility of the Health Department while the Engineering Department assists them in planning, formulation of programs and in procurement of vehicles, equipment and developing the landfill site. The Project Engineer is responsible for engineering components of SWM and vehicle procurement and maintenance.

Kochi MC presently has a network of community collection points, a significant number of which are open points. The generators, either through door step waste collection system or through bring system deposit the waste in secondary collection points or throw waste into open spaces / drains / water bodies. Subsequently, the waste from collection points is collected by manual / mechanical loading into fleet of vehicles and finally disposed.

For the purpose of solid waste management, the entire municipal corporation is divided into 21 circles. Each circle comprises of 1 to 5 wards and is managed by a Health Inspector Grade 2 who is assisted by Junior Health Inspectors. Deployment of vehicles for transportation is managed by the Vehicle Section (Circle 22) headed by a senior HI. This section is also responsible for direct collection of waste from hotels and hospitals in Eastern Zone of the city. The location of major waste generating sources in Kochi is indicated in the map 9.8.1 below.

Map No 9.8.1.- Major Waste Generating Sources



B. Solid Waste Management in the peripheral areas of Kochi City Region:

Similar or still poorer situation exists in the Municipalties and Panchayats of the Kochi City REgion. For the peripheral areas of the Kochi City Region, the problem is similar but to a lesser magnitude. Methods of vermi composting and biogas generation are practiced in the outlying areas where household land extent is comparatively more. The waste generated from the Panchayats and Municipal areas are also considered for treatment at the Brahmapuram treatment plant.

In the two Municipal areas and the Thrikkakkara Panchayat, the District headquarters, door to door collection is done from the central area of the local body. The O & M cost is being recovered from the beneficiaries. Thripunithura has 4 units of collection mechanism- 3 from households and one from market/hotel. A dumping yard / land fill site is available. But they are also interested in participating in the proposal for waste processing at Brahmapuram.

The present data on waste generation are given in Table 9.8.2

Table 9.8.2: Present data on solid waste generation

Sl. No.	**Type of Waste**	**Quantity in MT/day**	**% of Total**
1	Household domestic	330	55
2	Hotels/Eateries	36	6
3	Markets/Slaughter houses	30	5
4	Shops & Commercial Establishments	90	15
5	Building construction waste	30	5
6	Garden trimmings/plantain/tree cuttings	24	4
7	Institutional waste	30	5
8	Industrial waste (non-hazardous)	18	3
9	Hospital/clinics	12	2
Total waste generated/day		**600**	**100**
Waste collected/day		240	
Collection efficiency		40%	

The collection frequency, which is grossly inadequate, is shown in Table 9.8.3

Table 9.8.3 : Collection Frequency

Category	Once a day	Once in 2 days	Once in 3 days	Once in 7 days	Uncertain
Bio - degradable	40%	25%	15%	10%	10%
Non Bio - degradable	40%	15%	15%	10%	20%

Kochi has the rare distinction of being the hub of industrial activities in the state. Due to the contribution of industries and transport Kochi has become hot spot for environmental pollution. The scarce supply of fresh water has been contaminated by urban and industrial discharges. The Common Hazardous Waste Disposal facility coming up at Kochi will receive all the hazardous waste generated in the state. In short Kochi will be turning in to a dump yard of human as well as industrial wastes. The impact of all these will be felt on the natural resources of the region. It becomes the onus of the local authorities and the resident communities to take proactive measures to curtail and contain activities that are detrimental to the environment and which reduce the sustainability of the region. The present capacity of treatment plant commissioned at Brahmapuram for the Kochi Corporation is not sufficient to handle even the total wastes in corporation area.

Key issues related to solid waste in Kochi City Region are:-

a. Poor level of waste collection
b. No segregation at source
c. No planned recycle/reuse
d. Poor frequency of waste collection
e. Inefficient collection and disposal at temporary transfer locations
f. Obsolete waste handing and transportation system
g. Inadequate street cleaning arrangement
h. Water logging due to choking of drains with waste
i. Mosquito menace due to stagnation of water in drains
j. Filling environment not congenial to a tourists destination
k. Misery to the poor who are the worst affected due to poor waste management
l. No shared vision for solid waste management

9.8.5 Power/Energy

In any development exercise energy is the main input without which all efforts of development will be futile.

Different forms of energy input in the planning area are

1. Bio-mass
2. Petroleum products
3. Electricity
4. Non conventional energy sources like solar, wind, wave, etc.

9.8.5.1 Bio-mass

Fuels available from natural wastes such as wood, dry leaf, coconut husk, shells, cow-dung etc. are examples of bio-mass energy sources. In Ernakulam district bio-mass energy consumption is 41% of total consumption. Bio-mass energy sources are used for industrial purposes also. Following table shows the category wise use of bio-mass energy in Ernakulam district.

Table 9.8.4 : Bio-mass energy-Ernakulam District-2007

Category	**Percentage**
Cooking	56.60%
Industrial	20.30%
Commercial	23.10%
Total	**100**

Source: Report of Perspective Planning Division, Kochi

9.8.5.2 Petroleum Products

The main petroleum products are diesel, Kerosene, naphtha, aviation fuel, furnace oil, LPG etc. World oil and gas reserves are estimated at just 45 years and 65 years respectively with the present rate of extraction. Coal is likely to last a little over 200 years.

Sustainable development is defined as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Development is essential to satisfy human needs and improve the quality of human life. At the same time, development must be based on the efficient and environmentally responsible use of all of society's scarce resources - natural, human and economic.

Petroleum products are used for different purposes in Ernakulam district, as detailed in the table below.

Table 9.8.5 : Petroleum usage-Ernakulam Disrict.

Category	Percentage
Cooking	5.20%
Lighting	1.50%
Transport	30%
Industrial	61.20%
Commercial	1.80%
Others	0.30%

Source: Report of Perspective Planning Division, Kochi

9.8.5.3 Electricity

Various Sources of electricity production are,

a. Hydel power projects
b. Thermal power plant
c. Nuclear project
d. Non-conventional sources such as solar, wind, wave etc.

At city level a standard of 2kW per house hold which include domestic, industrial, commercial and other requirements is adopted. Total power required is 1.1 million kW. One 11kV substation for 15,000 populations is recommended.

In the master plan prepared by KSEB, for Kochi and suburbs known as “Electricity DE Frank”, consumption for the year 2009 is evaluated based on various factors. This load forecast is used to work out a consistent target network.

To meet the load demand the construction of the following substations were proposed.

i. 110 kV substation at Kaloor
ii. 110 kV substation at Kadavanthra
iii. 110 kV GIS substation at Fortkochi
iv. 66 kV GIS substation at Marine Drive
v. 110 kV substation at Katari Bash
vi. Enhance capacity of existing Kaloor and Kadavanthra substation to 50 MVA
vii. 110 kV substation with 2x25 MVA transformers in Cochin Port Trust area
viii. 110 kV substation at Vallarpadam
ix. EHT substation with adequate capacity at Puthuvype.

Kayamkulam thermal power plant with an installed capacity of 420 MWS is owned and operated by NTPC.

The capacity of Brahmapuram Diesel Power Plant is 100 MW with five generators of 20MW each. It is only partially operated. It is envisaged to generate 630.7 million lakhs units of electricity when the plant is operated in full swing.

Other non-conventional sources of electricity generation include wave energy, wind energy, solar energy and energy generated from solid waste etc.

Major share of electricity production is bestowed with the state government. The present day production is not sufficient for meeting the present and future demand. More projects and programs shall be formulated for meeting the demand.

9.8.6 SOCIAL FACILITIES

9.8.6.1 Adequacy of facilities

The evaluation of the adequacy and deficits in the spatial and quantitative distribution of social amenities has to be part of an integrated development plan for the society. The following seven important categories of social functions are considered in this connection.

1. Educational Institutions
2. Health facilities
3. Cultural and Religious Institution
4. Government Administrative centers
5. Cremation Grounds
6. Solid waste Management centers
7. Public open spaces

In order to decide the adequacy of facilities available now, the present facilities are to be compared with standards. A major problem confronted here is the difficulty in arriving at the appropriate standards. Various institutions world over have evolved standards for all these facilities. But they vary considerably depending up on the socio-cultural base of each society. They are influenced by many local factors including topography and climate. Based on a comparative study of standards adopted by other urban areas of the country and that suggested in UDPFI, standards suitable for Kochi, for a foreseeable future is evolved. The evaluations of each of the facilities that follow are based on these standards.

9.8.6.2 Educational Institutions

The fact that Kerala stands for most among the states in India in respect of literacy speaks for itself the importance given to the development of educational facilities in the state. The system of state education on modern lines was started as early as in 1818 in the erstwhile Kochi state and by the year 1910 there were 5 high schools and a number of primary and lower secondary schools in and around Cochin Town. The no. of schools & colleges in the Kochi City Region are given in Table 9.8.6. The table also shows the population covered by on L.P, U.P and high school respectively. All the constituent areas of the Kochi City Region have primary, secondary & high school facilities. Kochi city is well developed in terms of education facilities with a range of preprimary to secondary education, technical educational institutions and professional colleges run by Govt., private & semi Govt. agencies. However certain institutions lack facilities such as playgrounds, libraries etc. & also basic amenities like drinking water and proper toilet facilities.

