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RESEARCH ARTICLE

IMPACTOFURBANIZATIONINCHENNAI

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Abstract

Urbanization in India is more rapid around the major cities in India.Increase in industrial activities, population both endemic and floatingand vehicular population etc. have led to a number of environmentalproblems,oneofthembeingairpollution.Variouscontaminantscontinuouslyentertheatmospherethroughnaturalandman-madeprocessesandthesecontaminantsinteractwiththeenvironmenttocausedisease,toxicity,environmentaldecayandarelabeledaspollutant. Air Pollutants means any solid, liquid or gaseous substance(including noise) present in the atmosphere in such concentration asmay be or tend to be injurious to human beings or other living creaturesorplants orproperty orenvironment.Urban pollution refers to thepresence or introduction of hazardous or harmful substances in citiesand urban regions, Natural sources may contribute to urban pollution,but human-related emissions are by far the worst. Due to the localconcentration of people and human activity, anthropogenic sources ofpollution, such as factories, industries, transportation, and so forth, arefrequentlymade worse in cities. Serious attention should be given tothe need for improving urban strategies, which promote efficiency inresourceuse.Thepresentstudyanalysisresultstherelationshipbetween the levels of urbanization and the percentage of air pollution inselected area of Chennai. This paper tries to assess the forecasting of airquality and human health due to air pollution loads and human healthimpacts on major road networks of Greater Chennai. The aim of thestudy focuses on objectives to environment in Chennai city to estimatethe problems of air pollution environment in Challenge in Chennai cityandsuggesthealthcostofvehicularpollutionandtosuggesttheGovernment measure to control air pollution in environment Chennaicity.

Introduction:-

TheCityofChennai,capitalofTamilNadu,isone ofthebiggestcultural, economicandeducationalcentersinSouthIndia. According to the 2011 Indian census, it is the sixth-largest city and fourth-most populous urban agglomerationinIndia.

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The City has grown from trading port along Bay of Bengal and currently has a good mix of manufacturing andservicesectorIndustries.AmajorchunkofIndia'sautomobilemanufacturingindustryisbasedinandaroundtheCity.Itisam ajorhubofITandautomobileindustryinIndia.Inrecentyearsrapidgrowthinpopulationandin-migrationisbeing drivenbyIT/ITESservices.

Ambient air pollution has become one of the major health threats to the Indian population during recent decades. Aneffective clean air action plan is a powerful tool for achieving clean air for cities, comprising a list of mitigationmeasures for every air pollution source. The Clean air plan is a collection of regulations, policies, and programmes,which aims to improve air quality and publichealth by identifying costeffectivemeasures to reduce emissionsfromall the known sources. Government of India launched National Clean Air Programme (NCAP), in 2019, India'sflagshipprogramforbetterairqualityin124citiestotackleairpollutionproblemsofcitiesandstateswithalong-term,time-bound strategy to achieve a 20-30% reduction in the Particulate Matter (PM10) ambient concentrations by 2024consideringthebaseyear2017.

The growth of population increases in Chennai due to vehicular air pollution and cost of time for working people inenvironmentalchallengesinChennaicity.Thecarbonmonoxide,nitrogenoxidesandsulphuricacidarecausesthreattohuma nlife.Intermsofactualexposure,peoplearemorevulnerabletovehicular fumeswhiletravelingandincloseproximity to roads. Pollution concentration in our breath is 3-4 times higher than the ambient air concentration. Indensely-populatedcities,morethan50-60percentofthepopulationlivesorworksneartheroadsidewherelevelsaremuch higher. This is very serious in low income neighborhoods located close to roads. Road users, public transportusers,walkersand cyclistsarethemost exposedgroups–theyare alsothe urbanmajority.

Chennai Metropolitan Area extends over 1180 sq. km and has a population of more than 8.5 million. Rapid increaseinurbanizationwithvehiclecongestionhasincreasedmenacinglyontheroadsof Chennai. Asaresultofthis,gaseouspo llutantsandrespirableandsuspendedparticulatematterpollutantsarecontinuouslyincreasing intheambientairofChennai city. These pollutants have been assessed using high volume sampler at residential and traffic intersectionsampling stations in Chennai City. Vehicular pollution control in metropolitan cities and other cities deserves toppriority.

StudyAreaDelineation

The study intends to meet the development of the City to meet the mobility needs of the citizens of Chennai. ToachievethisaimtheChennaiMetropolitanArea(CMA)isdelineatedastheStudyArea.Thestudyareacoversabout1189sqk mwhichencompassespartsofChennaidistrict(176Sq.km),(whichgrewto426sqkmaftertheexpansionin2011), Thiruvallur district (637 Sq.km) & Kancheepuram district (376 Sq.km). The CMA comprises of the city ofChennai (Chennai Municipal Corporation area),16 Municipalities, 20 Town Panchayats and 214 Village Panchayatsin 10 Panchayat Unions. CMDA has notified to expand the area of CMA to 8,878 sq.km as per G.O.(Ms) No.13 ON22.1.2018.However ,the area of expansion is still under discussed Hence ,the area for the current study is limited to1189sq.km.[1]

Table2-1:- NumberofVillages.

LocalBody	**No.ofLocalBodies**
Municipality	16
TownPanchayats	20
VillagePanchayat	214

LocationAnd RegionalLinkages

The city is located at 13.0827° N, 80.2707° E and is well connected to major cities through National Highway 16 toKolkata,NH48toBengaluru,NH716toThiruvallurandNH32toTiruchirappalli.Chennaiislocated345kmEastofBangalor e and 627km South East of Hyderabad and is connected via NH4 and NH 16 respectively. Figure 2-2 showsthe connectivityofChennaiwithmajorcities.

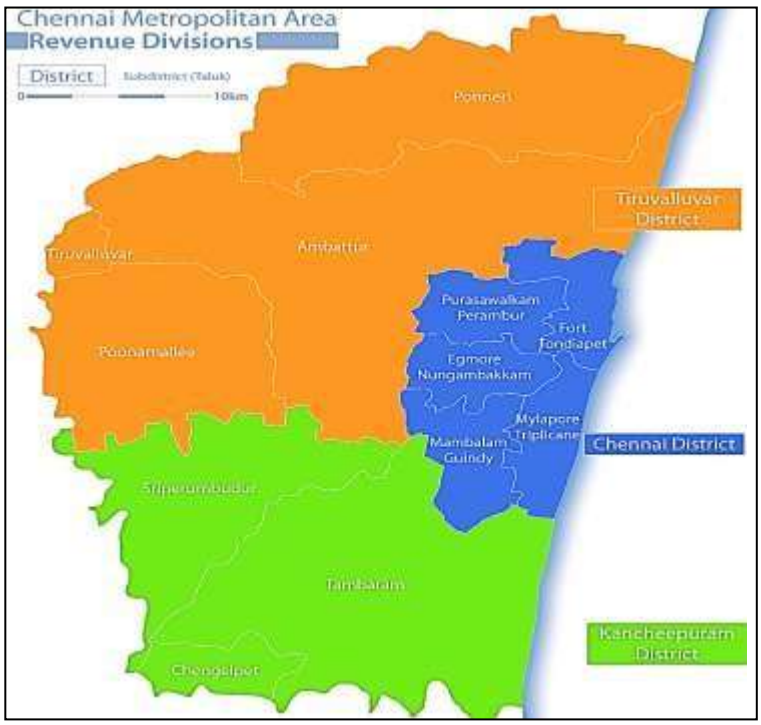

Figure2-2:- LocationandregionalconnectivityofChennai.

Figure2-1:- Revenue DivisionsofChennaiMetropolitanArea.

SpatialSettingAndGrowthPattern

ThesettlementstructureofChennaiiscommontomanylargeSouth-Asianconurbations,reflectingvariouseconomicandpoliticaldecisions.Theoldestareasaretheclosesttotheport Georgetown,thetraditionalcommercialcenter,andtheFortarea,once housing theBritishadministrativeand militaryheadquarters.

