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Planning for TOD along Kochi Metro Corridor

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Abstract: ***According to the Development plan of Kochi City Region, the city of Kochi was envisioned as a global city. The current urban sprawl has put a considerable stress on the infrastructure of the city. Hence need for transit oriented development along the corridors connecting the adjacent city centers were emphasized in the CDP [1]. After the metro, which was established along the corridor, the opportunities for TOD have increased. The study was driven based on two research questions: 1. What is the existing growth pattern along the corridor? 2.How can transit oriented development be planned for an organic development? This study explores the potentials of stations along the corridor based on the node, place and market values. The station areas are then classified into different station area typology. The study is based on LAP for Transit framework by CEPT university and Assessing TOD: a list of indicators by National Institute of Urban Affairs. A set of strategies are proposed through the end of the study which is applicable for the entire corridor.***

Keywords: Transit Oriented Development, Station Area Planning, LUTI

1. Introduction

Ernakulam is the commercial capital of Kerala. Earlier, Kochi was used to refer to the region encompassing Mattancherry, Fort Kochi, Palluruthy and Thopumpady [2]. Today, Kochi comprises the mainland Ernakulam, old Kochi, Kadavanthara, the suburbs of Edapally and the exurbia of Kalamasery and Kakanad to the northeast; Thripunithura to the south east; and a group of islands closely scattered in the Vembanad Lake [2]. Urban growth trends indicate urban expansion towards north and north-east. The expansion towards east is due to the presence of IT sector and special economic zone in Kalamasery region. The expansion towards the north is due to the presence of the satellite towns of Aluva and Angamaly.

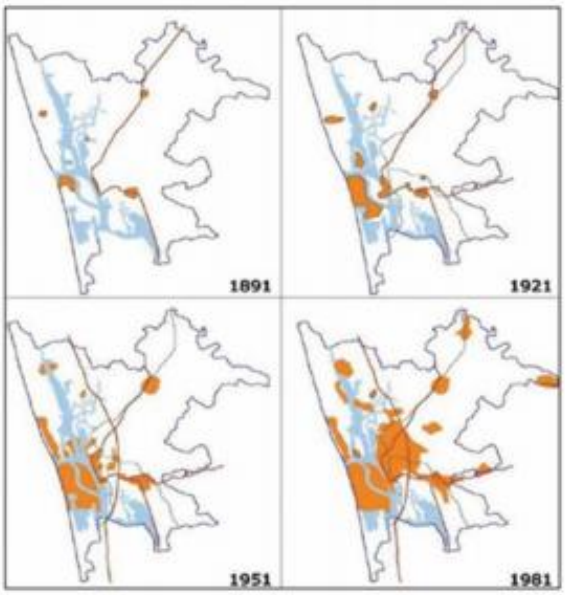


Figure 1: Map showing Sprawling urban area of Kochi
Source: Development plan for Kochi City Region 2031

Based on the extent of development and gradually changing urban character of Kochi and its surroundings, a development plan for Kochi City Region was proposed in 2010 by Department of Town and Country Planning Government of Kerala. The area delineated for the plan included Kochi Municipal Corporation, Thripunithura Municipality, Kalamassery Municipality and 14 panchayats; altogether encompassing of 369.72 sq. km area[1]. Ministry of Housing and Urban Affairs (MoHUA) predicts an average speed of 6 to 8 kmph by 2030, which is the speed of a morning walker if urban transport is not planned and developed properly [3].

To arrest the urban sprawl, the city is experiencing, transit oriented development (TOD) along the corridors connecting the other major centers have been proposed in the volume II of development plan of Kochi city Region. The plan emphasized the importance of MRTS along the corridor, and the opportunities TOD could introduce.

2. Need for TOD

The first metro system in the country with an integrated multimodal transport system. Kochi metro was constructed in four years with the fastest construction time. The section of 13.4 km from Aluva to Palarivattom was opened to passengers on 17 June 2017 followed by another 5km from Palarivattom to Maharaja ‘s college on 3rd October 2017. The third section of the metro from Maharaja ‘s college to Thykkoodam for a length of 5.65 km has been opened for traffic on September 3, 2019[3].

- Concentrating spatial and economic development in proximity to transit through TOD will help optimize public capital and recurring expenditure on infrastructure development and augmentation. In parallel it will also help achieve social and environmental benefits on expensive transit infrastructure projects.[4]
- To achieving compact city development, TOD is an opportunity to guide low carbon development around and towards transit, re-design public realm and increase public transit ridership. This will enable India to align with international climate change adaptation targets, to contain global warming to the 1.5 degree Celsius [4].

