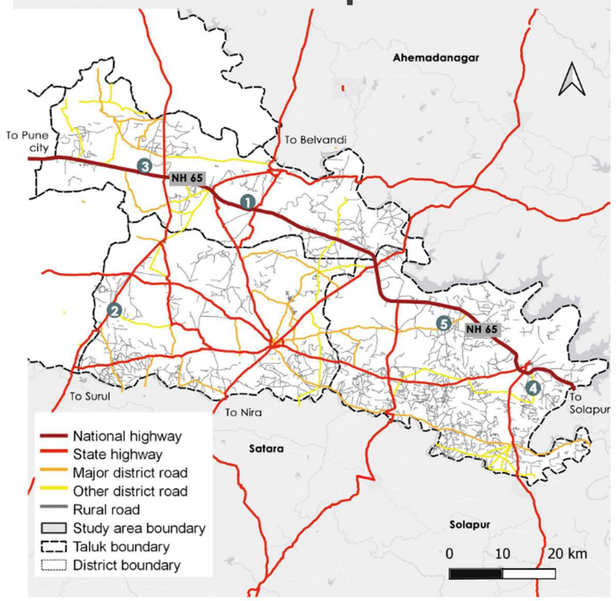
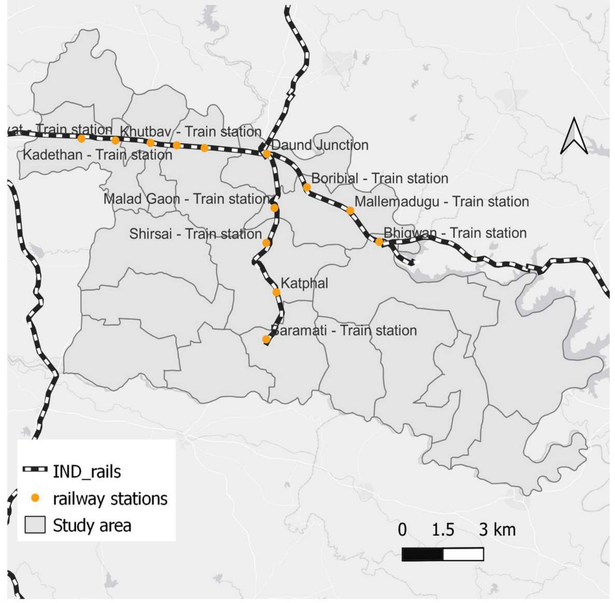
BASELINE STUDIES FOR THE DISTRICT : TRANSPORTATION

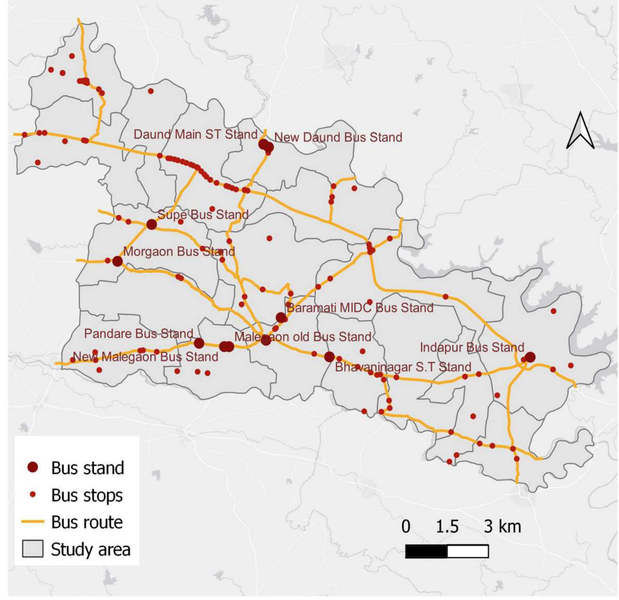
Road network map



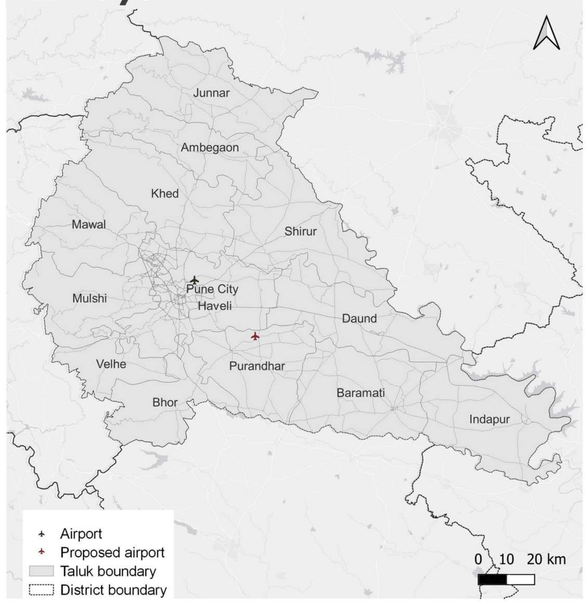
Rail network map



Public transportation



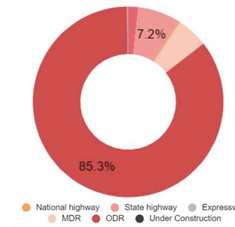
Airways



Item	2009-10	2010-11	Percent Increase or Decrease in 2008-09 in comparison with 2009-10
No of Road at the End of Year	903	894	-1
Total length of Roads	71007.2	70957.1	-0.1
Average length of Roads	78.63	79.37	0.9
Actual no of buses working	1016	1020	0.4
Average no of buses on the road per day	945	962	1.8
Average no of passenger per day	3.36	3.73	11
Yearly income	25404.8	29312.97	15.4
Average income per passenger	20.73	21.56	4

ROAD HIERARCHY

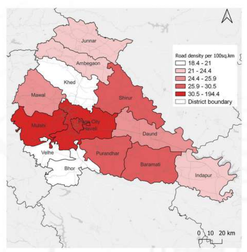
SOURCE: Maharashtra state data bank beta



- The road network in the city is primarily radial and rectilinear/ circumferential.
- The central core area of the city has network consisting of commonly 2-lane undivided roads that can broadly be marked as grid iron pattern, showing high density of roads

ROAD DENSITY/100sq.km

- Bhor, Velhe, Khed taluka has low road density due restriction on road construction in western ghat region.
- The maximum road density is of Haveli taluka due to high road network compared to taluka area.



SOURCE: PMRDA report

- Pune District is connected by the railway from the East to West direction but there is no railway connectivity from North through South region.
- The broad gauge single and double track rail length within the district have a total length of 311 km.
  Of these, a single line is 162 km, and the double line is 149 km.
- Pune and Daund are the two railway junctions in Pune district.
  The Pune Suburban Railway connects Pune to Lonavala, a small town en-route to Mumbai.
  Following are the three main railway routes
  1. Mumbai-Pune-Solapur Rail route: It enroutes the Khandala, Lonavala, Talegaon, Pune
  2. Pune-Miraj Rail route: It enroutes Fursungi, Alandi (Mhatobachi), Shidwane, Jejuri, Dondaj, Walhe, Nira.
  3. Daund-Baramati Rail route: It enroutes Shirsuphal, katphal, Tandulwadi

Characteristics of Existing Railway Lines in PMR

Route	Length (km)	Specification	Annual Ridership (million)	Capacity
Pune-Lonavala	63	Double line	28.6	142
Pune-Daund	64	Double line	NA	107
Pune-Miraj	32	Single line	14.5	118

Source: Central Railway, Pune Division.

BUS TRANSPORTATION SYSTEM

PMPML serves the city centre and suburbs up to 20 km from PMC and PCMC boundaries

A fleet size of **1,500** operating on **371** routes.

Long-distance PMPML bus routes operate at lower than **2-hour frequency** due to **less ridership.**

PMPML buses

PMPML Electric buses

2013

420 million passengers

Decreased ridership

2016

390 million passengers

Under the Maharashtra Electric vehicle policy, the state aims to achieve 25% electrification of public transport

MSRTC provides intercity bus services for passengers travelling outside Pune.