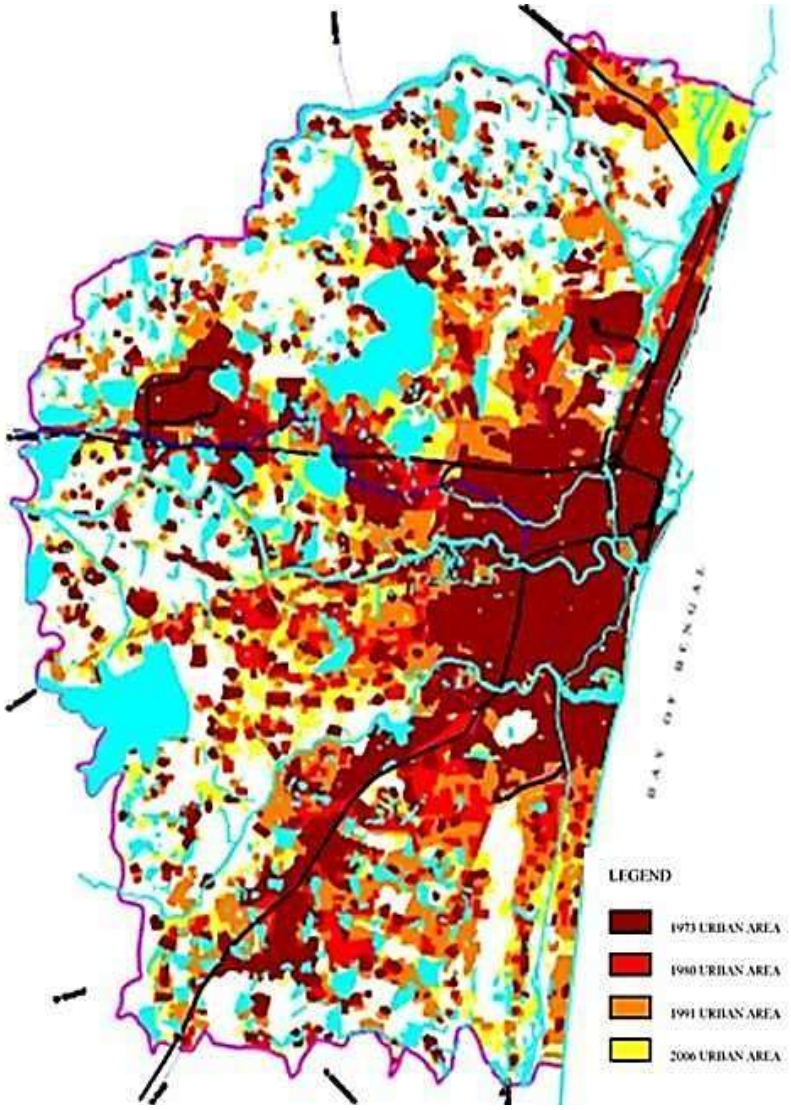

Figure2-3:- GrowthpatternofChennaiUrbanArea.

The industrial activity in the city developed in the Northern and Western parts supported by the bustling Ennore portand the growth in these regions are mix with residential developments. The new growth regions are emerging inNorthern and Eastern regions to support the manufacturing sector (in Northern Chennai) and Service sector (inCentral city). The advent of the Software and Services industry resulted in growth along Southern and South westerncorridors. The residential growth was higher along with the major corridors connecting to the central city area drivenby ease of access and economics of transportation. Figure 2-3 shows the development of urban area within Chennaioverthe years.The majordevelopmentcorridorsdeveloped include:

1. North-WestCorridor–AlongGNTRoad
2. WesternCorridor–AlongPoonamalleeRoad
3. South-WestCorridor–AlongGST RoadandRailwayline
4. SouthIT Corridor–AlongOldMahabalipuramRoad

Figure2-4:- Growthtrend withinstudyarea.

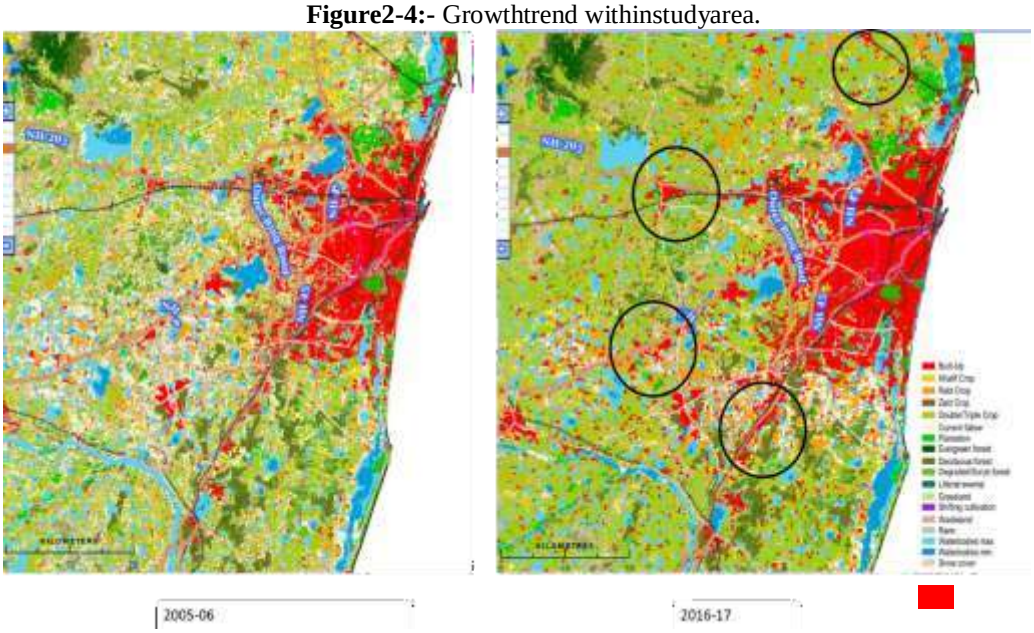

Figure 2-4 shows the growth trend within the study area over last two decades (2001 -2011). From the graphs, it isevidentthatovertheyears,urbansprawlhasincreasedowingtoincreasedeconomicactivities.[2]

Population

The population of Chennai Metropolitan Area and Chennai city were 86.54 lakh[3] and 714 lakh[4] respectively. Thedecadal population growth in CMA is 27%, while the city growth is 8%. Municipalities has grown at 41%, TownPanchayats at 67% and Village Panchayats at 91%. Some areas within the core city have also shown a negativegrowthrateinthelastdecade,while
highergrowthisobservedintheperipheralareasofcity.ThedecadalgrowthrateofCMAis 26.64%asperCensus 2011.

ThegrowthrateofCMAisattributedtothegrowth insuburbanareasofChennai becauseoftheinflowofpopulationin CMA for employment opportunities, institutional facilities, relatively less congested and more affordable housingopportunities within reasonable commuting distance of the City. Moreover, the industrial hub comprising of theautomotiveindustriesandtheIThubhavecontributedtotheexpansionofthecitytowardstheseagglomerations.

Table2-2:- Populationand DecadalGrowthRate(Source:Census,2011).

Area	PopulationinLakhs					DecadalGrowthRate			
	1971	1981	1991	2001	2011	1971-1981	1981-1991	1991-2001	2001-2011 *
ChennaiCity	26.42	32.85	38.43	43.43	46.46*	2.20%	1.58%	1.23%	0.68%
Rest of CMA(Municipalities, Town Panchayats, Village Panchayats)	8.62	13.16	19.75	26.98	40.08	4.32%	4.14%	3.17%	4.04%
CMA	35.04	46.01	58.18	70.41	86.54	2.76%	2.37%	1.93%	2.08%

*After the expansion process In October 2011 the City area has been revised to 426 Sq.km from 176 Sq.km with apopulationofapprox.66 Lakhsin2011and 71Lakhsin2019 (Source:GCCwebsite)5

PopulationDensity

Chennai is one of the major metropolitans which has high population density figures. The City has a gross density of264persons/ha,while CMAhas 75persons/ha.

Table2-3:- GrossDensityinthe StudyArea.

Description	Area(Sq.km)	Density(personsperhectare)					
		1971	1981	1991	2001	2011	2026(MasterPlan)
ChennaiCity	176	150	187	218	247	264	333
Municipalities	240	20	34	49	66	93	149
TownPanchayats	156	7	11	17	25	41	78
VillagePanchayats	617	4	5	8	12	23	32
CMA	1189	29	39	49	59	75	105

The gross density in most of the municipal areas and Town Panchayats is low, indicating that these areas offer highpotentialforgrowthandwouldbereceivingresidentialareasinfutureasproposedinSecondMasterPlan.

Figure 2-5 represents the spatial distribution of population and population density of CMA in 2018. The populationdensity is observed to be relatively higher in places such as George Town, Nungambakkam, T. Nagar, Koyambeduand AnnaNagar.