- Adopting TOD promises direct reduction in Green House Gas emissions. With high population growth rates in Indian cities, planning for TOD is crucial to integrate city-level development plans with city-level mobility and infrastructure plans and investments [4].

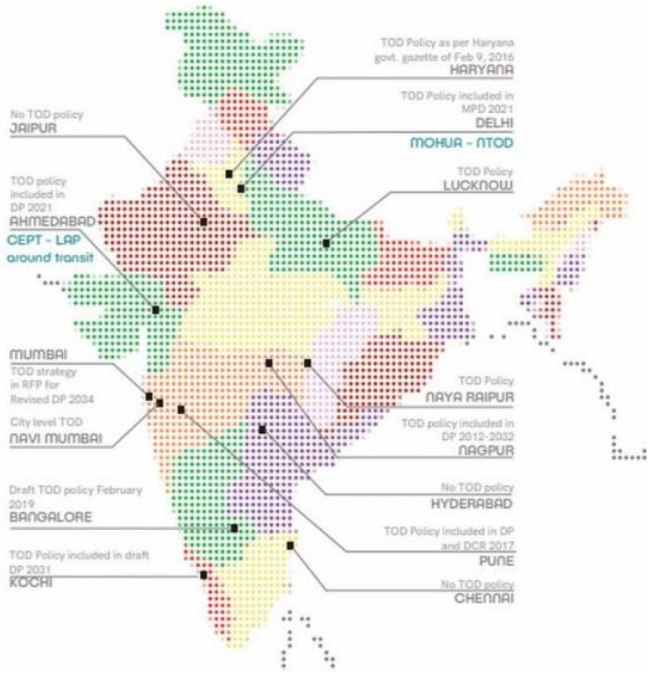


Figure 2 : TOD in various cities across India
Source: LAP for Transit

3. Aim and Objectives

Aim: To identify various typologies of Station Areas along the Metro Corridor of Kochi

Objectives:

- To study the concept of TOD, its indicators and criteria for various scales of TOD development.
- To delineate the influence zone of Kochi Metro Rail corridor.
- To examine the existing TOD-ness along the corridor using various criteria's.
- To classify the stations along the corridor into various typologies.
- To propose strategies and development controls for each station typology.

4. Scope and Limitations

Scope:

- The study focusses on Identification of TOD potential areas along the transit corridor of Kochi Metro Rail.
- It includes land use analysis and identification of land for future development along the selected stations of the corridor.

Limitations

- The study is based on secondary data.
- There is limited secondary data available on land use and built density.
- The study comprises only of the completed phase of Metro Rail.
- The cost benefit analysis would not be conducted.

5. Literature Review

According to Peter Calthrope, in The new America Metropolis, a transit-oriented development (TOD) is a mixed-use community within and average 2000-foot walking distance of a transit stop and core commercial area. A TOD is relevant as it promotes accessibility, increase job centers, create affordable housing, maximize usage of public transit system etc [5]. There are different variants of TOD which shows different relationship with transit and adjacent land uses. Transit Adjacent Development, Development oriented Transit, Transit Joint Development and Transit Enhanced Development [6]. The different levels of TOD implementation include Regional level, Corridor Level, Station Level and Parcel Level. [7]

Classification of stations based on 3V approach:

1) Node value: describes the importance of a station in the public transit network based on its passenger traffic volume, intermodality, and centrality within the network [8].
2) Place Value: describes the urban quality of a place and its attractiveness in terms of amenities, schools, and health care; the type of urban development; local accessibility to daily needs by walking and cycling; the quality of the urban fabric around the station, in particular its pedestrian accessibility, the small sizing of urban blocks, and the fine mesh of connected streets that create vibrant neighborhoods; and the mixed pattern of land use [8].
3) Market Potential Value: refers to the unrealized market value of station areas[8]

Table 1 explains criteria's and components for evaluation of station based TOD. The table is prepared as the summary of understanding from LAP for Transit framework by CEPT university and Assessing TOD: a list of indicators by National Institute of Urban Affairs and https://niua.org/tod/todfisc/book.php?book=1&section=4.