Number of fleets

over **18,000** buses.

Number of passengers on MSRTC buses

average of **0.3 million** passengers

Buses run from four bus terminals

- Swargate
- Shivaji Nagar
- Pune Railway Station
- Vallabh Nagar

- Pune district has one international airport which is at Lohegaon and is infused with an army base.
- It is 10 KM away from Pune city- centre.
- It has connectivity through the SH 27 and an 18 meter wide road.

runway length of **2,539 m**

The airport **shares facilities** with the **Air Force base** leading to **restrictions** on operations of civil flights.

- Government of Maharashtra has proposed developing a new greenfield airport in Purandar taluka.

38KM from Pune city

The airport ANNUALLY handles

8.16 million passengers

41,566 tonnes of cargo

growing passenger handle at an average **CAGR of 19%** in the past three years.

Special Planning Authority

MADC is appointed as the nodal agency

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Sub - Regional Plan: Pune District -2042

Sheet made by:
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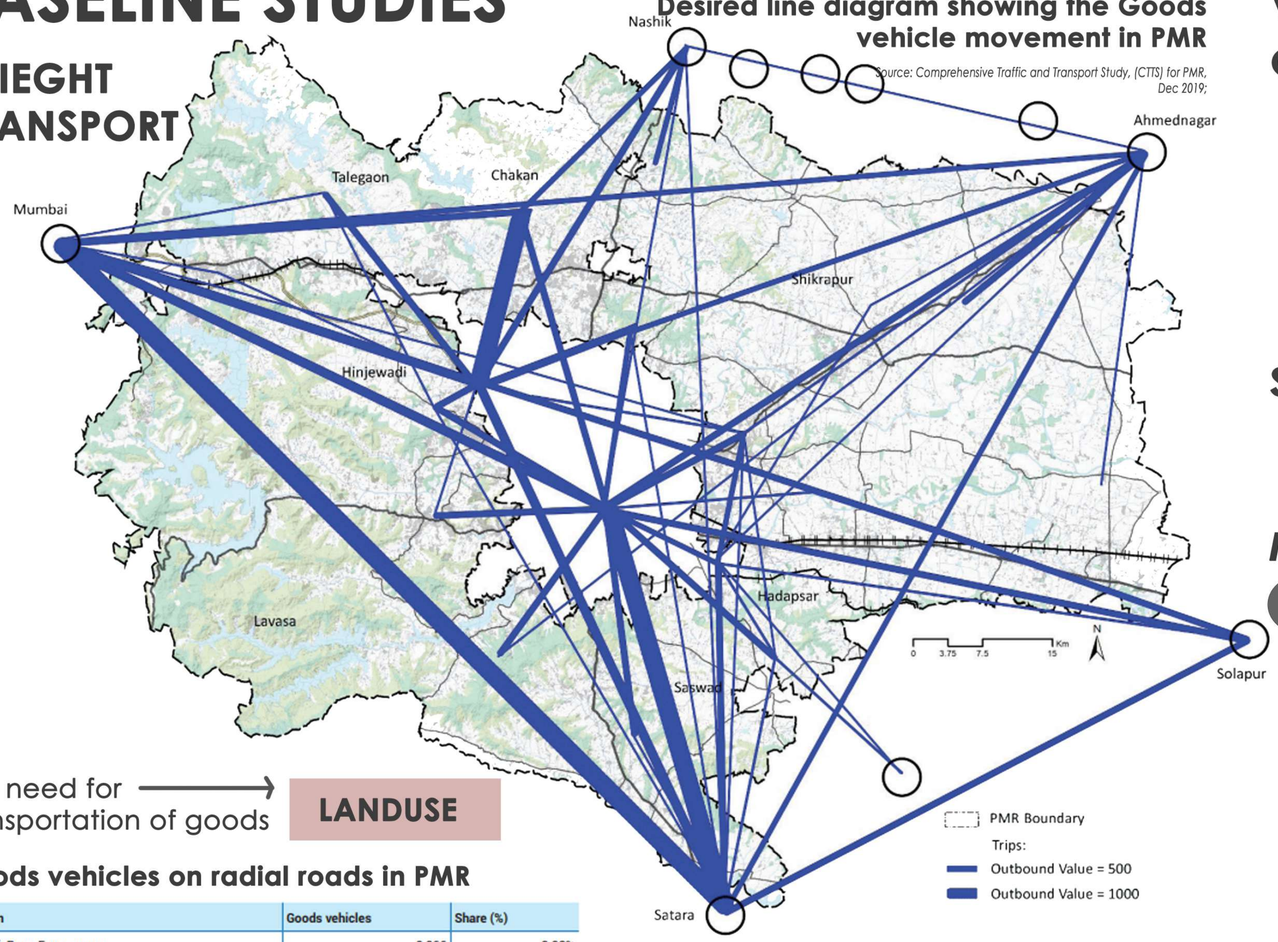
SHEET NO: **8.1**

Sector: Transportation

BASELINE STUDIES

FRIEGHT TRANSPORT



The need for transportation of goods → **LANDUSE**

Goods vehicles on radial roads in PMR

Location	Goods vehicles	Share (%)
Mumbai-Pune Expressway	9,066	8.03%
Saswad-Jejuri Road	3,482	3.08%
Moshi Toll Plaza, Nashik Road	13,810	12.23%
Near Sambhaji Chowk, Alandi Road, Alandi	5,365	4.75%
Nagar Road	10,484	9.28%
Kawadipeth Toll Plaza, Solapur Road	12,851	11.38%
Saswad Road	7,007	6.20%
Saswad-Bopdev Road	2,836	2.51%
Sinhgad Road	3,615	3.20%
NDA Academy Road	2,904	2.57%
Near Bhugaon, Mulshi Road	3,277	2.90%
Shivaji Chowk, Hinjawadi	3,376	2.99%
Dehu Road Toll Plaza, Mumbai-Pune Highway	9,781	8.66%
Talwade, Dehu Alandi Road	12,279	10.87%
Katraj-Satara Road	5,211	4.61%
Sus Road	1,758	1.56%
Nande-Balewadi Road (Mahalunge)	1,068	0.95%
Manjari Village, Manjari Road	2,742	2.43%
Lohegaon-Nirgudi Road	215	0.19%
Lohegaon-Wagholi Road	1,836	1.63%
Total	1,12,963	100

PMR

Automobile manufacturing hub with industrial and warehouses spread across the region along major transport corridors

Higher volumes of freight travelling are observed on :

Nashik Road | Nagar Road | Saswad Road | Solapur Road | Mumbai-Pune Expressway

- In terms of percentage share of traffic, the highest share is seen on Nashik Road and Solapur Road due to the rail siding facility near Fursungi.
- All national highways are identified as major freight corridors for PMR.
- The movement of heavy vehicles within the municipal limits during the daytime is restricted to avoid their impact on local traffic.
- Goods movement in PMR is also catered to by the rail systems.

Vision Formulation and Sectoral Methods

OBJECTIVES

1. To analyze and evaluate the existing transportation infrastructural facilities in the study area
2. To project the future line demand and requirements for the study area in terms of traffic and increasing vehicular count.
3. To recommend strategies to improve the quality of the transportation facilities and development patterns that provide easy and efficient access to the services

SCOPE

Preparation of vision documents, plans and formulation of stratergies for the study area which includes three talukas of Pune district ie, Indapur, Bharamati,Daund using GIS based mapping and network formation.