Table 9.8.6: Educational Facilities.

Sl.No.	Areas	L.P(L.P+U.P+H.S)	U.P(U.P+H.S)	H.S.S+H.S	Colleges	Others	Population per L.P	Population per U.P	Population per H.S+H.S.S	Population Existing
1	Kochi Corpn.	219	146	114	7	18	2,720	4,079	5,224	5,95,575
2	Thripunithura	26	18	12	2	3	2,303	3,327	4,990	59,884
3	Kalamassery	15	11	10	4	8	4,208	5,738	6,312	63,116
4	Chellanam	7	4	3	0	1	5,173	9,052	12,069	36,209
5	Cheranallur	9	5	2	0	0	2,924	5,263	13,158	26,316
6	Elamkunnappuzha	19	9	3	0	0	2,661	5,618	16,854	50,563
7	Eloor	11	10	5	0	1	3,234	3,557	7,115	35,573
8	Kadmakudy	5	3	2	0	0	3,165	5,275	7,912	15,824
9	Kumbalam	15	8	4	2	1	1,837	3,444	6,887	27,549
10	Kumbalangy	10	4	2	0	0	2,666	6,665	13,330	26,661
11	Maradu	9	5	3	0	0	4,557	8,202	13,671	41,012
12	Mulavukadu	10	4	2	0	0	2,284	5,711	11,421	22,842
13	Njarakkal	10	5	3	0	1	2,417	4,833	8,055	24,166
14	Thiruvankulam	8	2	2	0	1	2,715	10,859	10,859	21,717
15	Thrikkakkara	20	13	11	3	3	3,299	5,076	5,999	65,984
16	Vadavukodu	15	11	9	-	-	1,781	2,428	2,968	26,710
17	Varapuzha	8	4	3	0	0	3,061	6,131	8,175	24,524

In Chellanam, Maradu & Kalamassery the population served by one L.P School is, more than 3,500, which is not sufficient. All other constituent areas of Kochi City Region area satisfy the recommended standard for L.P Schools. In Thiruvankulam & Chellanam the population served by one U.P School is more than 9000. In Thiruvankulam, Chellanam, Kalamassery, Elamkunnappuzha, Kumbalangy, Maradu & Varapuzha the number of UP Schools are sufficient as per the standard adopted. There is sufficient number of High Schools except at Elamkunnappuzha. Generally it can be concluded that the no. of educational institutions both for school education & higher level are sufficient at present. But, to meet the requirement of Kochi City Region in 2026, facilities will have to be provided during the plan period to cater to the need of additional population. Also more emphasis should be given to increase the basic facilities of many of the schools in Kochi City Region.

There are 18 colleges in Kochi City Region, including one University. For the present population, there is no numerical shortage. But for the population of 2026, one more university is suggested, as Kochi will have to cater to surrounding areas as well, for university level education.

Table 9.8.7: Educational Facilities – Preprimary to Secondary

Sl. No:	Name of local body	Existing Scenario		Requirement as per UDPFI in the Year 2026		Requirement as per structure plan in the year 2026	
		No. of Schools	Area (Ha)	No. of Schools	Area (Ha)	No. of School	Area (Ha)
1	Corporation of Cochin	219	151.36	277	277.4	247	329
2	Thripunithura-(M)	26	19.02	36	36.8	33	44
3	Kalamassery –(m)	16	12.75	81	80.9	72	96
4	Chellanam-(P)	8	5.46	16	13.7	16	21
5	Cheranalloore-(P)	9	5.46	14	11.7	13	17
6	Elamkunnapuzha-(P)	19	10.52	31	32.4	27	36
7	Eloor (P)	12	9.51	23	25.5	21	28
8	Kadamakudy (P)	5	3.84	7	6.4	6	8
9	Kumbalam (P)	15	9.31	18	15.7	17	23
10	Kumbalangy (P)	10	5.67	13	11.3	12	16
11	Maradu (P)	9	6.07	32	32.8	28	37
12	Mulavukadu (P)	10	5.26	11	9.3	10	13

13	Njarakkal (P)	10	6.07	12	9.7	11	15
14	Thiruvankulam	8	4.45	21	23.5	18	24
15	Thrikkakkara	20	13.76	93	90.6	84	112
16	Vadavukodu	15	14.18	34	34.8	29	39
17	Varapuzha	8	4.65	11	9.3	10	13
		419 Nos.	287.34 Ha	730 Nos.	721.80 Ha	654 Nos.	871 Ha

Table 9.8.8: Higher Education.

	Existing		**As Per UDPFI**		**As Per Structure plan**	
	No	**Area (Ha)**	**No**	**Area (Ha)**	**No**	**Area (Ha)**
General college	15	68.8	16	64	13	78
University	1		1	70	2	200
Total	16 Nos	68.80 Ha	17	134 (Ha)	15	278

9.8.6.3 Health Facilities

With high humidity, air and water contamination air and water borne diseases are more common. Disease statistics available from health care institutions are only partial and cannot establish the trend which is needed to set health care goals.

- The industrial suburbs are reported to be the hotspots of environmental pollution.
- Kochi is listed as one of the cities unsafe to tourists with regard to water borne diseases.
- Typhoid, leptospirosis and cholera are reported at times.
- High ambient humidity and poor maintenance of schools make children a sensitive group to diseases caused by poor indoor air quality.

Adequate supply of safe drinking water is the prime requirement for human survival. Also quality of infrastructure attracts industries and tourists. Due to contribution of industries and transport Kochi has become hotspot for environmental pollution. Contamination of fresh water by urban and industrial discharges and lack of waste disposal facilities may lead to serious health problem in Kochi City Region in coming future.

Health facilities include medical institutions such as hospitals, dispensaries, nursing homes, maternity and child welfare centres etc. and veterinary hospitals.

Table attached shows the distribution of medical facilities in the constituent areas of the Kochi City Region. In Chellanam, Elamkunnappuzha, Mulavukadu and Thiruvankulam, in-patient hospital facility is not available which is considered as a necessity for areas with 20000 populations or above.

This analysis reveals glaring deficiencies in health institutions in the Kochi City Region for ensuring social and physical health of the community.

Table 9.8.9 :Existing Health Facilities

Sl. No	Constituent Areas	Hospitals			Total	PHC/CHC	Dispensary			Total	No. of Beds		
		Allopp.	Ayur	Homeo			Allop.	Ayur.	Homeo		Allop.	Ayur	Homeo
1	Cochin Corparation	87	7	3	97	22/10	137	67	91	295	33,400	700	150
2	Thripunithura	9	2	1	12	1/0	18	13	19	50	3,400	200	50
3	Kalamassery	2	1	0	3	1/0	5	8	12	25	400	100	0
4	Chellanam	0	0	0	0	2/0	4	3	3	10	0	0	0
5	Cheranellur	1	0	0	1	2/0	8	4	8	20	1000	0	0
6	Elamkunnapuzha	0	0	0	0	2/0	1	4	3	8	0	0	0
7	Kadamakudy	0	1	0	1	1/0	1	0	1	2	0	100	0
8	Kumbalam	2	0	0	2	4/0	1	2	2	5	400	0	0
9	Kumbalangy	1	0	0	1	01/1	2	3	4	9	400	0	0
10	Maradu	3	0	0	3	4/0	3	2	3	8	1,400	0	0
11	Mulavukkadu	0	0	0	0	2/0	3	3	6	12	0	0	0
12	Njarakkal	1	0	0	1	1/0	4	2	6	12	200	0	0
13	Thiruvankulam	0	0	0	0	1/0	8	4	5	17	0	0	0
14	Kloor	4	0	0	4	1/0	4	4	6	14	1,600	0	0
15	Thrikkakara	5	1	0	6	2/0	26	13	20	59	1,800	0	0
16	Vadavukodu	1	1	-	2	03/1	9	3	4	16	200	100	0
17	Varapuzha	1	0	0	1	3/0	4	4	5	13	200	0	0
Total					134	53/12				575	44,400	1,200	200

Total no of beds = 44,400 +1,200 + 200 = 45,800

9.8.6.4 Cultural and Religious Institutions

The category of Cultural Institutions includes stadia, auditorium, public libraries, reading room, clubs, gymnasiums, community halls etc. Considering the size of the city, the availability and distribution of these facilities are inadequate in Kochi. This does not become a glaring deficit owing to the fact that a large number of religious institutions in the city function not only as places of religious ceremonies but also as focal points of social and cultural activities.

Since the need for cultural and religious institutions is basically generated at the community level, provision for the same can be made with planning the residential areas. Land should be allotted in all major housing projects for such purpose and for the institutions built by public participation or by voluntary social organization. However at the city level, the needs for stadia and other cultural institutions have to be provided by the local body or development authority. The need for a large stadium for sports and games and a public gymnasium with swimming pools is keenly felt in Kochi city.