Table 1: Summary of Components and Criteria

SL.NO	COMPONENTS	DEFINITION / PURPOSE	BENIFFITS	INCDICATORS				APPROACHES
				CRITERIA	INDICATED VALUE			
					P.V	N.V	M.V	
1	Urban Density	The mass or number per unit area, focusing on utilising the available land resource efficiently.	Active Public spaces	Landuse density (FAR/ FSI)				Retrofit / Infill
			Sense of community	Population Density				Redevelopment
			Improve accessibility for all	Dwelling Unit densities				Greenfield Development
			Ensure balance between population and capacity of existing or planned infrastructure facilities	Job Density				
			Promote Active living					
2	Urban Diversity	Diversity in TOD is defined as the degree to which different land-uses are located within close proximity of each other, reducing the need to travel outside of the immediate area for common trip purposes	Reduce dependence on private vehicles	Streets having mixed use character				Reserved percentage of land for vending activities
			Ensure financial sustainability	Street vending opportunities				20% of mandatory housing units for EWS
			Provide social equity	Multiple options in housing				
3	Urban Design	Urban Design forms a framework for arrangement of built and open spaces, transport systems, services and amenities.	connect spaces	Public access through large blocks				Streetscaping
			create appealing, vibrant ar	Percentage of developed and undeveloped land within the boundary				NMT connectivity
			create a sense of place	Urban form height to width proportion				
			Allow flexibility of functions through time	Percentage of intersections				
			Encouraging pedestrian activity	Per capita green space within existing development				
4	Housing	To reduce the overall cost of living, cities should work to provide housing in areas connected with transit.	Residents living near transit are 5 to 6 times more likely to commute by transit than other residents in their region. (TCRP report 128 TOD)	Location : Proximity to transit				Urban villages
			EPA estimates TOD housing generated 45% fewer Vehicle Miles Travelled than traditional housing in US.	Typology : options available for mixed incomes				Inclusionary zoning for Affordable Housing
5	Mobility			Intermodal integration				Strategies for minimizing parking requirement
				Availabity of NMT				Vehicle restraint measures
				Quality of Public Mode of Transportation				Intelligent transportation system technologies
				Parking Management				

List of similar studies are shown below.

SL NO	REFERENCE	CASE STUDY	PLANNING CRITERIA	METHODOLOGY	INFERENCE
1	Densification of Metro Corridors - A case of Lucknow Author- Shubha Kant and Gaurav Singh	Lucknow	Identification of priority stretch Study on: Built Unbuilt Building Use Building Height Analysis of deficiency at neighbourhood level	Qualitative analysis of criterias	Potential site identification and strategy level recommendations
2	Re-Assessing TOD index in Jakarta Metropolitan region Author- Herika Muhamad Taki, Mohamed Mahmoud H. Maatouk	Jakarta	Landuse Population Social Infrastructure Building coverage ratio Floor area ration	Empirical analysis and calculation of TOD index	Identification of corridors showing difference from actual TOD
3	Transit Oriented Development (TOD) on the commuter Train Network R A Ramadhan, B Pigawati	Kedungsepur, Indonesia	Division of station typology based on population density Analysed based on Density, Diversity, Design	Quantitative descriptive method	Identification of 8 potential stations
4	Measuring and evaluating the impacts of TOD measure - Searching for evidence of TOD characteristics in Azambuja train line Author - Ana Galeloa, Anabela Ribeirob, Luis M. Martinezc	Azambuja Train Line, Lisbon	Travel Behaviour Built environment Economic Social diversity	explore the linkage between variables	Preliminary characterization of the line and station areas and analysis of relations between indicators
5	Developing context sensitive planning criteria for transit oriented development : A fuzzy - droup discussion approach Author- P. Phani Kumara, Manoranjan Paridaa and Ch. Ravi Sekhar	Delhi	Density Diversity Design Distance Destination Demand Demographics Transit Service Governance	AHP and Fuzzy-AHP (FAHP)	study established nine planning criteria and their corresponding indicators from the literature review and the expert consultation