METHODOLOGY

1 BASELINES STUDIES → **2 FORMULATION OF OBJECTIVES AND DATA TO BE COLLECTED**

District level data collection from secondary sources

- Comprehensive mobility plan- 2008
- Draft city development plan for Pune city
- PMRDA Report 2021-41
- Maharashtra electric vehicle policy
- Data bank

- Studying the existing transportation facilities → Focusing on the road network facilities, accessibility and coverge to public mode of transport
- Studying the road network and connectivity → Primary surveys on road inventory, traffic count, v/c for the major corridors
- Identifying the gaps and impact of public transportation sector on the urban system → Projections, Demand and gap assessment

3 ANALYSIS REQUIRED

- Connectivity index
- Road prioritisation
- Projection of vehicles and traffic for the project year
- Gap and demand extimations

4 EXISTING SCHEMES AND PROPOSALS

- Maharastra electric vehicle policy
- High speed rail corridor and crescent railway project
- Suburban railway
- Pradhan Mantri Gram Sadak Yojana
- Developmnet of metro linking growth centres to PMC and PCMC
- Expansion and upgradation of the NH, ring roads and secondary roads
- Development of multi-modal hub, truct terminals, tansit corridors under PMRDA plan

5 ISSUE IDENTIFICATION & PROPOSALS

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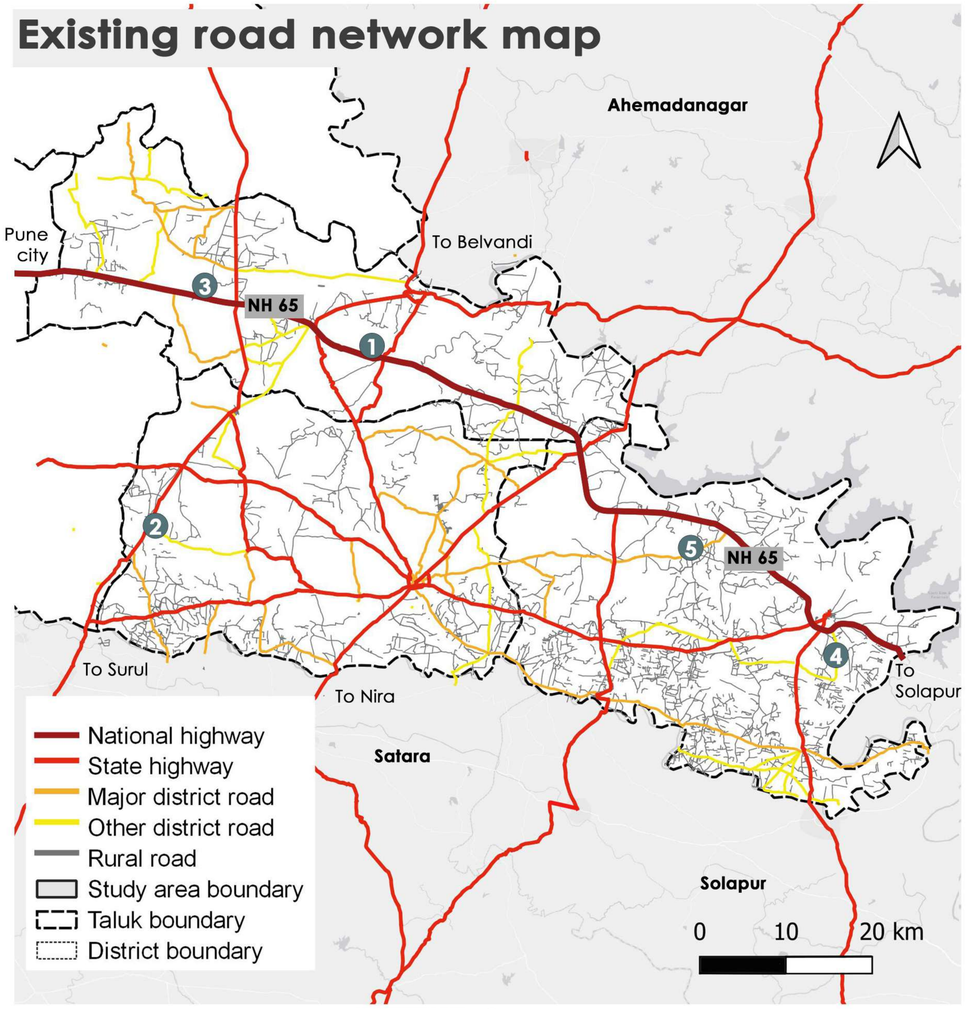
SHEET NO: **8.2**

Sector: Transportation

ANALYSIS : ROAD INVENTORY

Existing road network map



National highway- Solapur- Pune highway

State highway- Shirur Satara road

MDR- Choufulla-supa road

ODR- Raja Kelkar Rd

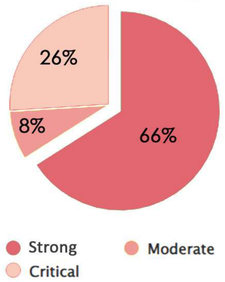
Rural road- Bhongalewasti Road

Baramati

Quality of road (All weather roads)

65%

% of GPs with Gap type



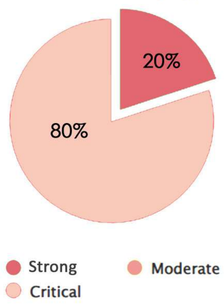
The overall coverage if all weather road is 65% out of which 26 gram pancayats are not having connection to these roads and 8 gram panchayats have partial connection

Gap Type	No. Of GPs
Strong	66
Moderate	8
Critical	26

Internal Road- (CC/ Brick roads)

56%

% of GPs with Gap type



The overall coverage of onternal roads are 56% out of which 80 gram pancayats are not having connection to these roads which is highly critical and needs to be addressed

Gap Type	No. Of GPs
Strong	20
Moderate	0
Critical	80

New villages connected to all weather road

6%

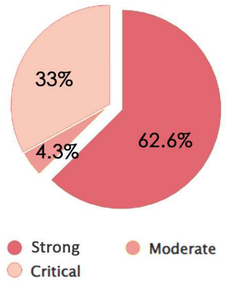
TYPE	LENGTH (IN KM)
Major district road	183.03
National highway	1517.93
Other district road	89.87
State highway	1552.50
TOTAL	**3343.33**

Indapur

Quality of road (All weather roads)

63%

% of GPs with Gap type



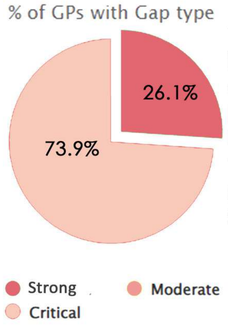
The overall coverage if all weather road is 63% out of which 38 gram pancayats are not having connection to these roads and 5 gram panchayats have partial connection

Gap Type	No. Of GPs
Strong	72
Moderate	5
Critical	38

Internal Road- (CC/ Brick roads)

67%

% of GPs with Gap type



The overall coverage of internal roads are 67% out of which 85 gram pancayats are not having connection to these roads and 30 gram panchayats have strong connectiivity

Gap Type	No. Of GPs
Strong	30
Moderate	0
Critical	85

New villages connected to all weather road

8%

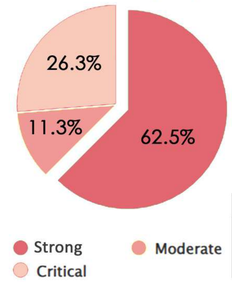
TYPE	LENGTH (IN KM)
Major district road	114.81
National highway	1517.93
Other district road	98.90
State highway	625.20
TOTAL	**2356.84**

Daund

Quality of road (All weather roads)

63%

% of GPs with Gap type



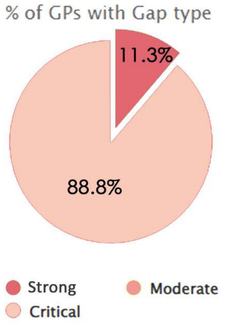
The overall coverage if all weather road is 63% out of which 21 gram pancayats are not having connection to these roads and 9 gram panchayats have partial connection

Gap Type	No. Of GPs
Strong	50
Moderate	9
Critical	21

Internal Road- (CC/ Brick roads)