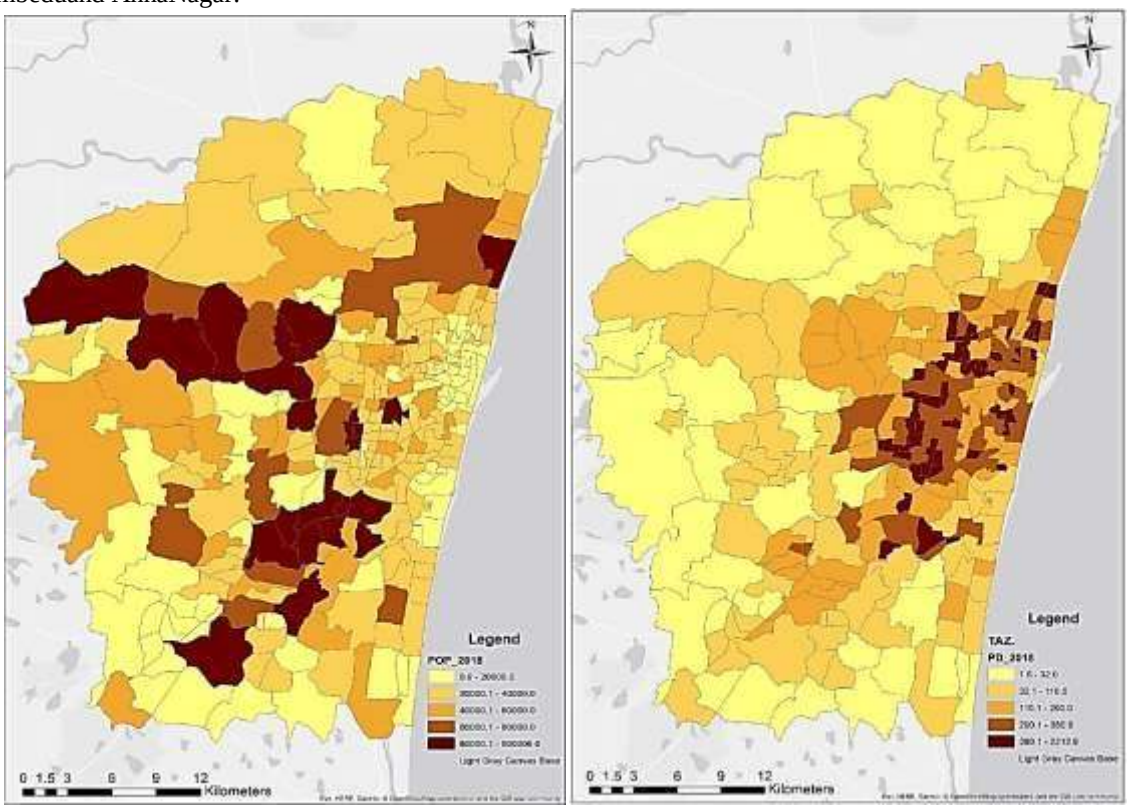

Figure2-5:- SpatialRepresentationof(Left)PopulationofCMAand(Right)PopulationDensityofCMAin2018

EconomicProfile

Chennai is one of the top cities in India as per Gross Domestic Product figures. The GDP of Chennai and adjoiningtwo districts had increased 2.7 times during FY 05-11 with a CAGR of 18% with a GDP of about $80 billion. TheeconomyofChennaiand itsextendedregioncontinuestogrowfasterthanrestofTamilNadu.Chennaihaswitnessedsignificant increase in per capita income levels over the years. With the economy and population on the rise, anefficientPublicTransportsystem&networkisrequiredtoaddresstheneedsoftravellingfasterandcomfortable.

Table2-4:-WorkforceParticipationfor Chennai(Census,2011).

Census	Population(Lakh)	Workforce(inlakhs)		
		Total	Male	Female
2001	43	15	12	3
2011	46	18	14	4

%Increase	1%	2%	2%	3%

89% of the total workers are Main workers and 11% are Marginal workers. 75% of the total workers are Male and25%Female(Figure2-6).

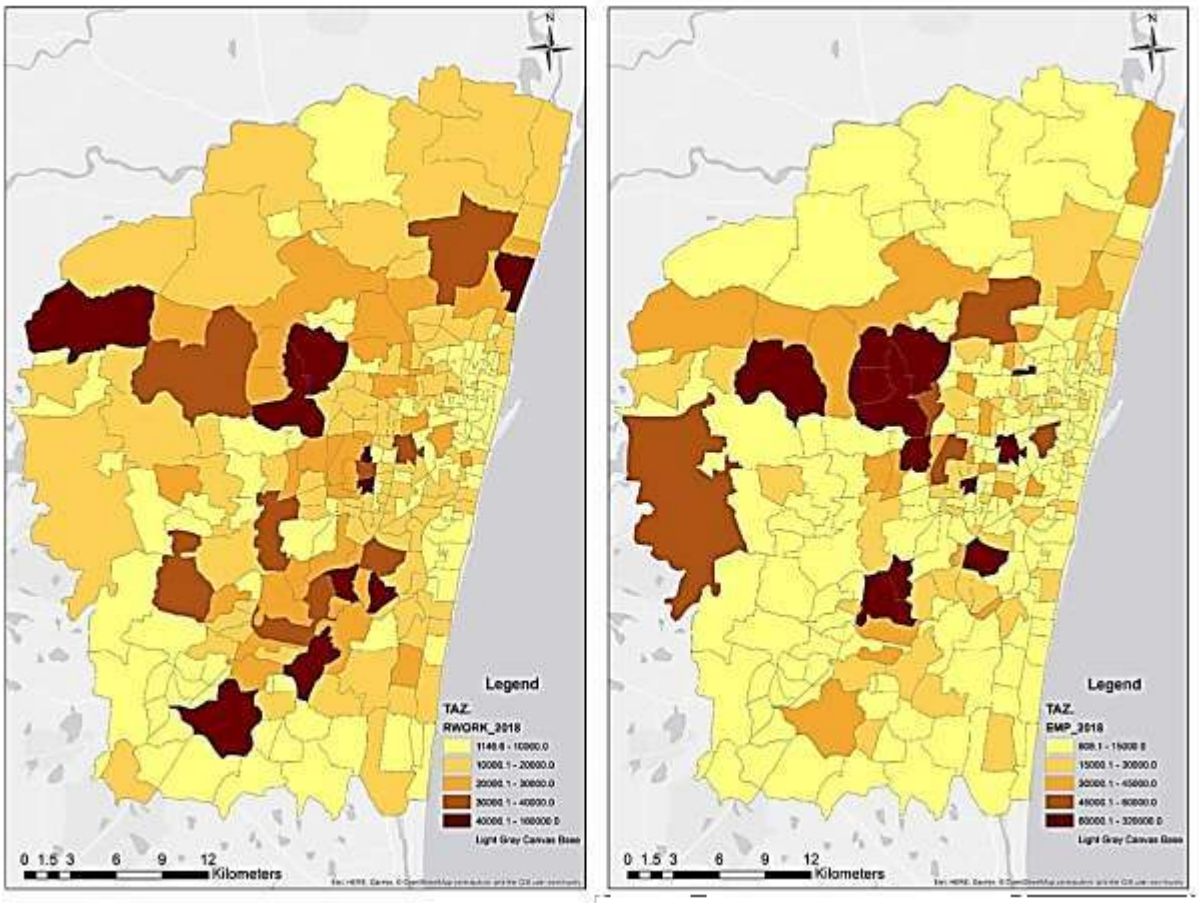

Figure2-6:- Spatialrepresentationof(Left)EmploymentandEmploymentDensityinCMAin2018.

LandUseCharacteristics

The major land use category is residential use in Chennai city, accounting up to 54%, followed by Institutional landuse, while in the rest of CMA, residential land use is 22% and Institutional land use is only 3%. In Chennai city andrest of CMA in 2006, about 12% land is lying vacant and undevelopable in the urban core, about 54% lie in similarconditionsintheCMA.

Table2-5:- ExistingLanduseinCMA(AsperSecondMasterplan2026).

Land-use	Chennai (in %)	RestofCMA(in%)
Residential	54.25	21.87
Commercial	7.09	0.37
Industrial	5.17	6.28
Institutional	18.48	3.01
OpenSpace&Recreation	2.09	0.19
Agricultural	0.57	11.92
Non-Urban	0.47	2.33
Others	11.88	54.03
Total	100	100

TheexistingandproposedMasterPlanlanduseforCMA-2006and2026asperSecondMasterPlanisasshowninFigure 2-7&2-8.

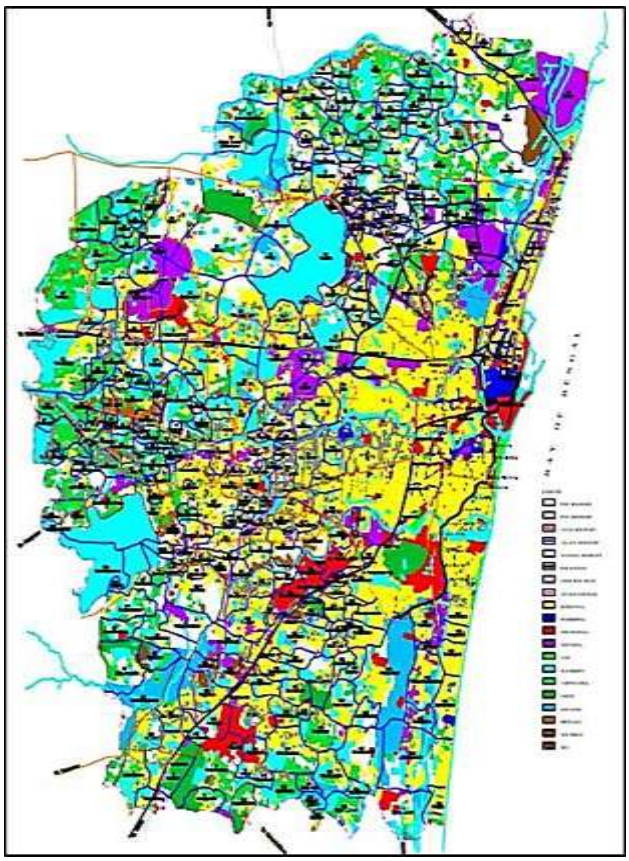

Figure 2-7:- Existing Landuse Map -2006.(Source:Second MasterPlanfor CMA-2026).