6. Methodology

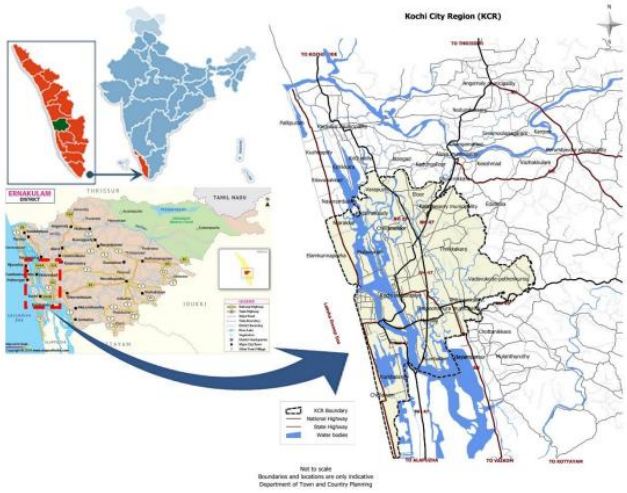


Figure 3: Map showing Kochi City Region

Kochi is the only first order settlement as per the district urbanisation report of 2011. Among the 14 ULB's, Kochi municipal corporation has the highest population, making it the urban core to the urban area of Ernakulam. The immediate influence zone of Kochi was delineated as the Kochi city Region, in the Development Plan for Kochi city Region, 2031 and included Kochi Corporation, Thripunithura Municipality, Kalamassery Municipality and 14 panchayats; altogether encompassing of 369.72 sq. km area. 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 Kochi metro project was introduced as a part of the development plan for Kochi city. It was chosen as a better solution for Kochi's traffic problems.

It is the first metro in the country which connects other modes of transportation like road, rail, and water transport facilities.
Metro corridor passes through the following roads:
Salem- Kochi Highway
Palarivattom Edapally Road
Banerji Road
M.G Road
South Railway Station Road
Sahodharan Ayappan Road
Ettumanoor Ernakulam Road.

Metro starts at Aluva passes through Choornikara Gram panchayat, Kalamasery Municipality, Kochi Municipal Corporation.
After the study of concept through literature study and analysis, the study area is delineated based on 800m from the transit stations along the corridor. The other delineation criteria are based on the ward boundary, water boundary and road boundaries.The map is prepared with reference to Google maps, the administrative map of Aluva, Choornikara, Kalamasery and Kochi Municipal corporation and by using Autocad software.