66%

% of GPs with Gap type



The overall coverage of interanl roads are 66% out of which 71 gram pancayats are not having connection to these roads which is comparatively lesser than the other tehsils in the study area

Gap Type	No. Of GPs
Strong	9
Moderate	0
Critical	71

New villages connected to all weather road

11%

TYPE	LENGTH (KM)
Major district road	79.93
National highway	1517.93
Other district road	123.05
State highway	1605.01
TOTAL	**3325.92**

source: Data retrieved from mission antyodaya 2020, Ministry of rural development, GOI

ROAD WIDTH

	Standard Roadway width (in m)	Existing roadwidth (in m)
National/ state highway	12	18 to 12
Major district roads	9	7 to 8
Other district roads	7.5	7
Rural roads	7.5	4

source: Author 2022, IRC standards

It can be observed that the connectivity to this region is predominantly served by major roads and highways and the region lack in local network connectivity which needs to be addressed

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Sub - Regional Plan: Pune District -2042

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SHEET NO: **8.3**

Sector: Transportation

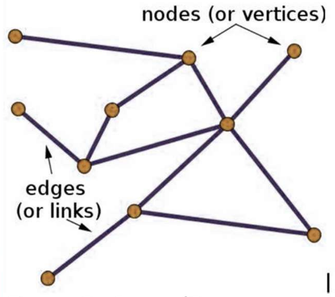
ANALYSIS : TRANSPORTATION

Connectivity index

Tthe relative degree of connectedness within a transportation network.

METHODOLOGY

1. Road network map of the study area to be obtained (Using open street map / Road transportation authority)
2. Conversion of shapefiles to network data, after removing all topological errors using Topology checker tool in QGIS
3. Use of network analyst extension in GIS to calculate the number of nodes, Edges to obtain the connectivity indices



NETWORK PARAMETERS

NODES- a point at which lines or pathways intersect or branch; a central or connecting point

EDGES / LINKS- is a link between two nodes

Total number of nodes- sum of the number of junctions and link ends

Total number of links- sum of number of roadway segments between junctions and link ends

Road density

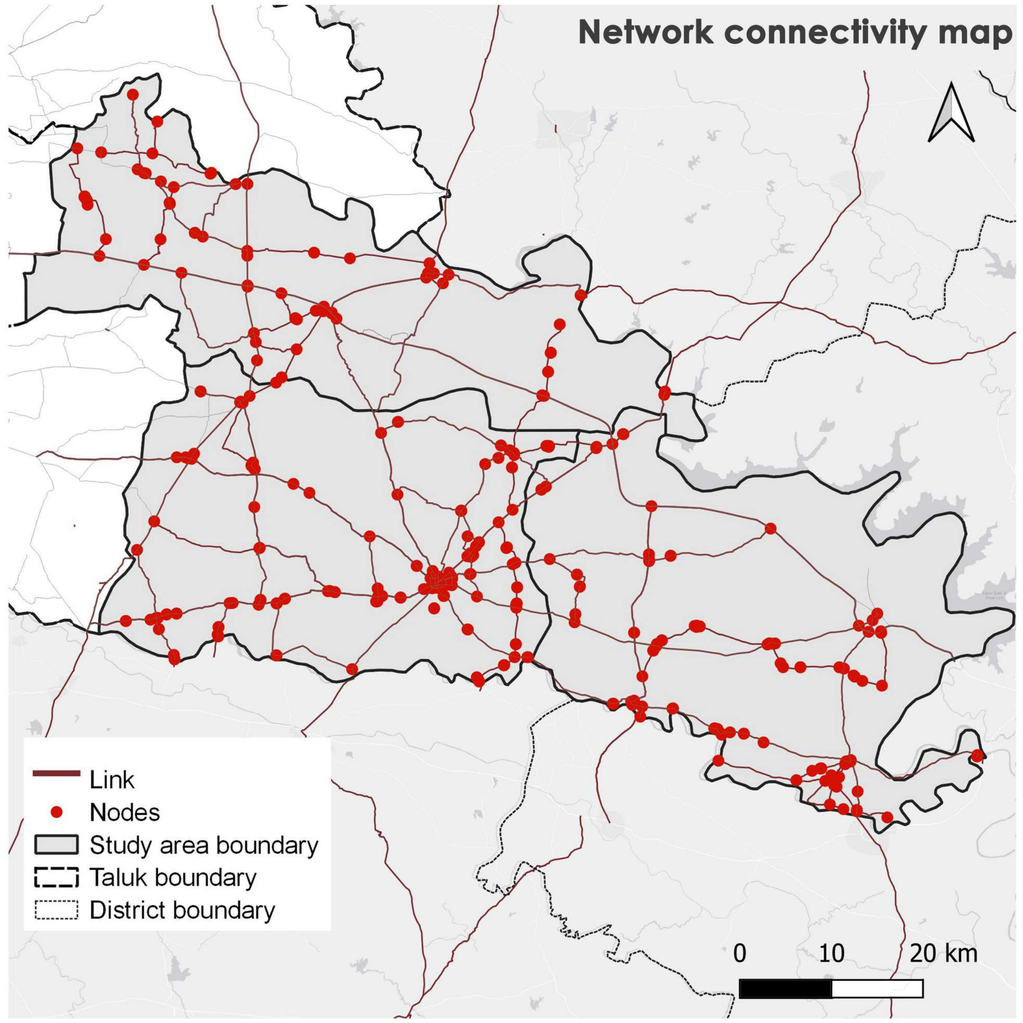
Tehsil Name	Length	Area (in sq km)	Population	Railway	Length of NH	Road density per 100 sq.km	Road Density Per Population	Railway density per 100 sq km
Daund	324.1882	1307	331,046	87.84078	178.92	24.80399	97.92843	6.72079
Baramati	361.1604	1371	375,185	26.12031	74.64	26.34285	96.26196	1.9052
Indapur	316.6132	1465	357,668	8.440943	163.83	21.61183	88.52154	0.57617

source: Author 2022

It is observed that Indapur have the least road density among the three taluks which indicated the relatibe lower connectivity
overall the road density values in the study area is lower, due to presence of undeveloped roads in the rural fringes of the district

CONNECTIVITY INDICES

Alpha index	α=(e-v+1)/2v-5	e = number of edges/ links v= number of nodes/	the degree to which it provides alternative paths for travelling from one node to another.	**index** usually ranges from **0 to 1**, but can be also expressed by percentage. The **higher the alpha value**, the **higher the connectivity** of a network
Beta Index	β=e/v	e = number of edges/ links v= number of nodes/	reflects the complexity and completeness of a network	**β < 1** indicates a **disconnected network**; **β = 1** a **single circuit**; **β > 1** implies greater **complexity**, **Higher** the **connectivity**, **lower** the **nodes**, **higher** the **beta value**
Gamma index	γ=e/3(v-2)	vertices e = number of edges/ links v= number of nodes/	the extent to which the nodes are connected. It yields the ratio between the links and nodes of a given network.	values range between **0 and 1 (or percentages)** and are **independent of the number of nodes** within a graph
Eta index	η =L/e	vertices L= summation of all the edges	measure the average edge length in the network	If a **new link is added**, so it will **decrease in eta index**, as average per link declines.
Cylomatic index	μ = e-v+1	e = number of edges/ links v= number of nodes/	indicates the complexity of a method by measuring the number of linearly independent paths.	**Highest Cyclomatic numbe**r represents its **more closeness** and more connected state of the network.
Aggregate Transportation score	ATS=β+α+γ+μ	α = alpha index β = beta index	the addition of alpha, beta, gamma indices and Cyclomatic number.	**Higher aggregate transportation score value** results in **higher degree of connectivity** and efficiency.
Connected node ratio	CNR=J/v	J= Number of junction v= number of nodes	the ratio of number of road junctions to the number of nodes (junctions plus link ends).	**Maximum value** of CNR is **1.0**. A higher number exhibits that there are proportionately few link ends and, theoretically, higher connectivity of road network.
Road density	RD= RL (km) / A (sq.km)	RL is the road length of road network and A is the area.	length of the total roads in the network per square kilometre of area.	**Higher number** of road density would exhibit more roads and probably, **higher connectivity** of road network.