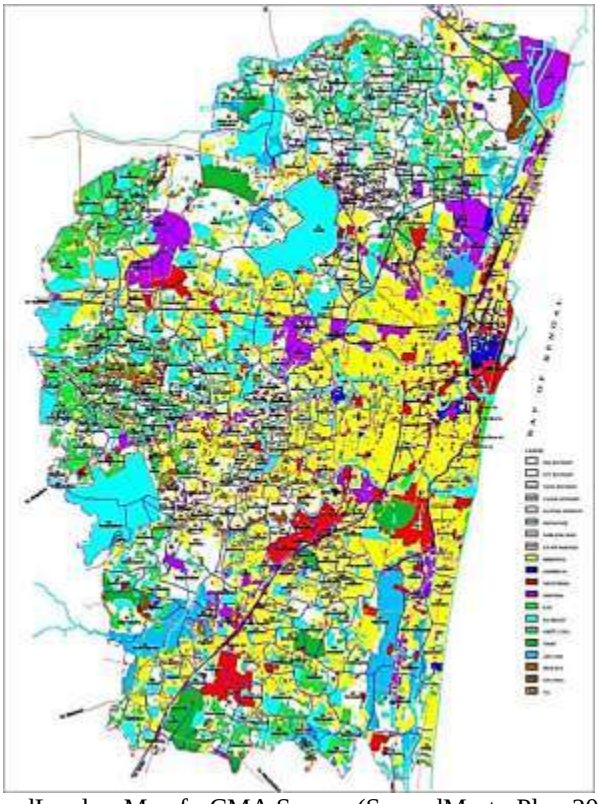

Figure2-8:-ProposedLanduseMap forCMA.Source:(SecondMasterPlan-2026 forCMA).

ComparisonOfProposedLandUseWithUrdpfiGuidelines

ThelanduseofChennaiproposedintheDevelopmentPlanhasbeencomparedwithUrbanandRegionalDevelopment Plan Formulation and Implementation (URDPFI) guidelines to assess the adequacy of existing areasundervariouslanduses.Asindicatedinthetablebelow,thecitylacksadequatelandusesshareunderindustrial,publicand semi-public and recreational categories. The commercial and industrial uses are not in proportion with theresidentialuse.

Table2-6:- ComparisonofProposedLandusewithURDPFI Guidelines.

Category	URDPFIGuidelines	Proposed(2026)	
		City	CMA
Residential	35-40	51.41	45.88
Commercial	04-05		
Industrial	12-14	4.67	10.56
Institutional		3.93	7.18
Public&SemiPublic	14-16	-	-
Recreational	20-25	5.68	0.38
Transportation	15-18	-	-
Others(Agriculture,WaterBodies,RedhillCatchmentArea,Roadsandforestsetc.)	Balance	21.31	39.34
Total	100	100	100
***OthersisnotapplicableforURDPFIComparisonasthefieldincludesRoads(asperCMDA–SecondMasterPlan)**			

TravelAndTransportCharacteristicsRoadNetworkCharacteristics

The corporation has approximately 6,010 km length of roads[6] spread over an area of 1,189 Sq.km. The road networkof Chennai has a radial pattern radiating from George Town, which is the main CBD (Central Business District) ofCMA (Chennai Metropolitan Authority). The prime road network consists of four National Highways connecting toothermajorcities.Othermajorarterialroadswithinthecityinclude ArcotRoad,KamarajarSalai,ThiruvottiyurHighRoad,OldMahabalipuramRoadandEast Coast Road.TheOrbitalroadnetworkimplementedaspertheFirst MasterPlancomprisesofJawaharlalNehruRoad(IRR)and ChennaiBy-passRoad.

Figure2-9:- ProposedRoadNetworkHierarchyinCMA. Source:SecondMasterPlan.

RegisteredVehiclesAndGrowthInVehicles

As per the State Transport Authority, Chennai district has reported 55.7 lakh (as on 2018) registered vehicles whichaccountsforover22%ofallvehiclesregisteredintheState.Asperrecords,theCAGRoverthelast10yearsis6.3%.TheVehiclesregisteredinKanchipuramandTiruvallurdistrictsstandat6.8lakhsand13.8lakhsrespectively.

Figure2-10:-TrafficcongestioninChennai.

Figure 2-10: Traffic congestion in Chennai

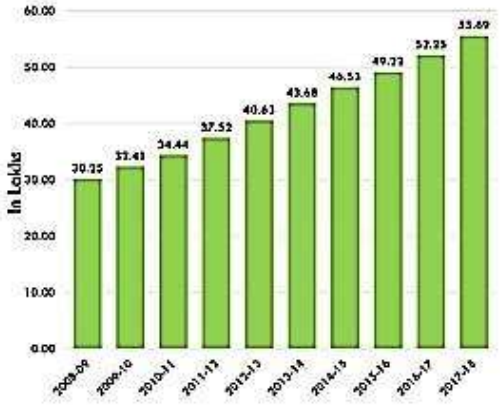

Figure 2-11: Growth of vehicles in Chennai District

S.No	Area	Total Registered Vehicles
1	Chennai	5568911
2	Kanchipuram	681755
3	Tiruvallur	1387223

Table 2-7 District Wise Vehicle Registered (as on 1.10.2018)

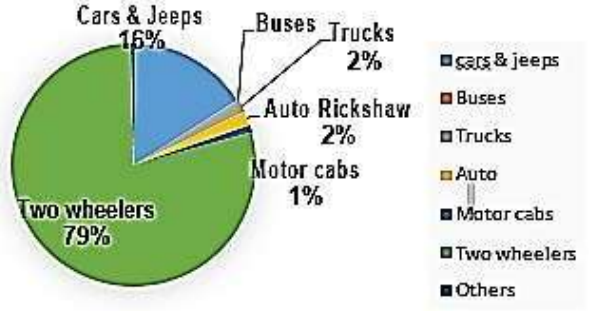

Figure 2-12: Registered vehicle Composition in Chennai

City BusSystem

The bus service in Chennai Metropolitan Area is operated by Metropolitan Transport Corporation (Chennai) with 27bus terminals in Chennai was nationalized in 1947 by introducing 30 buses and again in 1972 with a total fleet of1029.

At present MTC has a total fleet of 3740 buses which operate in 684 different routes (MTC, Chennai). There are 27bus depots in the metropolitan area. MTC bus services carry around 48 lakhs passengers daily. The MetropolitanTransport Corporation has 32 depots, each with an average parking capacity of 100 buses. Tambaram and AnnaNagardepots,with222and214buseseachrespectivelyarethelargest,andBasinBridgedepot,withonly45buses,isthe smallest.387.35kmofroadswithinCMAare demarcatedasbusrouteroads

Figure2-13:- CitybusesinChennai.

MTC buses follows distance-based stage fare system, where each stage is approximately 2km. The minimum fare isRs.5/- for the first two kilometres while the maximum fare is Rs.46/- for the last two stages. The summary of MTCservicesis as showninTable2-8.