9.8.6.5 Government Administrative Centres

The district headquarters is situated in Thrikkakkara Panchayat. Various administrative offices are functioning under one roof in this civil station complex. Most of the district level offices are located in this civil station. Originally the district head quarters was in the CBD area of Kochi Corporation and this shifting has relieved the CBD from congestion due to these administrative activities. This Civil Station complex is having scope for future expansion.

Other main administrative centres are at mini civil station Thrippunithura, R.D.O. Office Fort Kochi, Taluk office in CBD., judicial Complexes in the CBD etc.

The High court is also situated near the CBD area. One Revenue Tower building owned by Housing Board is under construction near Ernakulam boat jetty area.

9.8.6.6 Public Open Spaces.

Open spaces form an essential part of urban land use which provide for social and environmental needs in addition to passive & active recreational demands. In planning, open spaces mainly constitute playgrounds, parks, and other recreational areas. The total open space within the city boundaries also consists of permanent agricultural land and land under water. Number of parks, play grounds, stadia etc. which come under open spaces and grounds in the Kochi City Region area is shown in table 13.5. The total recreational space available is 176.12 ha that is 0.48% of total area. This area is much less when compared to the minimum standard of 0.05 hectare/1,000 populations. It is seen that the open spaces within the city are not evenly distributed. A significant feature of the land use of Cochin is the high proposition of

agricultural land within urban boundaries. With the increase in population and scarcity of land, these areas form potential land for conversion in to urban uses. During the past decades, large areas of land have thus been reclaimed from backwaters, low lying paddy fields and marshy lands to supplement the developed land. But at the same time, it is very important that a part of agricultural land may be retained within the plan area to cater to the open space requirement of future population.

The water bodies of the Kochi City Region substantially are added to the actual open space available in the city. A significant feature of the water sheets is its distribution in the city in the form of continuous stretches of canals and backwaters with water frontage. The canal system and water frontage offers potentialities for integrating them with the open space system.

Even though the water bodies are classified under agricultural use as per TCPO norms, their extensive scope for recreation makes it part of the permanent open space in the city. Considering the area of the water bodies and its importance as open space & recreational facility, measures should be taken for keeping this resource for public use, by waterfront development and evolving a green strip system along the canals. Also measures should be taken to protect this water bodies from pollution from various sources.

The vacant spaces owned by state and currently not put to rational use can be utilized as green cooling areas of the city. It is strongly suggested that the roads going to come up in the urban areas ought to have professionally planned green shoulders. Even on existing roads, wherever space constraints do not imperiously stand in the way, such green strips can be incorporated. Important measures should be taken to increase public open spaces, parks & playgrounds as the present area which comes under open spaces is far below the standards. The available area as open space in the Kochi City Region is to be increased up to 247 Ha by demarcating different areas. These areas included is also much less than the standards, which is 10 m² per person as per UDPFI guidelines and the per capita green areas & open spaces are a direct indicator of the environmental quality.

Table 9.8.10: Open Space & Recreational Facilities, Community Halls - Existing scenario.

Sl. No.	**Name of Constituent area.**	**Play ground**	**Park**	**Stadium**	**Recreation**	**Community Hall**
1	Corporation of cochin	5	6	8	31	41
2	Thripunithura.	1	0	0	21	13
3	Kalamassery	0	1	1	8	7
4	Chellanam	0	0	0	10	2

5	Cheranelloor	0	0	0	15	2
6	Elamkunnapuzha	1	0	0	2	8
7	Eloor	0	0	1	7	2
8	Kadamakudy	0	0	0	5	1
9	Kumbalam.	0	0	0	1	7
10	Kumbalangy	0	1	0	3	3
11	Maradu	0	1	0	10	3
12	Mulavukadu	1	0	0	4	1
13	Njarakkal	1	0	0	2	4
14	Thiruvankulam	1	0	0	13	4
15	Thrikkakkara	3	0	0	14	5
16	Vadavukodu-Puthenkurisu	1	-	2	37	-
17	Varapuzha	0	0	1	20	1
Total		**14**	**9**	**13**	**203**	**104**

9.9 ENVIRONMENT

9.9.1 Change in land use and its impact on environment

The land, and the way it is managed, affects the entire environment. It is important to monitor changes in land use, especially facing rapid urbanization and urban sprawl. There is a frequent need to reconcile the requirements for additional land for important uses such as housing, industry, commerce and retailing with a desire to protect the countryside and agriculture.

Table 9.9.1 : Land use pattern of Cochin Corporation

Land use	1967		1988		2005	
	Area (sq km)	%	Area (sq km)	%	Area (sq km)	%
Water bodies	24.96	26.31	22.07	22.78	20.88	22.01
Low lying areas/paddy fields	9.81	10.34	8.20	8.47	3.01	3.17
Mixed vegetation	41.25	43.47	12.77	13.18	7.14	7.52
Parks/open grounds	0.36	0.38	0.36	0.37	0.65	0.69
Built up area	18.20	19.18	53.20	54.91	63.20	66.61
Beach	0.30	0.32	0.28	0.29	0	0
Total	94.88	100	94.88	100	94.88	100

The water bodies include mainly the area covered by the Cochin backwaters and interlinking canals, during high tide. Massive reduction of the area is noticed during the period. The area is reduced from 24.96 sq km to 20.88 sq km.

The low lying areas/paddy fields are the areas which are seasonally flooded and include the pokkali paddy fields of earlier days, mud flats and other marshy areas. Mud flats of about 0.90 sq km were present along the banks of Chilavannor Lake, extended to the Karanamcode thode, during 1967 and 1988 .Now all these areas are built-up lands . One time paddy cultivation along with aquaculture in remaining period was prevalent in these areas. Prominent patches of mangroves were also present towards the banks. Now the paddy cultivation is stopped and aquaculture is being done in some areas. Considerable loss of the low lying areas (9.81 sq km to 3.01 sq km) occurred during 1967 to 2005, and the Mangroves present on the banks were almost completely destroyed.

The green areas with in the high land areas consists of cultivated crops like Coconut, Cocoa, Nut-meg etc and other open areas with conspicuous tree cover, which are mainly owned by Government departments like Shipyard, Navy, Railway etc and private holdings. These areas are classified as mixed vegetation. There was a considerable loss of mixed vegetation and the area is now reduced to 7.14 ha from the 41.25 ha of 1967. Almost all these areas were converted into built-up area.

The land used for residential, commercial and industrial uses are classified in the group of built-up area. The area is increased to 63.20 sq km from 18.20 sq km.

9.9. 2. Environmentally Sensitive areas of Kochi city region

The environmentally sensitive areas of Kochi city region include the following components:-

a. Backwaters
b. Mangrove areas
c. Low lands and paddy fields
d. Canal system

Spatial planning based on assessment of existing environmental profiles as well as potential assimilative capacity could help environmentally acceptable development and resolve the potential conflicts. Planning of activities based on assessment of local or regional environmental impacts could be a useful approach for introducing the concept of spatial planning.

9.9.2.1 Back waters

Back waters in Kochi play a vital role in the socio-economic and environmental aspects of the area. The major ecological and environmental functions of these back waters are:

- Controlling floods in the coastal plain,
- Preventing salinity intrusion,
- Efficiently filtering the floodwaters so that finer particles rich in organic matter get deposited in the inshore region and setting ideally preferred habitat for shrimps and allied flora and fauna,
- Recharging the ground water and providing perennial source of water along the coast,
- Providing habitat for unique assemblage of organisms evolved endemically as well as for those migrating from marine and fresh water, and
- Acting as breeding, feeding and nursery ground for a variety of species including commercially important shrimps and fishes.

The earliest human intervention within the whole Vembanad backwater system was in the form of dredging for a major natural harbor at Kochi and subsequent reclamation for locating the port facilities. In order to house the berths and wharves and other facilities, an entirely new island-the Wellington Island-was created 1920-36 with a land area of 6.5sq.km. Large-scale reclamation for residential and commercial uses and for extension of the park was carried out during recent years in Marine Drive area.

At present, the Kochi Backwater is subjected to serious anthropogenic interventions due to development activities in the mainland like urbanization (mainly by dumping of urban wastes and effluents into the system through the canals), industrialization (both in the Corporation and adjoining areas), activities in the port, shipyard etc.

Kochi generates around 255 mld of urban sewage that directly enters the backwater. Total dissolved solid content of water here may be as high as 53750 mg/1 during summer which may come down to 16 mg/1 during the rainy season. The sewage without proper treatment contains organic and inorganic pollutants along with pathogenic micro-organisms responsible for various water-borne diseases like typhoid, cholera and dysentery. The existing sewage treatment plant serves only 1% of the population of the city. Though septic tank-sewage system is generally used in most of the areas, a number of latrines constructed in the banks of the estuary cause direct faecal contamination. Water borne diseases, gastroenteritis in particular, is widely spread along the coast that becomes infectious agents. The effect of domestic sewage on the ecology of the backwater is significant. Faecal coliform counts up to 1800/100 ml have been recorded in many previous studies.