Number of links 945

Number of junctions 601

Number of nodes 1554

Number of Nodes= Number of junction + Number of links
= 945+6010 = 1554

S.NO	NAME OF THE INDEX	NOTATION & EQUATION		INFERENCE
1	Alpha index	α=(e-v+1)/2v-5	0.196	Low
2	Beta index	β=e/v	0.608	Low
3	Gamma index	γ=e/3(v-2)	0.203	Low
4	Eta index	η =L/e	4.329	
5	Cyclomatic number	μ = e-v+1	6.08	Moderate
6	Aggregate Transportation score	ATS=β+α+γ+μ	5.336	Low
7	Connected Node Ratio	CNR=J/v	0.392	

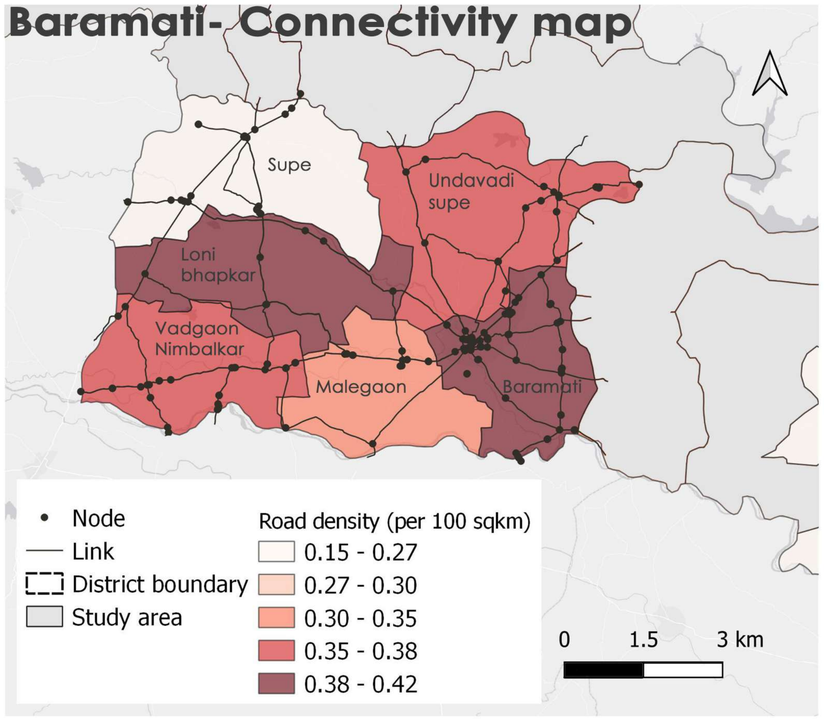
Since the aggregate transportation score value is 5.34, it represents the considerately low degree of connectivity in the study area
Since the beta value is less than 1, indicates that lower number of nodes, which is indirectly linked with the connectivity.

source: Author 2022

ANALYSIS : Connectivity indices

This analysis was carried out using the national highways, state highways, major district roads, other district roads as input data and the rural roads was excluded due to the presence of unclassified roads with dead ends, whereas the road density was caluculated considering all teh roads irrespective of its condition and width

Baramati- Connectivity map



Number of links 418

Number of junctions 230

Number of nodes 648

Number of Nodes= Number of junction + Number of links = 230 + 418 = 648

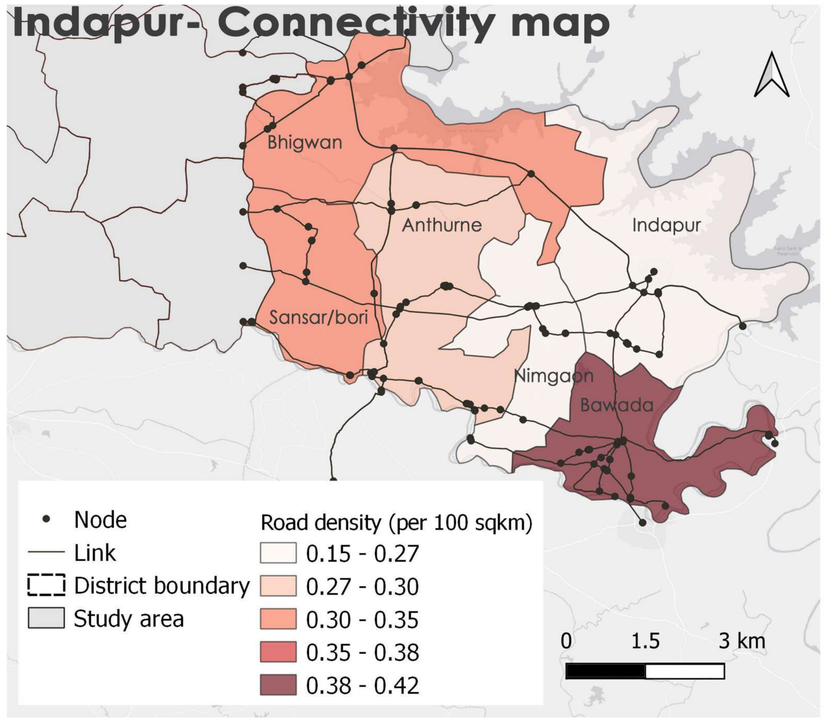
S.NO	NAME OF THE INDEX	INFERENCE	OUTCOME		INFERENCE
1	Alpha index	Higher value indicates more connectivity (**0.9- 0.28- lower value**, 0.28-0.47- Moderate value, 0.47-0.66- Higher value)	α=(e-v+1)/2v-5	0.18	Low
2	Beta index	Higher value indicates more connectivity (**0.1-1.37 - lower value**, 1.37-1.64 - Moderate value, 1.64- 1.93 - Higher value)	β=e/v	0.65	Low
3	Gamma index	Higher value indicates more connectivity (**0.46-0.57 - lower value**, 0.57- 0.68 - Moderate value, 0.68-0.79 - Higher value)	γ=e/3(v-2)	0.22	Low
4	Eta index	Higher value indicates more connectivity	η =L/e	4.79	
5	Cyclomatic number	Higher value indicates more connectivity (1-4.66 - lower value, **4.66-8.32 - Moderate value**, 8.32-12 - Higher value)	μ = e-v+1	6.46	Moderate
6	Aggregate Transportation score	Higher value indicates more connectivity and efficiency (1.56-6.15 - lower value, 6.15-10.74 - Moderate value, **10.74-15.35 - Higher value**)	ATS=β+α+γ+μ	12.28	High
7	Connected Node Ratio	Higher value indicates more connectivity	CNR=J/v	0.35	

Revenue circle	Road density (L/A)
Baramati	0.415
Malegaon	0.315
Undavadi supe	0.382
supe	0.262
Loni bhapkar	0.425
Vadgaon Nimbalkar	0.374

Road density

The higher density fo roads can be observed in Baramati and loni bhapkar due to its high network connectivity and usage since these areas saerves as the main core area of the taluka