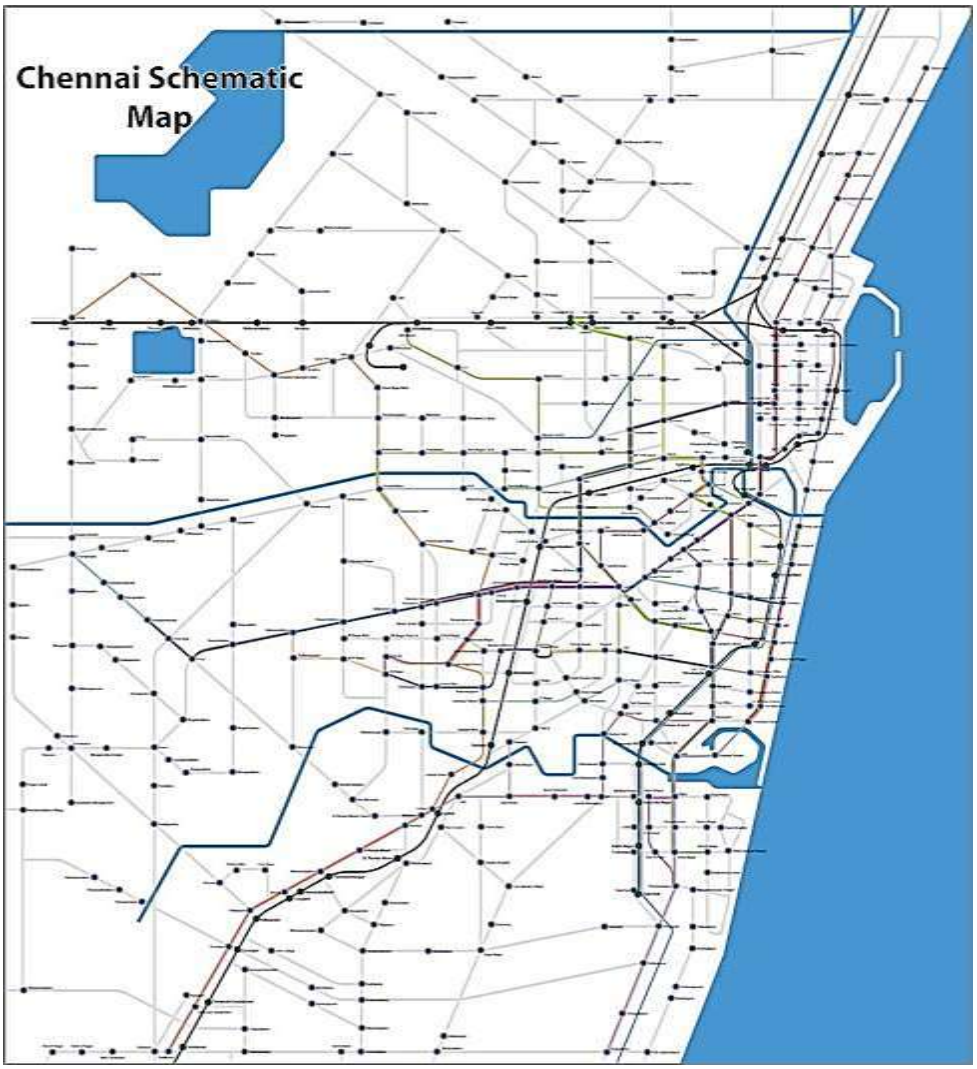

Figure 2-14:- SchematicBusRoute MapofMTC.

Table2-8:- MTCSummaryTable.

Year	Buses	Routes	ScheduledServices
Mar-14	3750	802	3531
Mar-15	3794	805	3531
Mar-16	3984	845	3685
Mar-17	3980	833	3688
Mar-18	3740	684	3439

It can be observed from the above table that MTC has considered reducing the routes of operation attributed to adecline inthefleetaswellas scheduled services.

Sub-UrbanRailwayAndMrts

Chennai Metropolitan Area has an extensive rail network traversing across the city. The city has three suburbanrailwaylines,namelyNorthline,West line,Southlineandthefourthbeing MRTSline.

Table2-9:-AreascoveredwithinSuburbanMRTSLine.

Line	Areacovered	Distance(km)
Sub-UrbanRailway	ChennaiBeach–Vandalur	34.4
	ChennaiCentral–Thiruninravur	29.0
	ChennaiCentral–Minjur	26.0
MRTS	ChennaiBeach–Velachery *	19.34
Total		108.74

*VelacherytoStThomasMountMRTSlineisunderimplementationstage

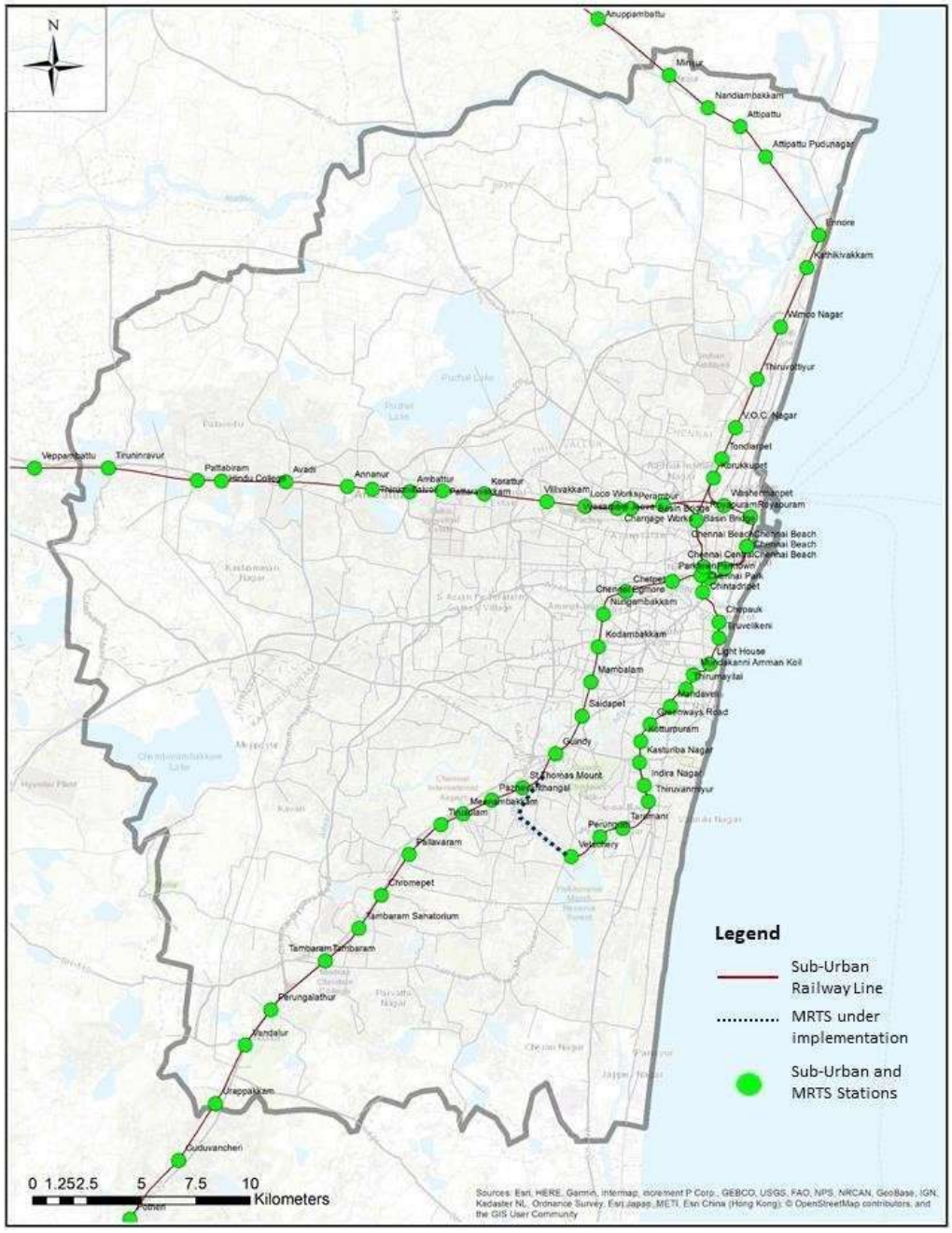

Figure2-15:- Sub-UrbanRailNetwork.

As per studies, low fare in comparison to other modes of transport has been cited as one of the main reasons forrelatively higher ridership in suburban trains. The same fare slab is also applicable on the exclusive MRTS line aswell.The revised fare slab forChennaisuburbanrailispresentedbelow:

Table2-10:-SuburbanFareChart.

DistanceUpto(km)	Fare(In Rs.)
<20	5
21-45	10
46-70	15
71-100	20

As per the secondary data obtained from Southern Railways, the suburban sector operates 700 services daily, thatincludes 244 in the Beach–Tambaram section, 230 services in the Chennai Central–Tiruvallur section, and 86 in theChennai Central–Gummidipoondi section. The busiest suburban rail line is the Beach-Tambaram line, which runs 9-12 coach rakes at peak hour headways of 8-10 min. This line has a peak demand of around 24,000 passengers perhourperdirection.The MRTSoperatedfromChennaiBeachto Velacherywith140services.

ChennaiMetroRail

Recognizingtheincreasingtraveldemandinthecity,thestategovernmenthasconstructedametrorailsystemwhichhas been operational in the city from 2015. Currently, the system has two lines in operation the details are shown inTable 2-11. The minimum fare is Rs.10/- for the first two kilometres while the maximum fare is Rs.60/- for the lasttwo stages.

Line-1

Thiruvottiyur-Washermenpet–Broadway(PrakasamRoad)–ChennaiCentralStation–GovernmentEstate–TaraporeTowers–Spencers–Gemini–AnnaSalai–Saidapet–Guindy–ChennaiAirport

Line-2

ChennaiCentral–alongEVRPeriyarSalai–Vepery–KilpaukMedicalCollege–Aminjikarai–ShenoyNagar–Annanagar East-Anna Nagar 2nd avenue–Tirumangalam–Koyambedu-CMBT– along Inner Ring Road–Vadapalani–AshokNagar–SIDCO–Alandur–St. ThomasMt.

TheportionsofCorridor-1withfromWashermanpettoSaidapet,andCorridor-2fromChennaiCentraltoAnnaNagar2nd Avenue willbe underground andtheremaining elevated.