Major industries on the banks of Periyar are located in the Udyogamandal area, outside the Corporation. It is estimated that nearly 260 million litres of trade effluents reach the estuary daily from the industrial belt of Kochi. The pathalam bund, a temporary structure, is constructed each year on the Eloor branch of Periyar river since 1981, to prevent salinity ingress from Vembanad backwater and contamination of the water supply from the industrial units located

there. But the enormous quantities of wastewater (about 8000$m^{3)}$ discharged daily into this branch are not flushed out, leading to stagnation and building up of pollution to toxic levels. The water is found to be highly acidic, loaded with ammonia, fluorides and phosphates, resulting in massive fish kills.

The area of the water bodies has been getting reduced at an alarming rate by the bunding, reclamation and encroachment for the purpose of agriculture, aquaculture, harbour development etc. The depth of the backwaters is also getting considerably reduced due to siltation. As a result of all these activities, the system now is unable to perform most of the normal ecological functions.

As the proportion of population that directly and indirectly depend on the backwaters is very huge, one cannot afford to ignore the degradation of these ecosystems. Moreover, a large number of other stake holders have already intensified their economic activities, which use estuarine resources and environmental assets mostly by excluding traditional communities and by producing externalities to other players. This choice of development path obviously is a wrong one and, if allowed to continue, will ultimately ruin estuaries and the people who depend on these ecosystems for subsistence. In order to introduce appropriate corrections to this development path, a scientific study on the nature of biodiversity degradation and the impacts such crisis make on the livelihood securities of local communities and on the ecosystem services, is essential.

9.9.2.2 Mangrove areas

Mangrove forests are characterized by trees, shrubs and vines that thrive in brackish water (water of varying salinity) and are often found around river estuaries (where freshwater from rivers meet the oceans). Mangroves support an ecosystem that is comprised of plants, animals and micro-organisms which are adapted to life in the dynamic environment of the tropical inter-tidal zone. These ecosystems are important environmentally and economically; mangrove trees can reach a height of up to 45m, producing dense, closed canopy forests that can support up to 80 different plant species; mangrove soils and waters support an abundance of permanent residents in addition to several migratory and juvenile organisms, including economically important species of fish. About 80% of global fish catches are directly or indirectly dependant on mangroves, as mangroves provides nursery areas for many pelagic species. Mangroves are salt-tolerant plants of tropical and subtropical inter-tidal regions of the world. The specific regions where these plants occur are termed as ‘mangrove ecosystem’. Besides mangroves, the ecosystem also harbours other plant and animal species. These are highly productive but extremely sensitive and fragile. Mangroves help in the production of detritus, organic matter, recycling of nutrients, and thus enrich the coastal waters and support benthos population of sea.

Mangalavanam behind the High Court premises is one of the major Mangrove areas in the city. In addition to this, Mangrove patches are identified along the banks of Kochi Backwaters and lowland areas in the city. Mangalavanam is important due to many factors. The area is well protected from natural predators and not many similar communal roosting sites are available to birds in a crowded city like Ernakulam. This site is crucial to the city dwellers also, since it serves as greenery in the middle of the urban expanse. Apart from the much needed breeding and roosting site for birds, the rare and threatened mangrove vegetation is preserved here. Mangalavanam qualifies the criteria for declaration as an International IBA (Important Bird Area) of the Birdlife International due to the presence of more than 1,500 Little cormorant and the presence of more than 1,000 Black-crowned Night Heron, which form one per cent of the total global population. Trans-continental migratory species were absent in the area. Migratory ducks and waders were conspicuous by their absence. The absence of migratory birds is mainly due to the non-availability of suitable habitats in the area. Shallow water spread is very low in extent, which is preferred by the migratory waders.

Remarkably good patches of mangroves are present at Eda-Kochi area near Kannancode temple, in the banks of pashnithode and in the small islands in the pokkali fields near Kannamkode and Chakkanattukari. These pokkali lands are under private ownership, and remain uncultivated for more than a decade. Part of the area is already filled. Most of Mangrove species present in Mangalavanam area is also seen here. Patches of Mangroves are observed in the marshy stretches along the Thevara canal near Konthuruthy area and Karanakodam thode near Chelavannur Lake. At Kochukadavanthra, opposite to Yetch Club, thick Mangrove vegetation is seen along with Coconut palm in about two acres of private land and are being cut down in one portion.

Kochi backwaters have many pockets of mangrove habitats often obscured by the dense fringes of coconut plantations. These habitats have the same species diversity, which one finds in any other mangrove ecosystem. Mangroves are also present along the banks of Kochi backwater at Willingdon Island and Vypin.

9.9.2.3 Lowlands and Paddy Fields

Most of the lowlands are getting filled up and converted for residential and commercial purposes. Unscientific reclamation in many places has caused flooding and remains as breeding grounds for many insects. Low lying marshy areas are still available extensively in Eda-Kochi, Perumbadappu, Vennala and Thevara areas.

In the earlier days, most of the lowlands were under paddy cultivation. A random survey conducted during the present study revealed that paddy cultivation in the pokkali land was

stopped in the early nineties. A major part is now remaining as uncultivated and aquaculture is being practiced in some areas like Kannamkode and Chakkanattukari. Mangrove patches are found extended to these areas. Paddy cultivation in the corporation area is now restricted to less than 2 hectares at Chakkanattukari near Eda-Kochi.

9.9.2.4 Canal System

The inter-woven canal network of Kochi and suburbs, which once brought fame for easy transportation at low cost, has, of late became a sordid nightmare to the dwellers of the area as the same canals are receptacles of filth, silt, dirt, waste and many other assorted debris. There are several slums and other houses situated on either side of the canals. All wastes, including night soil from these slums, nearby houses and waste materials from shops, market, etc. are directly deposited in the canals.

A preliminary reconnaissance survey was conducted to assess the general conditions of all canals revealed that the canals in the Fort Cochin zone are the most polluted. Similar situations but with varying degree were noticed in other zones also. The conditions in the mainland area were found to be comparatively better.

Flooding has been one of major problems faced by Kochi. The geography of Kochi contributes greatly to this problem. Kochi is crisscrossed by a network of canals that were earlier used for navigation purposes. Today, these canals have been turned into waste water drains. The canals show high level of pollution, clogging due to weeds, disposal of plastics and other wastes, encroachment and filling of many reaches, finally resulting in floods during the monsoon season. This also is the main reason for one of the most nagging problem in the city-the mosquito menace.

The major problems noticed with respect to the canal system in Kochi Corporation are:

- Indiscriminate disposal of solid wastes (including plastics, bottles etc) into the canals at many locations and the direct discharge of untreated waste water from the houses (including slums) located on the banks pose the biggest threat to community health and smooth functioning of the canal system.

- Absence of protection walls leads to siltation and weed growth in most of the canals.

- Encroachment is seen in many places with huts/houses built after filling the banks of canals, resulting in reduction in width.

- In many places culverts and bridges across the canals have been constructed with reduced waterway causing flow obstruction.

- The invert levels at the exit of many of the lateral drains that discharge water into the canal are lower than the low tide level in the backwaters. Such submerged outlets prevent positive flow and even water back-up during high tides and increase siltation.

- Many railway crossings with culverts and bridges have inadequate vent-ways causing water back-up and preventing navigation (country boats).

- The blockage in the canals makes the water become stagnant resulting in foul smell and mosquito breeding in many areas in the city. At times, water tops the banks and inundates the nearby areas.

- The result of water quality analysis revealed high degree of pollution in the canals. The analysed parameters such as turbidity, pH, conductivity etc. exceed the permissible limits for any class. The high levels of faecal coliform may infiltrate into the nearby wells and seriously affect the health of the residents in these areas.

9.9.3 Pollution Studies

Along with urbanization, come the problems of pollution with respect to air, water, and noise qualities. The term pollution refers primarily to the fouling of air, water, and land by wastes. Introduction of massive quantities of waste matter at any point in the bio system may "overload" it, disrupting the natural recycling mechanisms.

9.9.3.1 Air Pollution

Air pollution studies of Kochi City had earlier been made mainly by the National Environmental Engineering Research Institute (NEERI), and the ambient air quality data on an annual basis has been published. Their studies revealed that annual average Suspended Particulate Matter (SPM) concentration exceeds the standards prescribed by Central Pollution Control Board .

One of the major causes of air pollution in Kochi is the emission from the vehicles. Some of the specific factors are listed below:

- High emission from two and three wheelers
- Adulteration of fuel
- Violation of emission norms

- Lack of vehicle maintenance
- Large number of old vehicles in use
- Erratic traffic behavior
- Older engine technologies
- Inadequate road space preventing better mobility of traffic
- Poor maintenance of roads
- Inadequate traffic management
- Increase in population of vehicles

There are not many polluting industries within the Corporation limits. The air pollution caused by some of the industries in Eloor and Vadavukode-Puthencruz, contributed to the increase in the air pollution.