Indapur- Connectivity map



Number of links 222

Number of junctions 139

Number of nodes 316

Number of Nodes= Number of junction + Number of links = 139 + 222 = 316

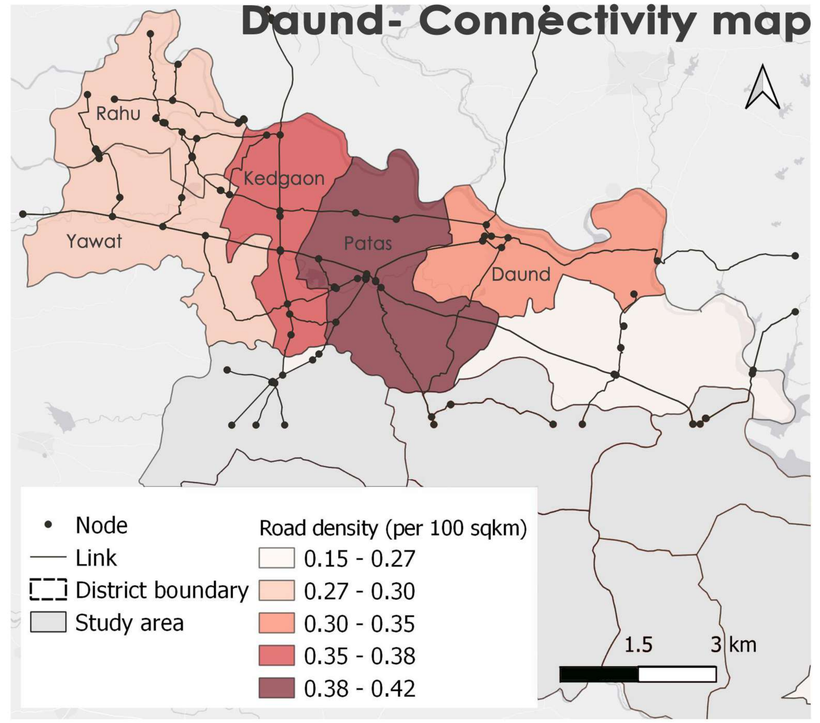
S.NO	NAME OF THE INDEX	INFERENCE	OUTCOME		INFERENCE
1	Alpha index	Higher value indicates more connectivity (**0.9- 0.28- lower value**, 0.28-0.47- Moderate value, 0.47-0.66- Higher value)	α=(e-v+1)/2v-5	0.01	Low
2	Beta index	Higher value indicates more connectivity (**0.1-1.37 - lower value**, 1.37-1.64 - Moderate value, 1.64- 1.93 - Higher value)	β=e/v	0.61	Low
3	Gamma index	Higher value indicates more connectivity (**0.46-0.57 - lower value**, 0.57- 0.68 - Moderate value, 0.68-0.79 - Higher value)	γ=e/3(v-2)	0.21	Low
4	Eta index	Higher value indicates more connectivity	η =L/e	4.21	
5	Cyclomatic number	Higher value indicates more connectivity (**1-4.66 - lower value**, 4.66-8.32 - Moderate value, 8.32-12 - Higher value)	μ = e-v+1	4.57	Low
6	Aggregate Transportation score	Higher value indicates more connectivity and efficiency (1.56-6.15 - lower value, **6.15-10.74 - Moderate value**, 10.74-15.35 - Higher value)	ATS=β+α+γ+μ	5.04	Moderate
7	Connected Node Ratio	Higher value indicates more connectivity	CNR=J/v	0.39	

Revenue circle	Road density (L/A)
Indapur	0.156
Bawada	0.388
Anthurne	0.299
Nimgaon	0.183
Bhigwan	0.351
Sansar/bori	0.329

Road density

The higher density fo roads can be observed in Bawada and Bori which have a relatively lower density compared to the condition in Baramati and Daund due to the presence of more unmetalled roads

Daund- Connectivity map



Number of links 170

Number of junctions 110

Number of nodes 280

Number of Nodes= Number of junction + Number of links =110 + 170 = 280

S.NO	NAME OF THE INDEX	INFERENCE	OUTCOME		INFERENCE
1	Alpha index	Higher value indicates more connectivity (**0.9- 0.28- lower value**, 0.28-0.47- Moderate value, 0.47-0.66- Higher value)	α=(e-v+1)/2v-5	0.01	Low
2	Beta index	Higher value indicates more connectivity (**0.1-1.37 - lower value**, 1.37-1.64 - Moderate value, 1.64- 1.93 - Higher value)	β=e/v	0.61	Low
3	Gamma index	Higher value indicates more connectivity (**0.46-0.57 - lower value**, 0.57- 0.68 - Moderate value, 0.68-0.79 - Higher value)	γ=e/3(v-2)	0.20	Low
4	Eta index	Higher value indicates more connectivity	η =L/e	3.68	
5	Cyclomatic number	Higher value indicates more connectivity (**1-4.66 - lower value**, 4.66-8.32 - Moderate value, 8.32-12 - Higher value)	μ = e-v+1	3.52	Low
6	Aggregate Transportation score	Higher value indicates more connectivity and efficiency (**1.56-6.15 - lower value**, 6.15-10.74 - Moderate value, 10.74-15.35 - Higher value)	ATS=β+α+γ+μ	4.49	Low
7	Connected Node Ratio	Higher value indicates more connectivity	CNR=J/v	0.39	

Revenue circle	Road density (L/A)
Daund	0.336
Ravangaon	0.219
Rahu	0.298
Yawat	0.282
Kegaon	0.373
Patas	0.406

Road density

Patas is observed to have relatively higher road density due to the presence of National / states highways and other major District roads which have added more significance to the region

source: Author 2022

Key observation

Overall **Baramati** is observed to have a relative **higher degree** of **connectivity** in the study area and **Daund** is observed to have a **lower connectivity index**

B.Planning IV Year, VII Semester
Department of Planning
School of Planning and Architecture, Vijayawada

Sub - Regional Plan: Pune District -2042

Sheet made by:
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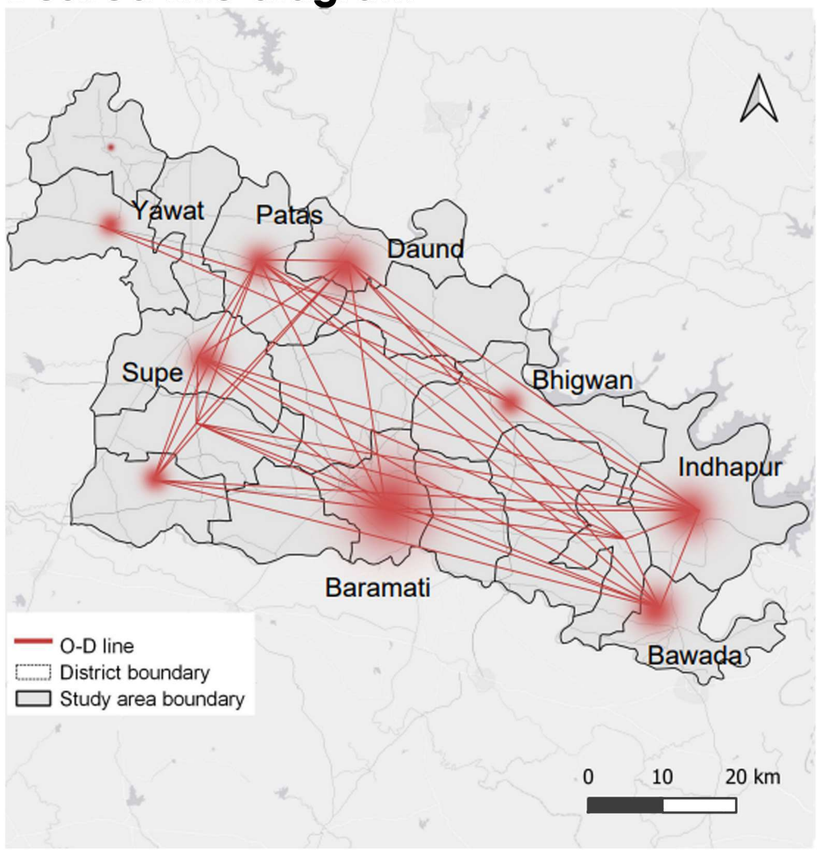
SHEET NO: **8.5**