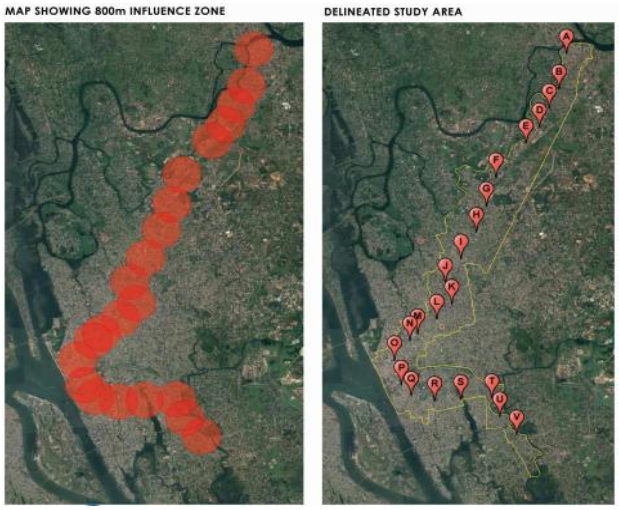


Figure 4: Process of Site delineation

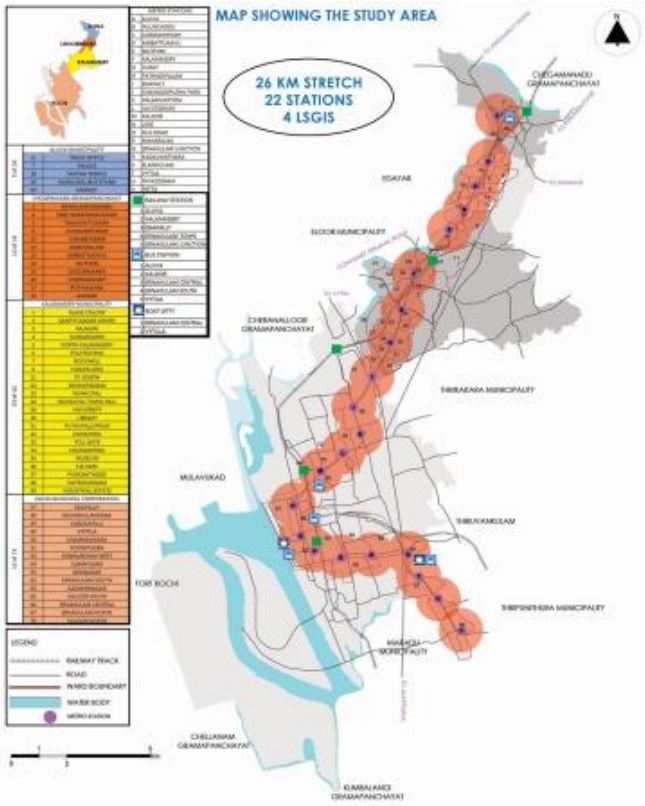
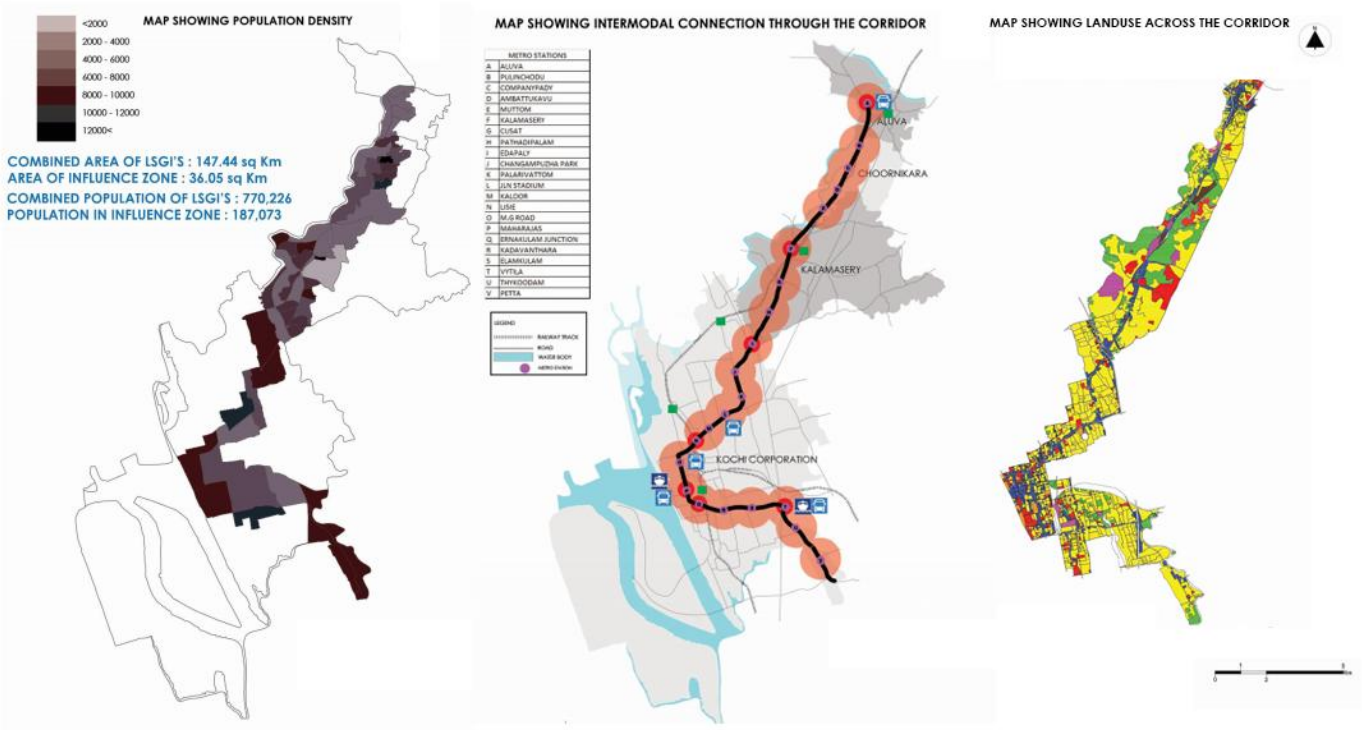


Figure 5 : Map showing the delineated study area

The spatial analysis of the area was conducted on different criteria such as land use, population density, intermodal connectivity etc for analyzing existing TOD. Then the station areas where grouped based on each criterion based on place value. The stations are grouped into Intense Urban areas, Urban Areas and Suburban areas.

7. Results and Discussion



An average population density along the corridor is 5000 people per sq km. This indicates there is potential to increase the density of people living around the corridor especially in Kalamasery and Aluva.

There are inter modal connectivity between railways, bus and waterways at few stations such as Aluva, Kalamasery, Edapally, Kaloor, Town Hall, Maharajas, Ernakulam Junction and Vytila.