9.9.3.2 Noise pollution

The effects of community noise on human beings range from hearing damage to the feeling of annoyance. In noise abatement policy, the effects of noise on different human activities should be taken into consideration. This means that different guideline values are to be suggested. Countries are expected to develop their own national and local noise standards in accordance with the amount of noise hazards they are prepared to accept.

Although it is clear that, for some levels of noise exposure, harmful effects are obvious, in other cases, objectivity in the demonstration of health effects is difficult. The effects depend not only on the sound pressure levels but also on the “type” or “quality” of the noise, on the number of noise events, and on the “image” of noise.

Noise control is always more effective and less costly if it is designed at a very early stage of development. It is more expensive to apply noise abatement measures after the noise problem has been realized. Local and national governments have guidelines for noise control in various types of non-industrial environments, but not directly for sound pressure levels at the point of noise emission.

Noise, being a physical pollutant is not easily recognized because the sensitivity of the human ear gets automatically adjusted to the ambient noise level of sound, thereby contributing to slow damage to the human auditory system. The indirect or secondary effects of noise are often hard to quantify and satisfactory assessment models are lacking. Often, large-scale epidemiological or social surveys would be required to assess those which involve increased risks of accidents by noise-exposed individuals, reduction in productivity at work and related effects.

The Ministry of Environment and Forests, Govt. of India, has published the Noise Pollution (Regulation and Control) Rules, 2000, in February 2000. There are four categories and the allowable noise limits in decibels [dB (A)] are specified separately for day and night time for each category, as shown in Table 9.9.2

Table 9.9.2: Noise level limits in different areas (Prescribed by MoEF)

Zone/Area	**Limits in dB (A)**	
	Day (06.00 to 22.00 hrs)	**Night (06.00 to 22.00 hrs)**
Industrial	75	70
Commercial	65	55
Residential	55	45
Silence	50	40

The major sources of noise pollution in Kochi are:

1. Construction activities
2. Laying of Highways
3. Rail traffic
4. Vehicular traffic on roads
5. Use of loud speakers for political, religious and advertisement purposes
6. Use of crackers during festival and other occasions

Ambient Noise level studies in Kochi City were carried out by the Atmospheric Science Division of Centre for Earth Science Studies (Sampath et al, 2004). Measurements were taken at 26 locations from the Corporation area and outside, out of which two were silent zones, one in a residential zone and the rest in commercial zones.

Table 9.9.3: Ambient Noise level studies in Kochi city

Zone/Area	**Limits in dB(A)**
Commercial	78.5
Residential	40.7
Silence	76.55

Source: Study by CESS.

The measured noise levels in the commercial and even in the silence zones were much higher than the prescribed limits, while it was lower in the sole residential zone. Special events like festivals, election campaigns etc., generate noise levels that are prohibitively above the permissible limit.

Traffic has been cited as the major contributing factor to noise pollution in Kochi, especially with ever increasing number of vehicles. Delineation of silence zones and commercial zones will help to monitor and implement noise regulations to minimize the menace of noise pollution.

9.9.3.3 Water Pollution

Water pollution is one of the major environmental problems in many of the urban areas in Kerala. Water pollution may be from point sources or non-point sources. Point sources of pollution occur when harmful substances are discharged directly into a body of water. A non-point source delivers pollutants indirectly through environmental changes. Pollution arising from non-point sources accounts for a majority of the contaminants in streams and lakes.

Many pollutants including sewage and fertilizers contain nutrients such as nitrates and phosphates. In excess levels, nutrients over-stimulate the growth of aquatic plants and algae. Excessive growth of such organisms consequently clogs the waterways, use up dissolved oxygen as they decompose, and block light to deeper water. This, in turn, proves very harmful to aquatic organisms as it affects the respiration ability of fish and other invertebrates that reside in water. When this occurs, it kills aquatic organisms in large numbers, which leads to disruptions in the food chain. Pollution is also caused when silt and other suspended solids, such as soil, wash off from ploughed fields, construction and logging sites, urban areas, and eroded riverbanks, enter streams when it rains.

Water logging has been one of the major problems faced by Kochi. The geography of Kochi contributes greatly to this problem. The canals in Kochi show high levels of pollution, clogging due to weeds, disposal of plastics and other wastes, encroachment and filling of many portions of these networks, finally resulting in floods during the monsoon season.

9.9.3.4 Ground water Pollution

Ground water is a natural resource, which, if harnessed efficiently, can help to solve the drinking water problem in the State to a great extent. However, over-exploitation may lead to the depletion of the aquifers and subsequent threat of saline intrusion. The quality of ground water is mainly influenced by natural processes like leaching of salt from the aquifer material, bacterial pollution and by man-made activities like discharge of untreated sewage and solid waste disposal contributing to its pollution. Water quality is also affected by iron, chloride and low pH contents.

The study on ground water chemistry of shallow aquifers in the coastal zones of Kochi. revealed that the coastal aquifers in this area experience severe degradation of water quality due to various anthropogenic activities.

Ground water present in the shallow aquifers of some of the stations was poor in quality and beyond potable limit as per the standard set by WHO and BIS. Based on Hill-Piper Trilinear diagram it is confirmed that some of the dug wells were characterized by high amount sodium and chloride (>200mg/1), indicating the influence of saline water intrusion. The presence of E.coli in all dug wells indicated potentially dangerous faecal contaminations, which require immediate attention. The groundwater collected from the six dug wells as part of the above mentioned study indicated that there is a mixing of fresh and saline water during the post monsoon period.

Owing to the high demand of groundwater to cater to the large population in the coastal areas of Kochi, mitigation of the deterioration in the quality of groundwater in shallow coastal aquifers was initiated through groundwater recharge . High population pressure, intense human activities, inappropriate resource use, unscientific solid and liquid waste disposal and absence of proper management practices led to the deterioration. The industrial effluent discharges and bacteriological contamination by sewage percolation pose a major threat to groundwater quality in the Kochi area. The quality of groundwater is comparatively good in the eastern parts of the Corporation and eastern Panchayats of the Kochi city region.

9.10 HERITAGE AND TOURISM

9.10.1 Heritage and Tourism - an over view

Heritage and tourism are the synonymous terms and tourism is the after effect of the heritage in a country or city. Heritage is the rich remains of the past history and culture where as tourism enjoys the glory and setbacks of the past.

Kochi has always been special for its Heritage and Pluralistic culture through its history, which is primarily based on trade oriented shipping activity. Being an island city, Kochi has unique environmental features and a cultural heritage, which is intervened with the environment. The city's ever-growing demand and potential for growth opportunities constantly interact and depend on its valuable natural and cultural heritage. Salubrious climate, serene beaches, emerald back waters, lusty hill stations, plantations and paddy fields, ayurvedic health resorts, enchanting art forms, magical festivals, historical and cultural monuments all offer a unique experience.

Tourism has emerged as a potential industry and an instrument of economic development and employment generation. More and more emphasis is being placed by the national Government upon tourism planning for increasing the GNP. This includes a set of strategies for attracting tourist arrivals with a view to increasing foreign exchange earnings and generation of employment. Tourism spots and destination areas of high congregation of people have to be provided with tourist infrastructure depending on the location, attractiveness and tourist demand. The most desired tourism products should consist of

- an environment of peace and stability
- an assurance of safety and security
- a system to provide required services
- accessible tourist attractions.
- international air seat capacity
- good transportation system
- hotels and restaurants
- entertainment and recreational avenue
- shopping and communication facilities
- tourist amenities
- amenities like drinking water, toilets, snack bars etc at tourist sites.

Kerala is the ' gateway to south India ' and Kochi is the gateway to Kerala by its location. The high growth of cruise tourism indicates that Kochi has highest potential for growth. In addition to heritage sites and natural features it has a variety in culture and arts. As far as Kochi city region is considered, depending upon the purpose of travel ,tourism can be categorized in to Recreational/Leisure tourism, Cultural/Heritage tourism ,Religious/Pilgrim tourism and Health tourism.

Table 9.10.1: Tourist Arrivals in Kochi

Year	**Foreign**	**Domestic**
1991	54474	614390
1992	59645	634424
1993	60761	655280
1994	78425	622762
1995	56590	568641
1996	61588	588196
1997	62371	627980
1998	56199	802060

9.10.2 Major heritage and tourist zones

9.10.2.1 Fort Kochi, Mattancherry, Fort Vypeen Integrated Heritage Zone:

The Fort Kochi, Mattancherry and Fort Vypeen placed right at the sea mouth has experienced immense trade related activities and has developed a rich pluralistic culture and tradition unique to this heritage zone. This is reflected in the heritage of this area, which exhibits great monuments, structures and settlements of outstanding heritage value. Fort Kochi and Mattancherry can proudly claim the uniqueness in the entire heritage zone which is not seen anywhere in the region, and this makes it a major attraction for the tourists as well.