Sector: Transportation

ANALYSIS : TRANSPORTATION

Desired line diagram

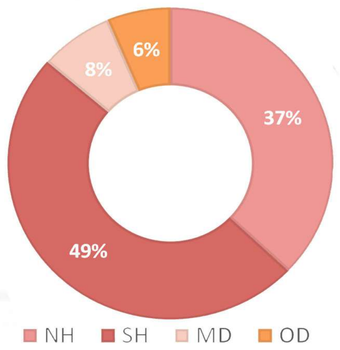


- The study area includes a National highway (NH65) connecting from Pune to Solapur
- The total length of the roads in the study area is 4092 km excluding the rural roads.
- Out of which The national and the state highway composition (37% & 49 % respectivity) is higher, which indicates the lack of connectivity at the neighborhood or local level of the study area

Hierarchy of roads in the study region

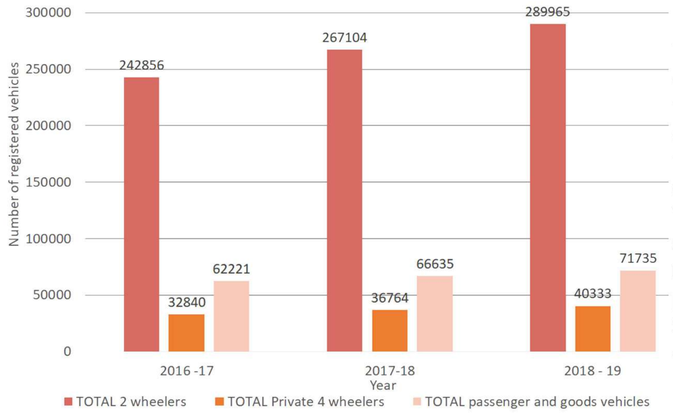
CATEGORY	LENGTH OF THE ROADS (KM)
National highway	1518
State highway	2014
Major district roads	302
Other district roads	258

source: Author 2022



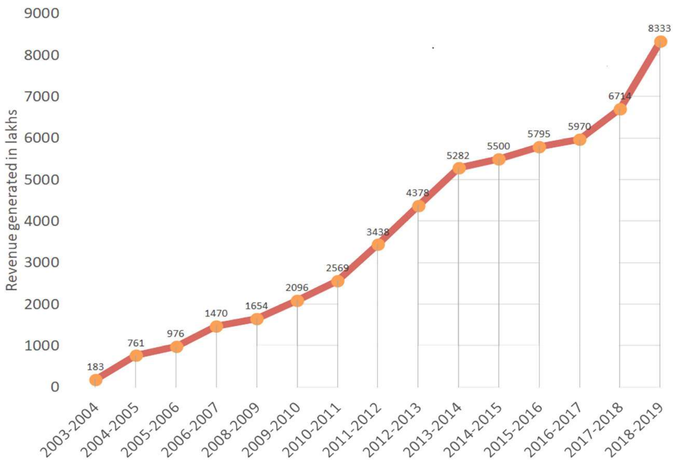
Vehicle ownership

Two wheelers are preferred the most



It can be noted from the graph that over the years from 2016- 2019, there has been an increase in the number of registered two wheelers and cars , which denotes the increasing dependence on private mode of transporation

Revenue receipts (in lakhs)



Overall for the study area, it can be observed that the use for private vehicles is higer owing to the poor connectvity of the public transportaion facilities

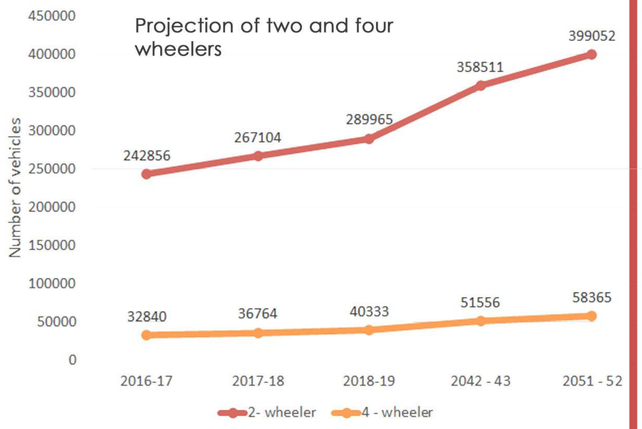
source: RTO office

Vehicular and travel characteristics

PROJECTION OF VEHICLES

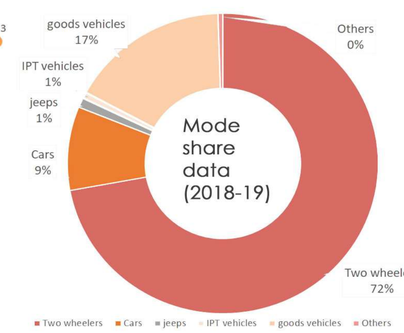
The future expected number of **two wheelers** is **399052** and the number of **4- wheelers** is **58365** vehicles, considering the rate of growth to be **9% and 10%. respectively**

Which calls for the need of stratergies and policies for reducing the dependence on private vehicles or develop startergies to reduce emmissions for the vehicles

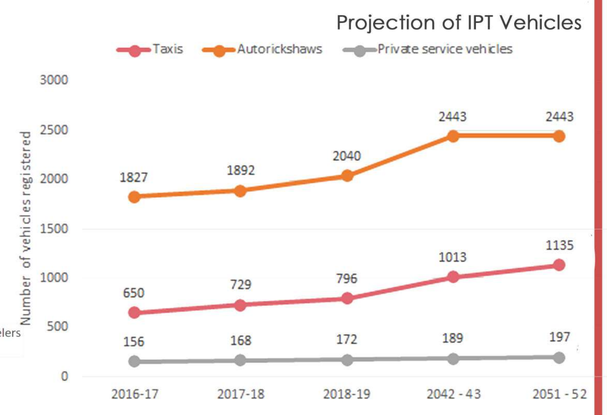


	Existing number			Projected number (geometric method)	
CATEGORY	2016-17	2017-18	2018-19	2042 - 43	2051 - 52
2- wheeler	242856	267104	289965	358511	399052
4 - wheeler	32840	36764	40333	51556	58365
IPT Vehicles	2633	2789	3008	3653	3775

MODE SHARE



source: RTO office



From the primary survey conducted from the study area of 60 respondents, it is also identifed that two wheelers are primary mode of transport for 41.7% of the respondents