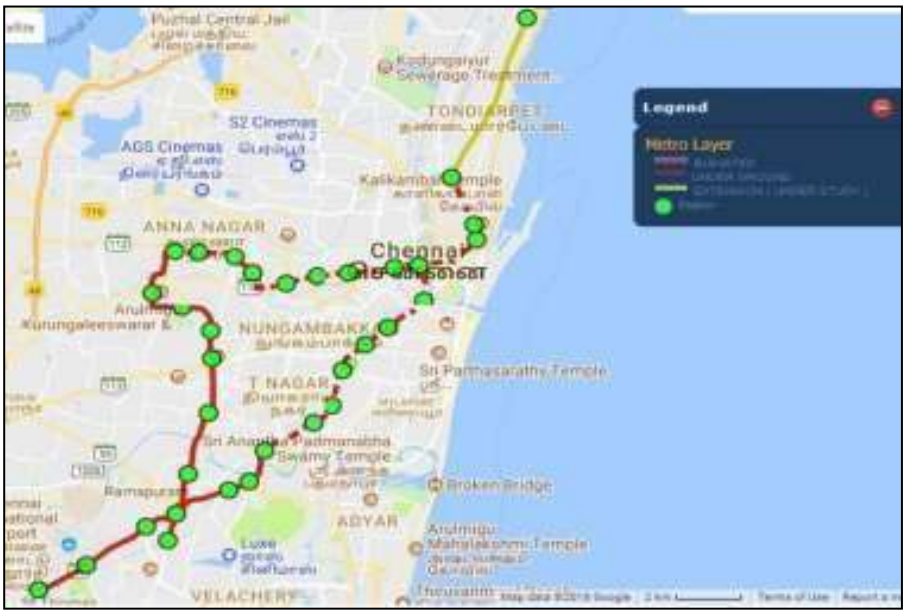

Figure2-16:- ChennaiMetro-Phase1 Alignment.

Table2-11:- ChennaiMetro PhaseI-KeyFigures.

Phase1	TotalNetworkDistance	CurrentlyOperational
Corridor1 +Extn.	32.10km(23+9)	23.10km
Corridor2	22km	m

IntermediatePublicTransportAuto Rickshaw

Auto rickshaws are one of the most popular modes of para-transit in Chennai city. They provide first and last mileconnectivity to a major share of city population. In spite of the existence of buses and trains, last mile connectivityremainsanunresolvedissueinChennai,duetotheunderdevelopedfeedersystem.TheIPTscatertoabout1.5millioncommuters in Chennai on a daily basis. Currently, there are 74,026[7] auto rickshaws plying in Chennai city, of whichabout 33% run on LPG and the remaining on petrol. The current fare stands at a minimum of Rs. 25 for an initialdistance of 1.8 km and Rs. 12/- for every subsequent kilometre as per government fixed rates. The registered autoRickshawsforChennai,KanchipuramandThiruvallurdistrictare88,994,7100and8415respectively.

Figure2-17:- AutoRickshawsinChennai.

SharedAutoRickshaw

Share Autos are a preferred mode of transportation for short distances in Chennai. People dependent on the informalsector find this para transit system highly convenient, as they can get bored or get off wherever they seek to.Moreover, this system is well connected and passengers are not forced to wait long times as this mode has muchhigher frequency of operation compared to MTC buses. The autos charge Rs. 10/- to Rs. 50/, a fare though higherthanbuses,butmuchlowerthanthe autorickshaws.

As per the study conducted by City Connect on the Para-transit Sector in Chennai, each Share Auto caters to around154 passengers per day, and are estimated to cater to approximately 18,48,000 passenger-trips per day. In additionalto private and shared auto rickshaws, demand responsive system in the form of Motor cab and Maxi cabs stand at acombinedfigureof57,000vehiclesasofyear2018.

GoodsTransport

Themovementofthegoodsvehiclesparticularlytheheavyvehiclesandtrucksarerestrictedonthecityroads.Aspartof the Second Master Plan, several market activity centres have been relocated and truck terminals are proposed ontheouterlimits ofChennai.

Some important places of arrival and dispatch of goods are observed to be at George Town, Salt Cotaurs, ChennaiHarbour, Industrial Estates at Guindy and Ambattur and the timber yards near Chrompet and Tambaram on NH-45andthe petroleuminstallations atKorukkupetandManali**.**

At present, the movement of goods vehicles is considered as haphazard to other users and several restrictions areplaced on their movements. The CMDA has taken steps to shift some of the wholesale markets and create truckterminals on the periphery of the City. Of these, Sathangadu steel market, Koyembedu perishables market andMadhavaramtruckterminalhave beenmade operational.

Figure2-18:- Vehiclescateringtogoodstransport.

MajorPollutingIndustriesInChennai

Chennai district in Tamil Nadu constitutes the metropolitan city of Chennai which is one of theleading Industrial towns in the country. Chennai is hub of Information Technology and has Clusterof many Cluster group industries.Thelistofmajor polluting industries in Chennai U A isgiveninthetable 2-15.

Table.2-15:- ThedetailsofmajorpollutingindustriesinChennaiUA.

S.No	NameofIndustry	Category	Classification
1	PiramalEnterprisesLTD	Red	Large
2	MRFLTD	Red	Large
3	AshokLeylandLTD	Red	Large
4	SRFLTD-TechnicalTextileBusiness	Red	Large
5	ManalIPetrochemicalsLTDPlantII	Red	Large
6	CoromandelInternationalLTD	Red	Large
7	HindujaFoundriesLTD	Red	Large
8	ITCLTD-Packagingand PrintingDivision	Red	Large
9	ManaliPetrochemicalsLTD-PlantI	Red	Large
10	CPCLPropylene ButyleneLubePlant	Red	Large
11	CPCLRefineryIIICPP	Red	Large
12	TPL-HeavychemicalsDivision	Red	Large
13	TPL-LabPlant	Red	Large
14	MadrasFertilizersLTD	Red	Large
15	CetexPetrochemicalsLTD	Red	Large
16	RoyalEnfield-UnitofEicherMotorsLTD	Red	Large
17	KothariPetrochemicalsLTD	Red	Large
18	IndianAdditivesLTD	Red	Large
19	CPCL-HexanePlant	Red	Medium
20	BrakesIndiaLTD	Red	Large
21	LucasTVSLTD	Red	Large
22	RaneBrakeLiningLTD	Red	Large
23	MohanBreweriesandDistilleriesLTD	Red	Large
24	SundaramFastnersLTD	Red	Large
25	ManaliPetrochemicalsLTDPlantIIPOWER	Red	Large
26	CoromandelInternationalLTD-AMMStorage	Red	Large

27	CPCL-DHDSPlant	Red	Large
28	BalmerlawrieandCO LTD-LeatherChemDN	Red	Large
29	CPCLRefineryIII	Red	Large
30	MILIndustriesLTD	Red	Large
31	IOCLChennai-MaduraiPipelineProject	Red	Large
32	TamilNaduCo-opMilkProducersFED	Red	Large
33	IOTInfrastructure EnergyServicesLTD	Red	Large
34	IOCLChennai-BangalorePipelineProject	Red	Large
35	NATCOParmaLTD,ChemicalDivision	Red	Large
36	IOCLManila-AirportATFPipelineProject	Red	Large
37	BallmerLawryCoLTDGreaseDivision	Red	Large
38	TamilNaduCo-opMPFLTDCentralDairy	Red	Large
39	CooksonIndiaLTD	Red	Large
40	TamilNaduPetroProductsLTD-ECHPLA	Red	Large
41	RajPetroSpecialtiesPVTLTD	Red	Large
42	UltramarineandPigmentsLTD	Red	Large
43	Cetex PetrochemicasLTD-FineChem-UNITI	Red	Medium
44	CPCL-TertiarySewageTreatmentPlant	Red	Large
45	BalmerLawrieandCoLTD-BarrelDivision	Red	Large
46	MadrasFertilizersLTD-TTP	Red	Medium
47	CPCL-TwentyMWGTGPowerPlant	Red	Large
48	TPL-PowerPlant	Red	Large
49	KothariIndlCorpnLtdFertilizerDivision	Red	Medium
50	CPCLCrudePipelineChennaiPorttoCPCL	Red	Large
51	TMTEMetalTechPVTLTD	Red	Large
52	CPCL-ResidUpgradationProject	Red	Large
53	KothariPetroChemicalLimited-PowerP	Red	Large
54	Hindustan Petroleum Corporation LtdCasi	Red	Large
55	BasinBridgeGas TurbinePowerStation	Red	Large
56	IMClimited	Red	Large
57	HPCL,BBT,(Closed)	Red	Large
58	INDIANOILCORP. LTD.,ForeshoreTerminal	Red	Large
59	BharathPetroleumCorporationLimited	Red	Large
60	GeminiIndustriesandImagingLtd-closed	Red	Medium
61	IndianOilCorporationLtd-TDRTerminal	Red	Large
62	IndianOilCorporationLtd-KrptTerminal	Red	Large
63	IndiaPistonsLimited	Red	Large
64	SouthernRailwayCarriageandWagonWork	Red	Large
65	GMRPowerCorporationltd	Red	Large
66	ExideIndustriesLimited	Red	Large
67	ICFShellDivision	Red	Large
68	CreativeTanneryLimited	Red	Medium
69	MechanicalOreHandlingPlant-Closed	Red	Medium
70	SimpsonandCompanyLimited	Red	Large
71	IntegralCoachFactoryFurnishingDvn	Red	Large
72	IndianOilCorporationDoubleEntry	Red	Large
73	HINDUSTANPETROLEUMCORP.LTD.,	Red	Large
74	IMCLimited	Red	Medium
75	Ms/ShasunChemicalsBioTech	Red	Large
76	SouthernRailwayLocoWorks	Red	Large
77	ChennaiInternationalTerminalsPvtLtd	Red	Large
78	MadrasFertilisersLimited	Red	Medium
79	OilDockIandII	Red	Large
80	ChennaiContainerTerminal(DPWORLD)	Red	Large
81	HindAgroIndustriesPVTLTD	Red	Large