The land use pattern indicates there is high diversity at the Kochi CBD area and Aluva. There is also a small change in the pattern of activities at Edapally station area. Large amount of wetlands is present in the boundary between Choornikara and Kalamasery. The satation areas in Kalamasery and choornikara are predominantly residential but opportunities for public recreation is negligible

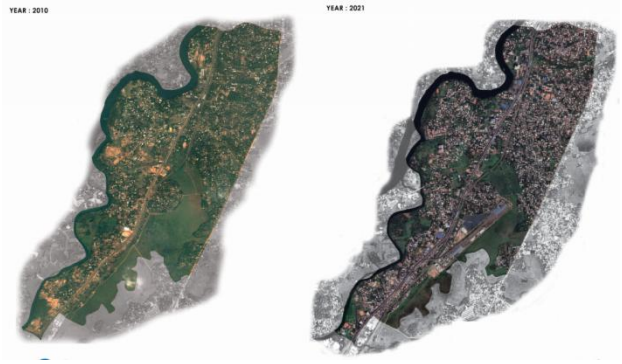
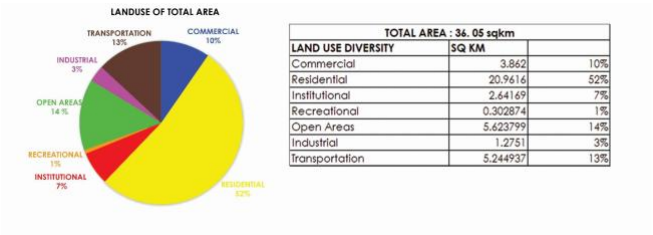


Figure 6 : Growth of urban fabric in Choornikara



TOTAL AREA : 36. 05 sqkm		
LAND USE DIVERSITY	SQ KM	
Commercial	3.862	10%
Residential	20.9616	52%
Institutional	2.64169	7%
Recreational	0.302874	1%
Open Areas	5.623799	14%
Industrial	1.2751	3%
Transportation	5.244937	13%

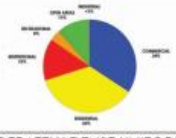
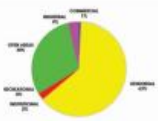
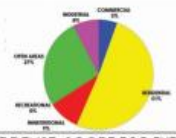
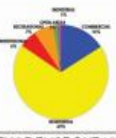
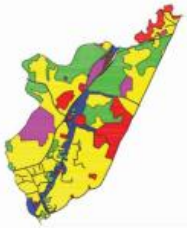
Figure 7 : Land-use distribution

Table 2

EXISTING AND PROPOSED FIRST AND LAST MILE CONNECTIVITY

SLNO.	LAST / FIRST MILE CONNECTIVITY	FEATURES
1	PAVAN-DOOT AIRPORT FEEDER BUS SERVICE	MODE : BUS
		ROUTE : ALUVA METRO STATION TO COCHIN INTERNATIONAL AIRPORT
		TRAVEL TIME : 30 MINS
		FARE : RS. 50
		TOTAL BUSES : 2
2	E-AUTO SERVICE	SHARED E-AUTO SERVICE AVAILABLE FROM MAHARAJAS COLLEGE METRO STATION ON 3 DIFFERENT ROUTES IN A RADIUS OF 3Km
		FARE: RS.10 PER PASSENGER
		TOTAL 12 AUTOS
3	MAJOR BUS STANDS NEAR METRO STATIONS	ALUVA : PRIVATE BUS STAND
		KALOOR: PRIVATE BUS STAND
		KADAVANTHARA : BUS STAND
		VYTILLA : KSRTC + PRIVATE BUS STAND
4	FEEDER BUS SERVICE FROM JLN STADIUM METRO STATION TO KAKANAD INFO PARK	
5	BICYCLE DOCKING STANDS	AVAILABLE AT :
		CUSAT
		EDAPALLY
		CHANGAMPUZHA PARK
		PALARIVATTOM
		JLN STADIUM
		KALOOR
		TOWN HALL /LISIE
		MG ROAD

Table 3 : Summary of Analysis

	ALUVA	CHOORNIKARA	KALAMASERY	KOCHI
TOTAL NO OF WARDS	26	18	42	74
NO.OF WARDS IN INFLUENCE ZONE	5	12	23	15
TOTAL POPULATION	22428	43207	71038	633553
POPULATION IN INFLUENCE ZONE	4538	21097	42531	118907
TOTAL AREA	6.46 sq km	6.85 sq km	27 sqkm	107.13 sq km
AREA IN INFLUENCE ZONE	1.8 sq km	4.052 sq km	11.83 sq km	18.4 sq km
METRO STATIONS	1	4	3	14
LAND USE DIVERSITY				
DENSITY	MODERATELY DENSE UNIFORMLY ACROSS STUDY AREA	NOT DENSE- SCOPE FOR FUTURE DEVELOPMENT	NOT DENSE- SCOPE FOR FUTURE DEVELOPMENT	MODERATELY DENSE BUT NOT UNIFORM THROUGH OUT THE
NUMBER OF INTERSECTIONS				
HOUSING CONDITIONS	INDIVIDUAL PLOTTED HOUSING AND FEW OPTIONS OF GROUP HOUSING	INDIVIDUAL PLOTTED HOUSING	INDIVIDUAL PLOTTED HOUSING	INDIVIDUAL PLOTTED HOUSING AND FEW OPTIONS OF GROUP HOUSING
PARKING MANAGEMENT	FEW ALLOTED PARKING OPTION AVAILABLE BY THE METRO STATION	NO OPTIONS AVAILABLE	FEW ALLOTED PARKING OPTION AVAILABLE BY THE KALAMASERY METRO STATION	FEW ALLOTED PARKING OPTION AVAILABLE BY THE METRO STATIONS