9.10.2.2 Willingdon Island Heritage Zone:

During the period of British Rule in early 20th century, dredging of port and formation of Willingdon Island was executed under the design and direction of Sir Robert Bristow. Subsequently Kochi emerged as the major port in the entire region. Willingdon Island grew as the port and seat of power for British rule. The entire port town was designed by Sir Robert Bristow and left an outstanding heritage settlement built during the British period. The heritage structures including that of the Port Trust, Palatial Bungalows, Commercial godowns and public places of the Southern Naval Command area become part of this heritage zone.

9.10.2.3 Ernakulam Central Area Heritage Zone:

In the 19th century during the British Rule, Kochi rulers shifted to Ernakulum. As a result, market and associated settlements flourished. The Ernakulam Heritage Zone is in fact the heart of today's city of Kochi. Most work places, administrative and institutional centers and market places are located here. Moreover the city's widely used parks and public open spaces are located defining the landward edge of this zone, which connects the city to its natural heritage of backwaters. Many cultural and religious institutions with some of the oldest temples, churches, mosques and synagogues also become part of this heritage zone. Old commercial streets with buildings abutting roadsides are also seen in this area, especially in Broadway. Redevelopment of the area on conservative principles will increase the productivity.

9.10.2.4 Canal and Backwater Network Heritage Zone:

Canal network is part of our regional traditional heritage planning. The entire development in the low lying coastal areas has been dependent on canal systems integrated by backwaters, lagoons and estuary and was instrumental for trade and commercial activities. The canal network in Kochi is very much intervened with rivers and backwaters. Most of the

traditional areas and heritage zones are connected by such canal system. The issues related to the canal network are basically the major issues of Kochi city itself.

9.10.2.5 Mangalavanam Natural Heritage Zone:

Mangalavanam Mangrove area comprises of a shallow tidal lake in the centre with its edges covered with thick vegetation. It gained importance because of the mangrove vegetation and also due to the congregation of commonly breeding birds. It is considered as a “green lung space” of Ernakulum city.

9.10.2.6 Kochi Estuary Natural Heritage Zone:

Kochi estuary is an important natural ecological feature in the entire Vembanad lake region. A major transactional point for most of the marine species and habitat for many of them, Kochi estuary becomes a major zone of great environmental significance.

9.10.2.7 Tripunitura Heritage Zone:

The main area covers the major heritage features like the Fort area, Hill palace, Temples, Palaces, Malikas, Churches, Christian settlements, Tamil settlement and Konkani settlement. The temple forms the focal point of the city.Tripunitura is the seat of the former ruling family of Kochi. Many palaces in and around the city memorises the rich tradition and history of the place.

9.10.2.8 Bolghatti Island :

It was the seat of the British Resident whose palatial Bungalow or Residence (Bolghatti Palace) still exists at its southern extremity and is used as a tourist Bungalow. There is a Golf link adjoining the Palace.

9.10.2.9 Edappally:

It was once the capital of a principality called Elangallur Swaroopam. It has today an old palace built in the Kerala style of architecture. Edappally is an important centre of Christian Pilgrimage. The St. George church draws thousands of pilgrims throughout the year. History records that a session of the synod of Diamper (1599) was held here. It is also the birthplace of the poet Changampuzha Krishna Pillai. His tomb is situated here. Here there is Museum of Kerala History.

9.10.2.10 Thrikkakara:

Thrikkakara is well known throughout Kerala as the seat of an ancient Vishnu temple. This is the only temple in Kerala where Vamana is the presiding deity. This temple has a large number of lithic records some of them of great historical importance. In days gone by the prominent princes and chieftains of Kerala used to assemble at Thrikkakara to celebrate the Onam festival. This celebration under the Kulasekharas as festival of religious fereor and national solidarity has made Thrikkakara a place of unique cultural importance to the people of Kerala even today. There is an underground passage called Mudikuzhi at a place 3 km of Thrikkakara temple. It is believed that the Pandavas made their escape through this passage when the arakkilam was set on fire. Veega land the amusement park situated at Pallikkara is at distance of 12km from this place.

9.10.2.11 Varapuzha:

Varappuzha 12 km from Parur was the seat of the Carmelite order of the Roman Catholic Church. The Carmelite Church here dates from 1673. In 1682 the Carmelites founded here a seminary for both Syrian and Latin Clerics.

9.10.3 Problems and Potentials

9.10.3.1 Problems :

General :

- Even though the number of tourists is showing an increasing trend the percentage share of foreign tourist arrivals is decreasing.
- The period of stay of tourist in Kochi is decreasing as the other locations in the neighbouring districts are getting popularised.
- Lack of information and publicity about that tourist centres other than that of Fort Kochi and Mattancherry.

Transportation :

- Transportation linkages connecting various tourist spots are weak.
- Transportation facility from terminals to tourist centres is insufficient.
- Absence of signages, facilitation centres and complaint points at terminals tourist centres and travel circuit.
- Inadequate off-street parking spaces at tourists centres.
- Disuse of inland water ways.

Inherent attractions:

- Under utilisation of the extensive networks of rivers lakes and canals.
- Destruction of heritage elements
- Lack of performing arts centres recreational activities such as golf course etc.

Tourist facilities:

- Absence of moderate hotels with good services near tourist centres.
- Absence of eating places serving hygienic local food.
- Lack of wayside amenity centres and comfort stations along travel circuits.
- Absence of enough conducted tours connecting various tourist sites.
- Lack of qualified guides.
- Lacks of boats and coaches

Image :

- The image of backwater city is not properly maintained
- Uncontrolled water front development without considering the landscape and environment
- Lack of marketing facilities for the products from souvenir industries and traditional cottage industries.
- Health care sector - especially Ayurveda - is not properly exploited
- Non availability of good quality potable water at tourist centres
- Poor drainage and sanitation system
- Inefficient solid waste management system
- Growing trend of slums

9.10.3.2 Potentials :

- Presence of backwater
- Presence of historical monuments
- Availability of road/rail/water transportation facilities.
- *Presence of international airport*
- Highly literate inhabitants
- Personal security and safety.

9.11 DISASTER RISKS IN KOCHI CITY

9.11.1 Introduction

Kochi City is located on the south-west coast of India. The area under the Municipal Corporation of Kochi is 94.88sq.km. The city is located in the low lying area and the backwaters divide Kochi into two zones viz, the east zone (Ernakulam) and west zone (Fort Kochi & Mattanchery). An artificial island named Wellington Island was developed between the two zones, starting 1933, now almost with an area measuring 250 ha. It is a part of the Corporation Area. This island accommodates the Southern Naval Command, Kochi Harbour, Airport and Harbour Railway Terminus. The eastern and western zones of the city are connected by bridges passing through Wellington Island. The total population of the City is 5, 95,575 (the census 2001). The average population density in the corporation area is high at 5,945P/sq.km.

The average wind speed is high during March, April and May and the wind speed reach up to 10.9km/hr.

9.11.2 Disaster Risks in Kochi Area

Among the, thirty odd disasters falling within major categories like (1) Geological (2) Water and climate related (3) Chemical and industrial and nuclear related (4) biological and (5) Manmade have been identified by the State Disaster Management Committee the following may be applicable to Kochi area.

1) **Geological:** Earthquakes
2) **Water and climate related :** Flood, Local severe storm, Coastal erosion, Thunder and lightning, Tsunami, Cyclone, Storm surge.
3) **Chemical and Industrial related:** Industrial pollution due to effluents / waste discharge, accidents, gas leak etc., Oil spills, Pesticide contamination of air water land etc.
4) **Biological:** Food poisoning, Mosquito vector diseases
5) **Accident related disasters:** Urban fires, building collapse, festival related disasters, electrical, road accidents, rail accidents, boat capsizing, liquor tragedy, drug abuse.

Vulnerability

The vulnerability of the area for each type of hazard is determined by the geology, location, climatic factors etc. As pointed out earlier, generally there is a close link between the

monsoon and the occurrence of hazards as most of the Water and climate related calamities occur during rainy season. The response and consequent impact of a natural hazard is determined by the terrain condition and geology.

9.11.2.1 *Geological Disasters*

Among geological disasters, like all other places in the state, Kochi is also considered as prone to earthquakes or to the effect of earth quakes happening in other parts of the country or in the offshore regions. It must be remembered that seismic hazard of a region depends on the site conditions and proximity to the epicentre. Amplification of seismic energy due to landfills and liquefaction of subsurface rocks are some major site effects of concern.

Geology of Kochi area clearly indicates that Kochi Corporation area is located on a thick sedimentary pile consisting of alternating layers of clay and sand. This thick pile of sediments is resting on a westerly slopping basement. The upper sediments have a phreatic water table while the lower horizon has a piezometric surface just below the ground surface. Further, most part of Kochi area forms part of the extensive Vembanad wetland system with its ample water saturated substratum. Any near source seismic event can disturb these sediments. The presence of alternating layers of clay and sands is a favourable condition for liquefaction.