82	ChennaiPortTrust	Red	Large
83	ChennaiPortTrust-Revetmentstructure	Red	Large
84	IndianoilCorporationLimitedFORESHORE	Red	Large
85	Indian OilCorporation,	Red	Large
86	IOCLForeshoreTerminalPipeline	Red	Large
87	TheTamilNaduCoopMilkProducers	Red	Large
88	ChennaiInternationalAirport	Red	Large
89	IndianOilCorporationLtdaviationfuel	Red	Large
90	IntegratedMSWProfacilityPerungudi	Red	Large
91	AdhesivesandChemicals	Red	Large

Source:TNPCB

EnvironmentalQuality

With increasing population and improving economy the population levels in urban areas has increased drastically.The purchasing power of individuals have also paved way for increased vehicle ownership. The average householdswith at least one vehicles stand at 54 %. This affluence in the population has resulted in increasing pollution load inthebigcities.ThepollutionlevelsasmonitoredbythemacroscopicparametersPM10andNOxemissions(asonDec.2018)are as following.

1. AnnualMeanConcentrationofSO2–9.0
2. AnnualMeanConcentrationRangeofOxidesofNitrogen(NOX)-17.0AnnualMeanConcentrationofSPM–62.0
3. AnnualMeanConcentrationofRSPM-32.0

CurrentStatusAmbientAirQualityInChennaiU.A

Themajorsourcesofairpollutionat Chennaicityareroaddust,vehicularemission,constructionactivities,Industriesetc.,(source:https://cpcb.nic.in/displaypdf.php?id=Q2hlbm5haS5wZGY=)TNPCBisregularlymonitoringtheambient air quality at Chennai through eight manual NAMP stations installed in and around the city under NationalAmbient AirQualityMonitoring(NAAQM)ProjectfundedbyCPCBundertheMinistryofEnvironment,ForestandClimate Change(MoEF&CC),Govt. ofIndia.

In addition to the NAMP stations, ambient air quality is measured by seven Continuous Ambient Air QualityMonitoringStation(CAAQMS).ThelocationsoftheNAMPandCAAQMSaregiveninthetable2-12andfig2-20.

Table.2-12:- ThelocationsofNAMP andCAAQMSinChennaiU.A.

Manual	**CAAQMS**
1.Kathivakkam	1.Kathivakkam
2.Manali	2.Koyambedu
3.Thiruvottiyur	3.Royapuram
4.AnnaNagar	4.Perungudi
5.Adyar	5.Kodungaiyur
6.ThiyagarayaNagar	6.Manali
7.Kilpauk	7.Gummidipoondi
8. Nungambakkam	

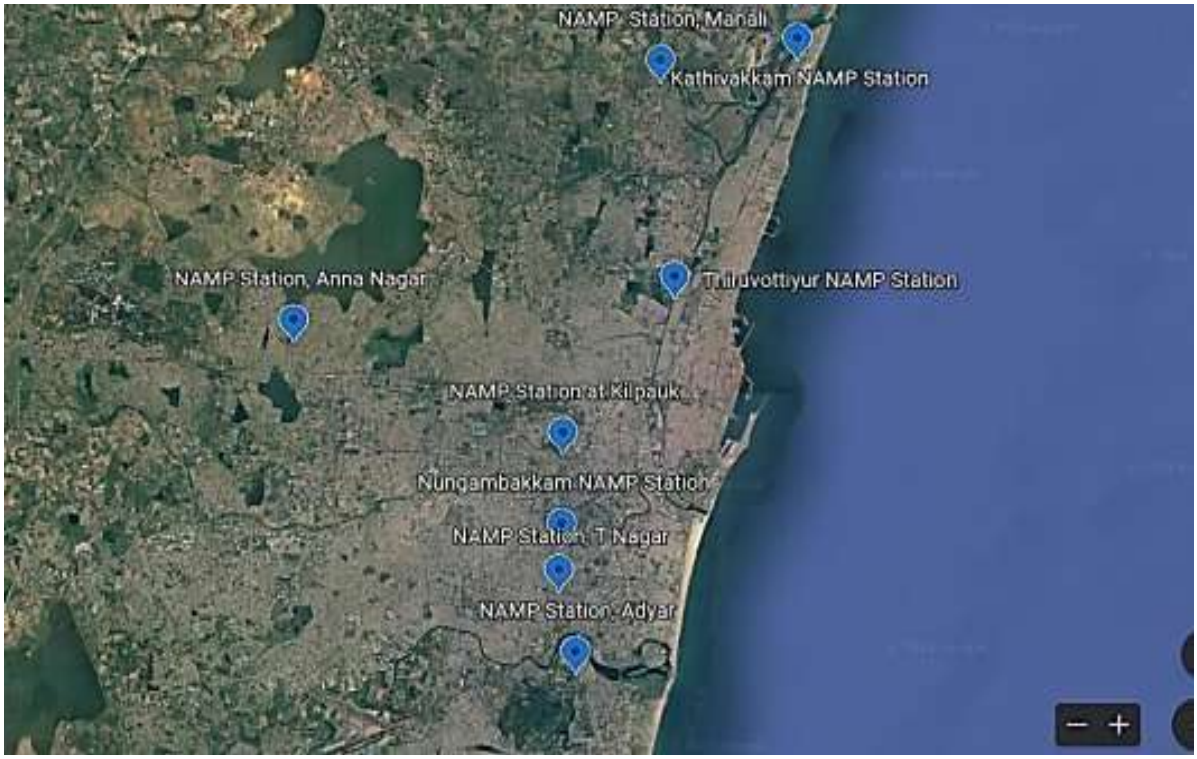

Figure2-20:- LocationsofNAMP StationsinChennaiU.A.

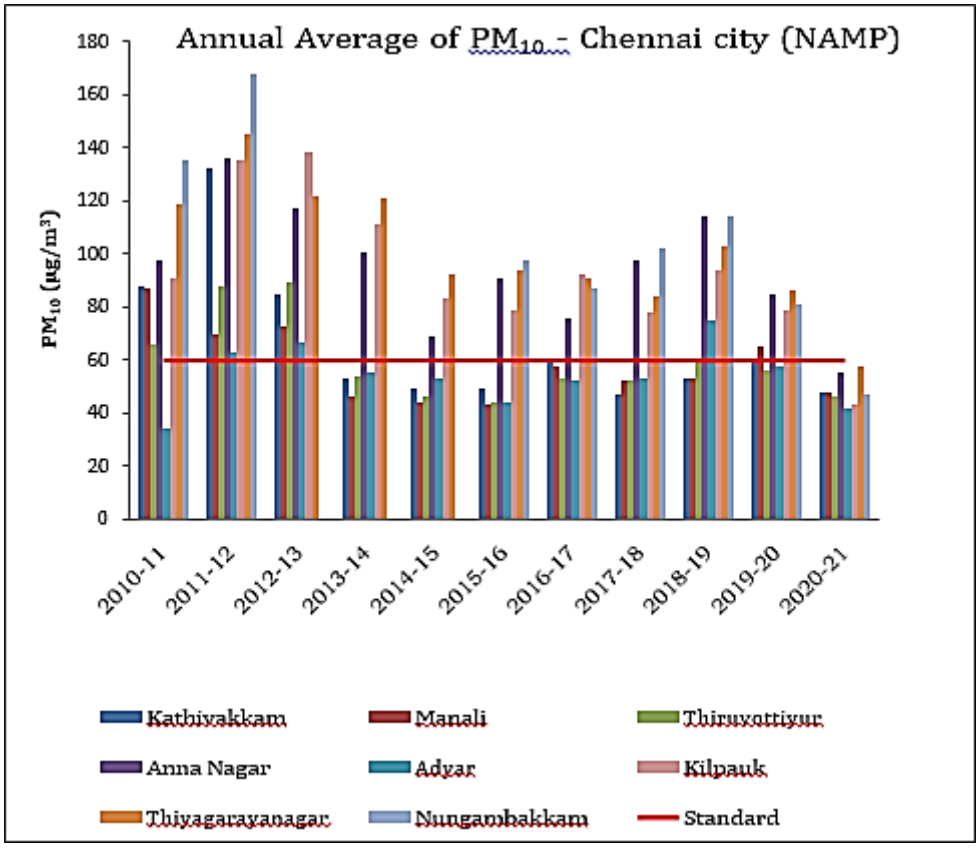

Figure2-21:- AnnualaverageofPM10–ChennaiCity.