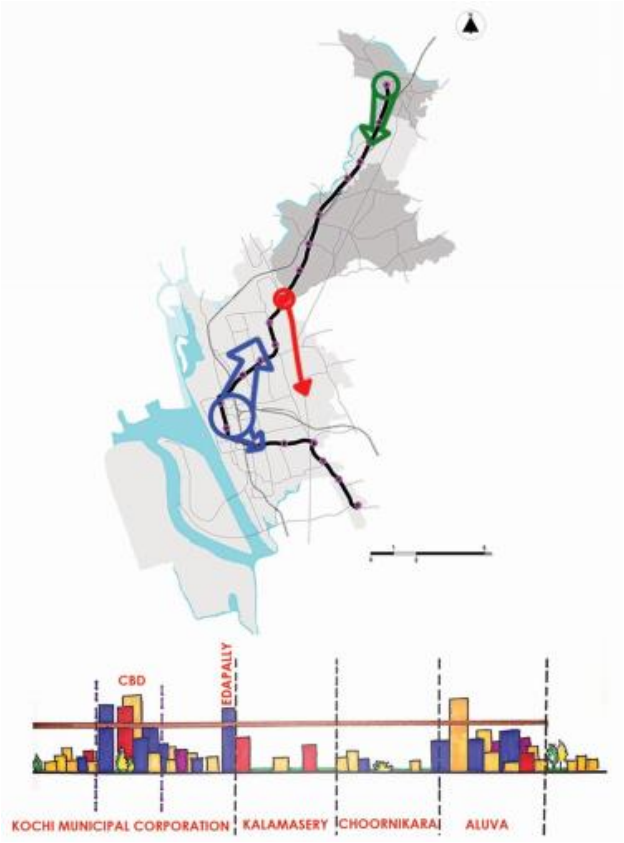


Figure 8: Existing pattern of growth along the corridor

Aluva, Kochi CBD and Edapally have been seen as major influences along the corridor. These are areas with moderate density and high diversity of activities. The current pattern of growth shows a development oriented transit.

Based on the existing pattern a compact city could be developed. The vision is to develop Kochi Metro Corridor as a transit oriented compact city and improve the quality of urban living. To make the corridor Transit Oriented the following have to be achieved. Better, walkable and active streets, less number of cars on roads, high density development for the reduction of sprawl, increased number of affordable housing around major nodes.

Classification of Nodes:

The station areas are divided based on place value typology as:

1) Intense Urban areas
2) Urban areas
3) Suburban area

Table 4 : Values at different stations

	PLACE VALUE	MARKET VALUE	NODE VALUE
ALUVA			
PULINCHODU			
COMPANYPADY			
AMBATTUKAVU			
MUTTOM			
KALAMASERY			
CUSAT			
PATHADIPALAM			
EDAPALLY			
CHANGAMPUZHA PARK			
PALARIVATOM			
JLN STADIUM			
KALOOR			
TOWN HALL / LISIE			
M.G ROAD			
MAHARAJAS			
ERNAKULAM JUNCTION			
KADAVANTHARA			
ELAMKULAM			
VYTILA			
TYKOODAM			
PETTA			