Moderate earthquakes of M 6 are a possibility both on land as well as offshore sources.(Area falling within zone III of seismic zonation map) So far moderate earthquakes (M5) experienced in Kerala at distant sources(Erattupetta, Wadakkancherry sequence) from Kochi has not caused any damaging effects on these sedimentary piles. But in case such a seismic event takes place at or adjacent to this sedimentary pile (onshore or offshore) the effect is unpredictable. Such a calamity can seriously affect the foundation of multi-storeyed structures to cause its collapse.

9.11.2.2 *Water & Climate Related Disasters*

Kochi Corporation area falls within the coastal wetland zone and hence it is only natural that water related disasters are encountered very often. Major back water of Vembanad Lake with the connected net work of canals makes the terrain highly fragile. Pressure of population with demand for land resulted in indiscriminate reclamation, which permanently and irretrievably damaged the ecosystem. The major hydrological functions of the wetlands like repository or source of water, floodwater storage and consequent flood control, ground water discharge or distribution, groundwater recharge, regulation of water quality, silt trapping and control of saline

water intrusion are hampered by the development activities there by adding to the vulnerability of the terrain to water and climate related disasters.

9.11.2.2.1 Flood

Kochi corporation area being a flat land adjacent to the coast is subjected to floods during monsoon affecting normal life and disrupting traffic in the city. Added to this, water logging is one of the major problems in Kochi. It is natural that stagnation occurs in wetland ecosystems, which is an area having water saturation. Subsurface geological data reveals the presence of a persistent clay layer below the quaternary sediments along with layers of grey organic clay within the upper quaternary sequence. These clay layers prevent percolation thereby allowing water to stagnate on surface. Practically wherever such clay layers are present almost the entire rainwater accumulating has to be drained through surface channels only. Any disruption of flow through these channels may lead to flash floods in the city area. Since Kochi city is a low relief area, slope of drains are also minimal. With this type of topography normally the watersheds are also not well defined with clear exit channels The entire western half of the Kochi Corporation is covered by the Vembanad Lake and its intricate system of canals forming part of a typical wetland ecosystem. Unplanned urbanization has altered the ecosystem in the past so that it is unable to exert the required flood cushioning for the area which is one of its main functions.

History of such floods reveals that the worst affected areas in the Kochi city can be divided into two major sectors namely East and West sector. South Railway Station, North Town Hall, Kaloor, Palarivattom in the east sector and Thamaraparambu and Palluruthy in the west sector are subjected to severe flooding. The city is drained by a variety of natural drains– Edapalli thodu, Puncha thodu, Thevara-Perandur Canal, Mullasseri canal, Thevara-Chambakara canal, Vytilla-Karanakodam thodu and Changatam Pokku.

The canals in Kochi City are functioning as cesspools due to insufficient free flow. Solid waste including plastics generated in the urban life finds their way into these canal systems. The plastics are choking them and blocking even the minimal flow possible. Added to this, the inadequate drainage system in the City prompts hotels, houses, hospitals, dwellings, city refusals etc to let out their waste into these canals causing blockage of storm water drains. Slums along the canals further add waste dumping into the canals. Many culverts in canals were constructed without sufficient vent way to drain storm water during high intensity rains. Growth of aquatic weeds is another factor reducing free flow of canals. Thus the main causes standing in the way of optimum functioning of the canal system of Kochi area are: encroachment, silting up of channel, dumping of solid waste, tidal effect, aquatic weeds,

insufficient vent way in culverts, dis-functioning of storm drains, overloading of drains and canals, etc.

The flat nature of terrain along with its inherent wetland characteristics and a detailed examination of the present erosion / accretion status of Kerala coast by the CESS (Centre for Earth Science Studies) indicate that the coastal sites can be classified into low, medium and high erosion / accretion zones. The Coastal Climate is influenced by S-W and N-E monsoons. Strong S-W monsoon winds, with speed sometimes exceeding 60 km/hr blow over the coast during June to September. The waves are also highest during this period. The wave climate is governed by the south west monsoon when wave action can be strong with prevailing wave directions from north-west to south-west. Deep water (15m) wave observations in the past indicate the significant wave heights of 4m, 2m, and 1m at the water depths of 10m, 5m and 2m respectively, the predominant wave direction being west.[1] During the fair weather period of November-May the wave height is far below 1m. The wave energy is not uniformly distributed along the coast and shows a general reduction towards the North. Corresponding to the wave climate, the long shore currents are stronger during S-W monsoon with a general southerly wind. During the other seasons the directions are governed by local conditions. The tide is diurnal with a maximum range of 90 cm at Kochi. Maximum recorded high tide value is +0.44m and the maximum recorded low tide value is +0.158m with respect to Indian mean sea level.[2] The tidal range decreases or increases towards the south and north respectively. The coastal area adjoining the Kochi Corporation is categorized by scientists as medium accretion sites. However, unusual monsoonal conditions can disturb the situation. The presence of harbour further assures proper maintenance of this zone. Further, the Vembanad estuarine wetland acts as a buffer to protect this coast line. As such the vulnerability to coastal erosion for the area within Kochi city is lower.

Storm surges are slow flooding of coastal areas. This happens due to unusual wind patterns developing waves and forcing sea water to flood low lying coastal terrain. This is normally a localized phenomenon and not of major concern as a disaster threat for Kochi.

9.11.2.2.2 Thunder and lightning

An investigation conducted by CESS on field reports through out the state during 1986 - 2002 shows that on an average annually 71 people died and 112 people were injured in 188 incidents of lightning in Kerala. The information on loss on the infrastructure is not available. However the loss in the telecommunication sector alone is of the order of 1.92 crores in 2002.

At present a real time high resolution lightning map or isokeraunic map (Contour map of thunderstorm days) is not available to assess the status of vulnerability of Kochi area against other parts of the State. The BIS (Bureau of Indian Standards) provides a map of lightning distribution in India along with their standards for protection of buildings.

9.11.2.2.3 Tsunami

Tsunami is a very rare natural phenomenon in the Indian Ocean, as seismic risk zones which are Tsunamigenic are few in this part. The recent Indian Ocean tsunami which affected Kerala coast (December, 2004) is now established as the strongest in the world over the past 40 years. Taking into consideration the unpredictable nature of the earthquake activity within ocean basins which triggers tsunami waves the possibility of this natural phenomenon cannot be assessed and hence any vulnerability.

9.11.2.3 *Chemical, Industrial and Nuclear Related*

Industrial pollution due to effluents / waste discharge, accidents, gas leak etc., Oil spills, pesticide contamination of air water land etc. are common in almost all fast developing urban areas. The Kochi area with its fast developing industrial infrastructure is not any exception. The lack of proper facilities for waste disposal, waste treatment, sewage disposal, lack of alertness in treating industrial effluents before their ultimate disposal to the soil or nearby water bodies etc cause sever pollution of air water and land. Compared to other cities in the State the level of vulnerability of Kochi city is high due to it being a prime harbour city handling huge quantities of chemicals, oil and gas for consumption in the country.

Annexure 7

EXISTING LANDUSE (2007 updated in 2009)