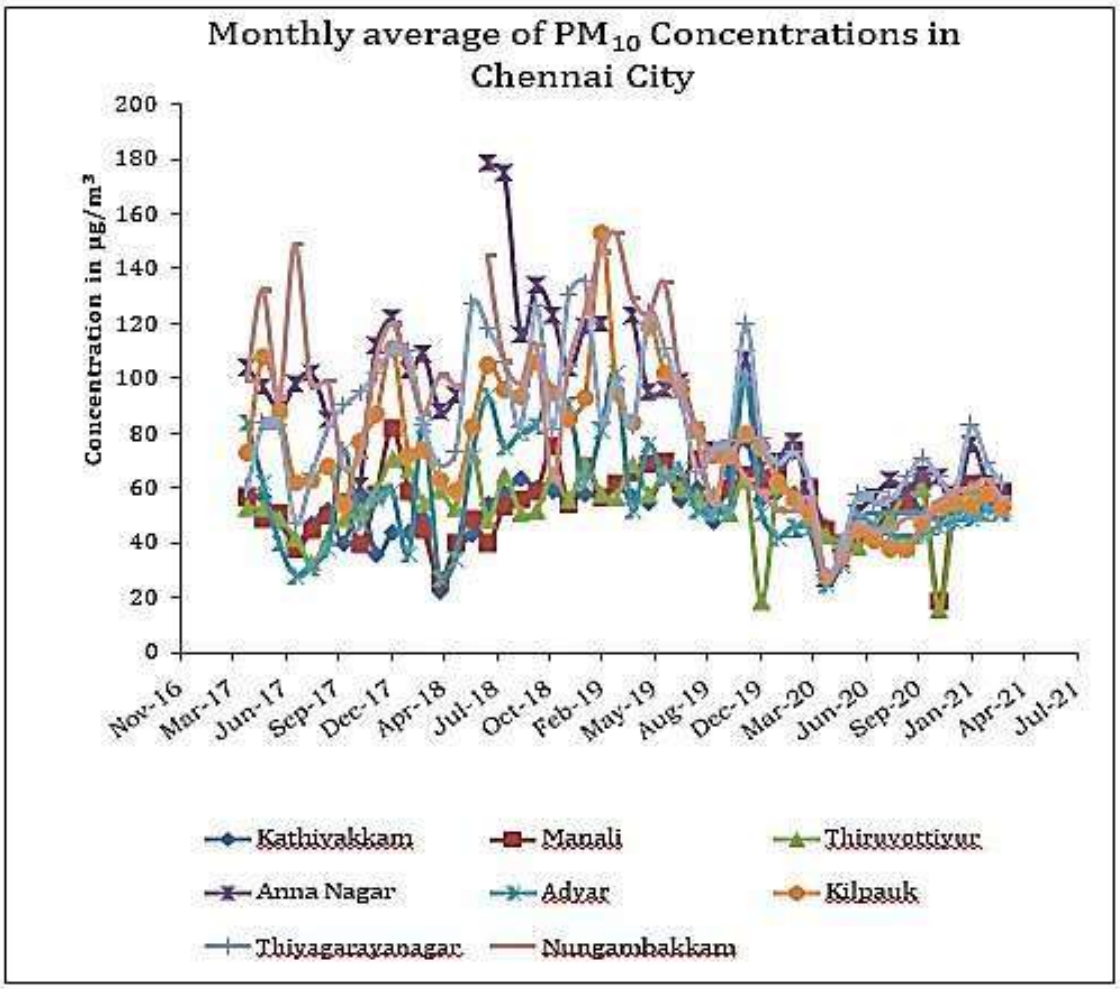

Figure2-22:-Monthlyaverage ofPM10 Concentration inChennaiU.A.

Table2-13:- Annual AverageofPM10valuesinChennaiUA.

Year	Kathivakkam	Manali	Thiruvottiyur	AnnaNagar	Adyar	Kilpauk	Thiyagarayanagar	Nungam-bakkam	AveragePM10 inheCity
	µg/m3								
2010-11	88	87	66	98	34	91	119	135	90
2011-12	132	70	88	136	63	135	145	168	117
2012-13	85	73	89	117	67	138	122	--	99
2013-14	53	46	54	101	55	111	121	--	77
2014-15	49	44	46	69	53	83	92	--	62
2015-16	49	43	44	91	44	79	94	98	68
2016-17	60	58	53	76	52	92	91	87	71
2017-18	47	52	52	98	53	78	84	102	71
2018-19	53	53	59	114	75	94	103	114	83
2019-20	59	65	56	85	58	79	86	81	71
2020-21	48	48	46	55	42	43	58	47	48
AnnualAverageStandard=60µg/m3									

AirqualitycategorybasedonPM10ConcentrationfurnishedinTable2-14.

Table2-14:- AirQualityCategorization.

Category	PM10µg/m3
Severe+orEmergency	AmbientPM10concentrationvaluesof 500µg/m3persistfor 48hoursor more
Severe	AmbientPM10concentrationvalueis between430µg/m3
VeryPoor	AmbientPM10concentrationvalueisbetween351-430µg/m3
Poor	AmbientPM10concentrationvalueisbetween251-350µg/m3
Moderatetopoor	AmbientPM10concentrationvalueisbetween101-250µg/m3
Satisfactory	AmbientPM10concentrationvalueisbetween51-100 µg/m3
Good	AmbientPM10concentrationvalueisbetween0-50µg/m3

Based on the observed PM_{10}concentration (Fig 2-20- & 2-21), the concentration of the PM_{10}pertains to yearly andmonthly average for the period April-17 to March 21 at Kathivakkam, Manali, Thiruvottiyur, Annanagar, Adyar,Kilpauk,ThiagarayanagarandNungambakkamare variedfrom47to60,43to65, 44to59,55to114,42to75,43to94, 58 to103and47to 114.Air quality dataPM10(24h)concentration of Chennai city during the period April2017toMarch2021showedthe Chennaicityfalls under**—Satisfactory**.

Results/Key Observations:-

FromthereviewofChennaicity profile,certainkey observationshavebeenmadepertainingtogivemorefocusonreducesofimpactofurbanization inChennai.The focuscontext,aslistedbelow:

1. Thecityhaswellestablishedroadnetworkconnectingvariousother importantcitiesinIndia.
2. Theroadnetworkhasaradialpattern, withfivemajor roadsdepictingafive-finger plan
3. Ribbondevelopment ofurbanareasalongmajorradialroadsovertheyearshasbeenobserved
4. TheMunicipalitiesandTownPanchayatshaveexperiencedhighergrowthratethanthat oftheCity.
5. TheCMA hashighdecadalgrowthrate owing to the growthofpopulationalong the outerregions.
6. Totalvehiclepopulationhasincreasedbyanaverageof6.61%perannumwithamajorshareofincreaseinpersonalisedmodes.
7. Two wheelers and pedestrians account to85% of the accidentvictims calling for the need forimprovementinroadconditions andraisingsafetyconcerns.
8. AirqualitydataPM10(24h)concentrationofChennaicityduringtheperiodApril2017toMarch2021showed theChennaicityfallsunder**—Satisfactory**

Referernces:-

1. ChennaiMetropolitanDevelopmentAuthority,(2008),SecondMasterPlanforChennaiMetropolitanArea,2026,Vol.I, II,III.
2. ChennaiMetropolitanDevelopmentAuthority,MetroRainLtd.,&UrbanMassTransitcompanyLtd.(2019),Comprehe nsive MobilityPlanforChennaiMetropolitanArea,FinalReport,May,2019.
3. Census2011.
4. Source:OfficialwebsiteofGCC(Populationmentionedforanareaof426sq.km)
5. http://www.chennaicorporation.gov.in/about-chennai-corporation/aboutCOC.htm
6. http://www.chennaicorporation.gov.in/departments/roads/index.htm
7. http://www.tn.gov.in/sta/g4.pdf
8. TamilNaduPollutionControlBoard(2014),ActionPlanforcontrolofAirPollutioninMillionPluscityofTamilNadu (Revised),ChennaiU.A
9. TamilNaduPollutionControlBoard(2021),ActionPlanforcontrolofAirPollutioninMillionPluscityofTamilNadu(Re vised),ChennaiU.A.