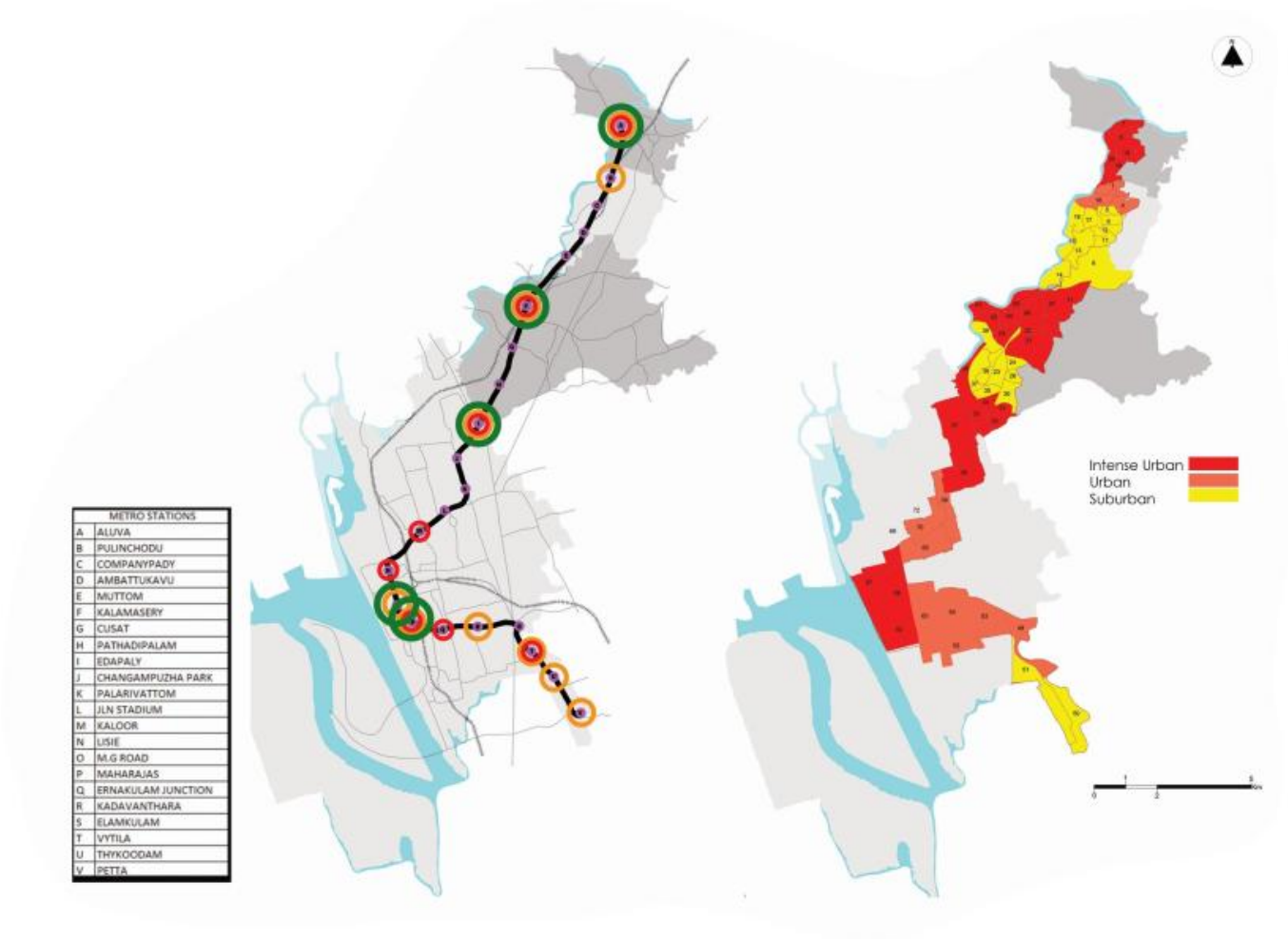


Figure 9 : Classification of Station Areas

8. Conclusion

General strategies and recommendations:

1) Implementation of additional tax collection from individuals owning a plot accommodating single house and a car of their own.
2) Improvement of land administration system of the influence zone for better land development of the region.
3) Introducing a land bank facility so that the owners can first sell their property to the government. Developers could also buy land from the bank. A method of value capture
4) Ensure affordable housing stock of at least 30% of the total housing stock.
5) Incentives provided to the people interested in joint development of plots. This include making streets interconnected, creating more active spaces, high density land development etc.
6) Additional F.A.R according to the plot area could be allowed.
7) Buildings in dilapidated conditions due to legal issues are to be acquired by the land bank.
8) Area of Aluva bus depot, Kalamasery waste management plant to be revitalized. These areas could be adopted for affordable housing initiatives.
9) Each station area should have a station area plan for the designated influence area.
10) Suburban station area are to be developed to foster high dense Residential development with sufficient social and physical infrastructural support.
11) All the intermodal hubs should have NMT connectivity to each mode, this is to promote an active lifestyle.

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