Sl. No	Land use	Thrikkakara		Njarakkal		Elamkunnapuzha		Varappuzha		Eloor		Kadamakkudi		Cheranalloor		Mulavukadu		Maradu		Thiruvankulam		Thrippunithura		Kalamassery		Kochi		Kumbalam		Kumbalangi		Chellanam		Vadavukodu Puthenkurisu	
		1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17	
		Existing Ha	Existing % (Gross)	Existing Ha	Existing % (Gross)	Existing Ha	Existing % (Gross)	Existing Ha	Existing% (Gross)	Existing Ha	Existing % (Gross)	Existing Ha	Existing % (Gross)	Existing Ha	Existing % (Gross)	Existing Ha	Existing % (Gross)	Existing Ha	Existing % (Gross)	Existing Ha	Existing % (Gross)	Existing Ha	Existing % (Gross)	Existing Ha	Existing % (Gross)	Existing Ha	Existing % (Gross)	Existing Ha	Existing % (Gross)	Existing Ha	Existing % (Gross)	Existing Ha	Existing % (Gross)	Existing Ha	Existing % (Gross)
1	Residential	**1216**	**44.28**	**478**	**55.63**	**488.4**	**33.75**	**234.1**	**30.25**	**843.7**	**59.37**	**420.9**	**32.57**	**398**	**37.59**	**267**	**13.85**	**620**	**50.23**	**459**	**43.75**	**1026**	**54.88**	**1176**	**43.56**	**5040.9**	**53.13**	**837.1**	**40.27**	**364.8**	**23.13**	**525**	**29.83**	**1662**	**45.06**
2	Commercial	**10.06**	**0.37**	**0.68**	**0.08**	**4.84**	**0.33**	**6.25**	**0.81**	**9.8**	**0.69**	**0.53**	**0.04**	**5.35**	**0.51**	**6.65**	**0.35**	**45.6**	**3.69**	**3.74**	**0.36**	**22.2**	**1.19**	**26.87**	**1.00**	**211.64**	**2.23**	**4.77**	**0.23**	**1.69**	**0.11**	**2.61**	**0.15**	**3.76**	**0.10**
3	Public & Semi public	**162.2**	**5.91**	**14.5**	**1.69**	**23.07**	**1.59**	**26.86**	**3.47**	**82.43**	**5.80**	**10.05**	**0.78**	**23**	**2.17**	**18.2**	**0.95**	**48.3**	**3.91**	**44.28**	**4.22**	**77.7**	**4.16**	**405.6**	**15.02**	**444.8**	**4.69**	**56.39**	**2.71**	**13.01**	**0.82**	**21.7**	**1.23**	**66.29**	**1.80**
4	Industrial	**196**	**7.14**	**0.7**	**0.08**	**4.57**	**0.32**	**3.25**	**0.42**	**201.8**	**14.20**	**0.25**	**0.02**	**2.99**	**0.28**	**0.31**		**0.38**	**0.03**	**140.6**	**13.40**	**18.2**	**0.97**	**385.1**	**14.26**	**173.5**	**1.83**	**1.71**	**0.08**	**0.93**	**0.06**	**10.63**	**0.60**	**982.6**	**26.64**
5	Transportation	**117.8**	**4.29**	**24.6**	**2.86**	**53.24**	**3.68**	**36.29**	**4.69**	**47.29**	**3.33**	**19.96**	**1.54**	**34.6**	**3.27**	**13.4**	**0.70**	**76**	**6.16**	**67.69**	**6.45**	**72.5**	**3.88**	**195.6**	**7.24**	**553.58**	**5.83**	**46.01**	**2.21**	**22.96**	**1.46**	**23.24**	**1.32**	**81.62**	**2.21**
6	Park & Open spaces	**2.9**	**0.11**	**3.02**	**0.35**	**2.53**	**0.17**			**5.53**	**0.39**			**0.6**	**0.06**			**0.97**	**0.08**					**1.42**	**0.05**	**66.68**	**0.70**							**30.14**	**0.82**
7	Hazardous							**1.32**	**0.17**															**0.8**	**0.03**									**21.54**	**0.58**
8	Others (SEZ and Unclassified area)																									**397.3**	**4.19**								
9	Paddy/ Wet land	**709.4**	**25.83**	**188**	**21.87**	**348.2**	**24.06**	**303.5**	**39.21**	**148**	**10.41**	**510.1**	**39.48**	**404**	**38.12**	**464**	**24.10**	**235**	**19.02**	**261.7**	**24.95**	**508**	**27.17**	**430.4**	**15.94**	**441.02**	**4.65**	**281.3**	**13.53**	**301.2**	**19.10**	**999.2**	**56.78**	**284.8**	**7.72**
10	Dry Cultivation/ Agriculture	**236.5**	**8.61**				**0.00**	**0.91**	**0.12**	**5.54**	**0.39**			**30**	**2.83**					**11.68**	**1.11**			**44.28**	**1.64**	**10.22**	**0.11**			**7.22**	**0.46**			**407.7**	**11.05**
11	Water bodies	**95.19**	**3.47**	**150**	**17.44**	**241.2**	**16.66**	**161.6**	**20.87**	**76.96**	**5.42**	**330.3**	**25.56**	**161**	**15.17**	**1157**	**60.04**	**208**	**16.87**	**60.37**	**5.76**	**145**	**7.76**	**33.79**	**1.25**	**2148.3**	**22.64**	**851.7**	**40.97**	**865.2**	**54.86**	**177.6**	**10.09**	**148.3**	**4.02**
12	Port Land (Puthuvypeen)					**281.1**	**19.43**																												
	Total	**2746**	**100**	**860**	**100**	**1447**	**100**	**774**	**100**	**1421**	**100**	**1292**	**100**	**1059**	**100**	**1927**	**100**	**1235**	**100**	**1049**	**100**	**1869**	**100**	**2700**	**100**	**9488**	**100**	**2079**	**100**	**1577**	**100**	**1760**	**100**	**3689**	**100**

Annexure 10

Details of existing water supply schemes serving the Kochi City Region

Sl.No.	Name Scheme	Service Areas	Source	Date of commission	Population as per '91 census	Population benefited	Design Lpcd	Present supply	Level of satisfication with r.t Lpcd	Present Demand
1	EMWSS	Kochi Corporation	Periyar	1972	564589	643003	170	70	41	200
2	WBA WSS to GCDA	Kalamassery	Periyar	1995	53342	5400	240	140	58	240
3	UWSS to Thripoonithura	Thripoonithura	Periyar		51078	5700	140	70	50	140
4	EMWSS	Kadamakudy	Periyar	1972	14668	17380	70	30	43	100
5	WBA WSS to GCDA	Kumbalangy	Periyar	1995	24601	28403	120	15	13	140
6	WBA WSS to GCDA	Chellanam	Periyar	1972	32978	37507	120	15	13	150
7	EMWSS	Cheranallor	Periyar	1972	21407	24305	120	50	42	150
8	EMWSS	Mulavukadu	Periyar	1972	22322	25466	120	30	25	100
9	WBA WSS to GCDA	Trikkakkara	Periyar	1994	51166	52216	240	120	50	240
10	RWSS to Eloor	Eloor	Periyar	1994	29948	34443	40	40	100	120
11	RWSS to Varapuzha	Varapuzha	Periyar	1994	22514	22514	40	40	100	120
12	WSS to Puthencruz	Vadavukodu - Puthencruz	Muvattupuzha	1993	26144		75	75	100	120
13	WBA WSS to GCDA	Maradu - Kumbalam	Periyar	1993	59138	80700	140	40	100	140
14	WBA WSS to GCDA	Maradu - Kumbalam	Periyar	1993	59138	80700	140	40	100	140
15	ARWSS to Thiruvankulam	Thiruvankulam	Muvattupuzha	1988	18412	16000	40	25	63	70
16	WSS to Vypeen Areas	Njarackal - Elankunapuza	Periyar	1993	70856		100	40	40	120

Annexure 11

Details of existing treatment plant, OH & GL tank, pump capacity, pumping main and the intake source-serving the Kochi City Region

Sl. No.	Service Area	Name of Plant	Components processing etc.	Installed Capacity (with year of commission)	Source of intake	Capacity of pump	Pumping Main	Location of Tank with capacity OH&GL
1	Kochi Corporation, Kalamassery (M)	Aluva Plant located at Aluva	2 clarifiers,6 rapid sand gravity filters 2 Addl clarifiers 2 clarifiers one filtration plant (12 filters)	Ist 48 mld IInd 72 mld IIIrd 70 mld (1993)	Periyar well (5 No) Periyar (1) well	2x45 HP (Well pump) 3x300 Hp 2x335 Hp 5x270 Hp 2x215 Hp 1x215 Hp	300 mm C1 pipe 42” 42”	OH tank
2	Vadavukodu Puthencruz Industries at Ambalamugal, CRL, HOCL, BCBL, Milma, Thiruvankulam and Chottanikkara	Choondy Plant Industrial water supply	Aeration, flocculation rapid sand filtration chlorination aeration, sedimentation etc.	7.2 mld (1993) 32 mld	Muvattupuzha (Ramamagalam)	50 Hp	300 mm	OH tank (12.1 lakh ltrs)

Annexure 12: Details of Storage tanks in KMP area

Sl.No.	Location Name	Type	Capacity mld	Area Served
I	**Corporation**			
1	Thammanam	GL	130	Kochi Corporation & Tripoonithura Municipality, Maradu
2	Thammanam	GL	84.3	Kumbalam, Kumbalangi and portion of Chellanam
3	Perumanoor	GL	11	Mattanchery, Cochin Porttrust, Naval Base, Cochin
4	Perumannor	GL	18	Shipyard and Thevara
5	Pachalam	GL		Vypin, Mulavukad, Kadamakudy and Cheranellor
6	Karuvelipady	GL	50	Western Kochi and Cheranellor
7	North zone	OH	18	Not loaded due to non availability of sufficient water
8	East zone	OH	18	Not loaded due to non availability of sufficient water
9	South zone	OH	18	Not loaded due to non availability of sufficient water
10	Thevara	OH	4.5	Not loaded due to non availability of sufficient water
11	Thoppumpady	OH	18	Not loaded due to non availability of sufficient water
12	Koovapadam	OH	18	Not loaded due to non availability of sufficient water
II	**Municipality**			
1	Kalamassery	GL	29	Kalamassery (M)
		OH	18	
2	Tripoonithura	OH	25	Tripoonithura (M)
III	**Panchayat**			
1	Kumbalamgy	GL	29	Western Kochi and Chellanam
		GL	4.1	Not loaded due to non availability of sufficient water
2	Mulavukad	GL	1	Not loaded due to non availability of sufficient water
3	Trikkakara	OH	18	Trikkakara
4	Maradu	OH	14.7	Maradu
5	Kumbalam	OH	17.4	Kumbalam
6	Chellanam	GL	17.4	Chellanam