Average daily trip length

6.5km

Trip Purpose

Education	work	Health	Recreation
16%	58%	19%	6%

** this data is obtained from primary survey collected from 60 respondents*

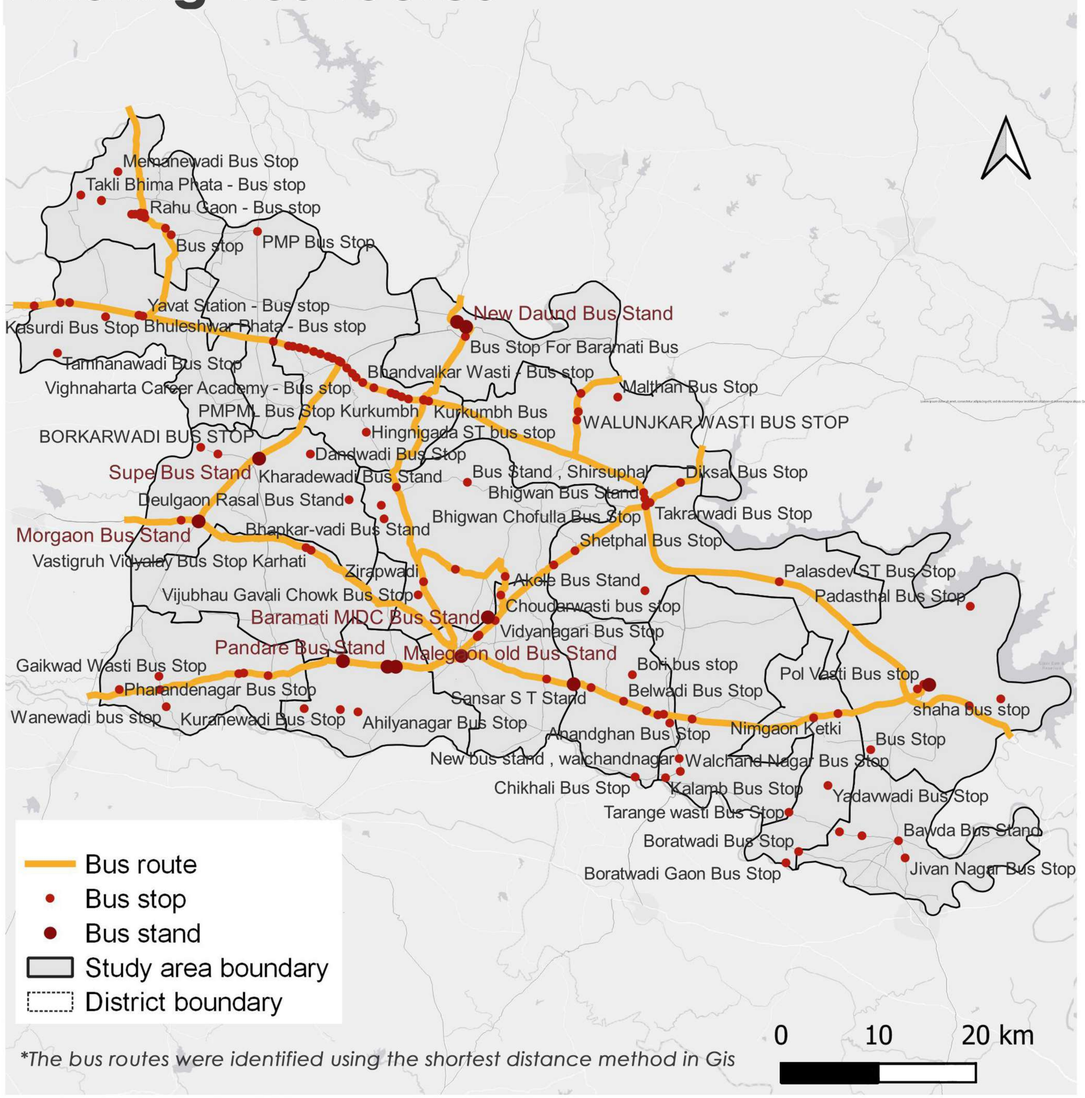
User rating for different modes of transport (1-poor to 5- excellent)

Highest rating is observed for private vehicles, due to comfort and reduced travel time

source: Author 2022

ANALYSIS : BUS TRANSPORTATION Network service area analysis

Existing Bus routes



*The bus routes were identified using the shortest distance method in Gis

Number of buses
88 *buses*

Bus capacity
44 *persons*

Expenditure per day
6-7 *lakhs*

Revenue per day
8-10 *lakhs*

Tentative passengers per day
15,000 *(In & Out)*

Fleet utilization
96% *avg*

source: Bus depot ,Baramati, Authors 2022

CONCESSIONS

- Free ticket after 75 years
- 50% concession, after 65 yrs and 5-12 yrs
- Concession of 25%-33% for students
- Free ticket fro girls upto 12th class under the schemes of ANILA....
- Free tickets for journalist and freedom fighters

METHODOLOGY

1 INPUT DATA- POINT FEATURE
The input data here is the bus stand point feature layer, for which the influence area have to be identified

2 MODE, DIRECTION & CUTOFF
DISTANCE/ TIME CUTOFF- mention the benchmark time or distance to be generated
Layer Properties window > Analysis Settings

3 Identification of critical zone
The area that does not fall under the services area- Critical zone

Time based analysis

- To identify the fire service station's service area, travel time zones i.e. within 1, 2, 3, 4, ...10,15 minutes were defined by adopting assumed drive time as impedance.

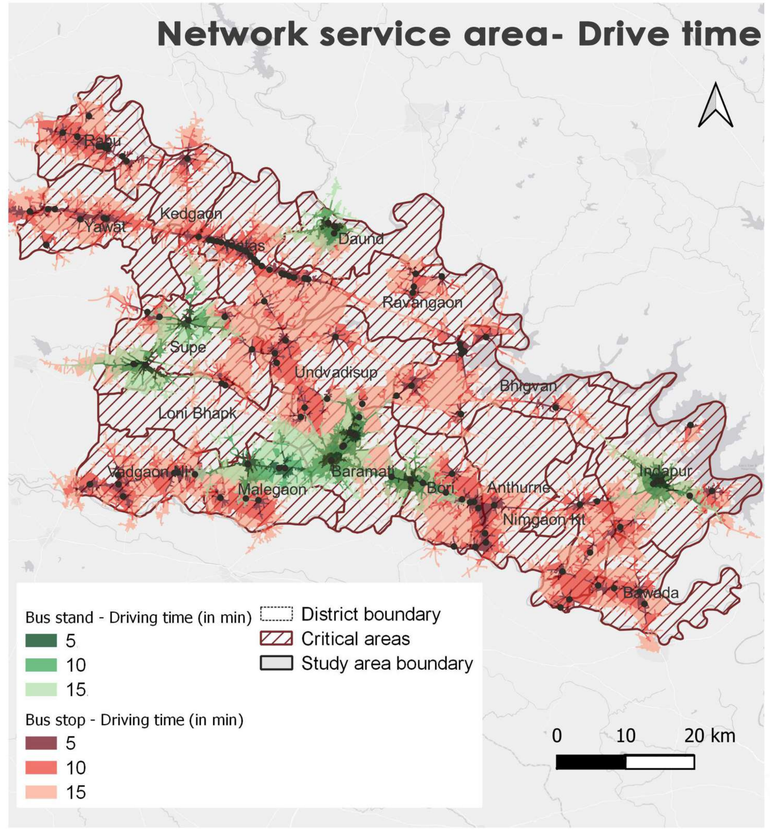
Identification of critical areas

- From the Service area analysis the area that are served and unserved by the facilitiy is identified By subtracting the served area from the boundary limits of the study area
- From this analysis the extend of coverage of each facilities in terms of accessibility is identified

Key finidngs

- This reveals that each of the existing stations covers only a negligible proportion of area in the study area within the 10 minutes travel from their location and hence, it is required atleast one more station for non-servicing areas
- The incorporation of risk prone areas in the service area analysis provides clear picture on high risk zones where fast accessible is absolutely necessary

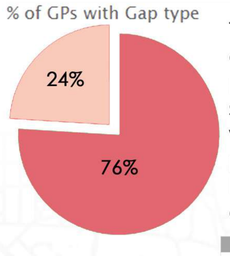
Network service area- Drive time



BARAMATI

Public Transport
74%

% of GPs with Gap type



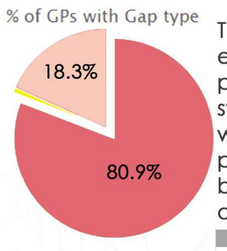
The overall efficiency of the public transportation system is 74% out of which 24 gram pancayats is not been served- Critical areas

Gap Type	No. Of GPs
Strength	76
Moderate	0
Critical	24

INDAPUR

Public Transport
85%

% of GPs with Gap type



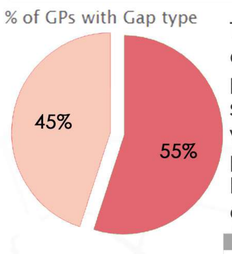
The overall efficiency of the public transportation system is 85% out of which 21 gram pancayats is not been served- Critical areas

Gap Type	No. Of GPs
Strength	93
Moderate	1
Critical	21

DAUND

Public Transport
56%

% of GPs with Gap type



The overall efficiency of the public transportation system is 56% out of which 36 gram pancayats is not been served- Critical areas

Gap Type	No. Of GPs
Strength	44
Moderate	0
Critical	36

source: Data retrieved from mission antyodaya 2020, Ministry of rural development, GOI

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Sub - Regional Plan: Pune District -2042

Sheet made by:
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SHEET NO: **8.7**

Sector: Transportation

PROPOSED ROAD NETWORK

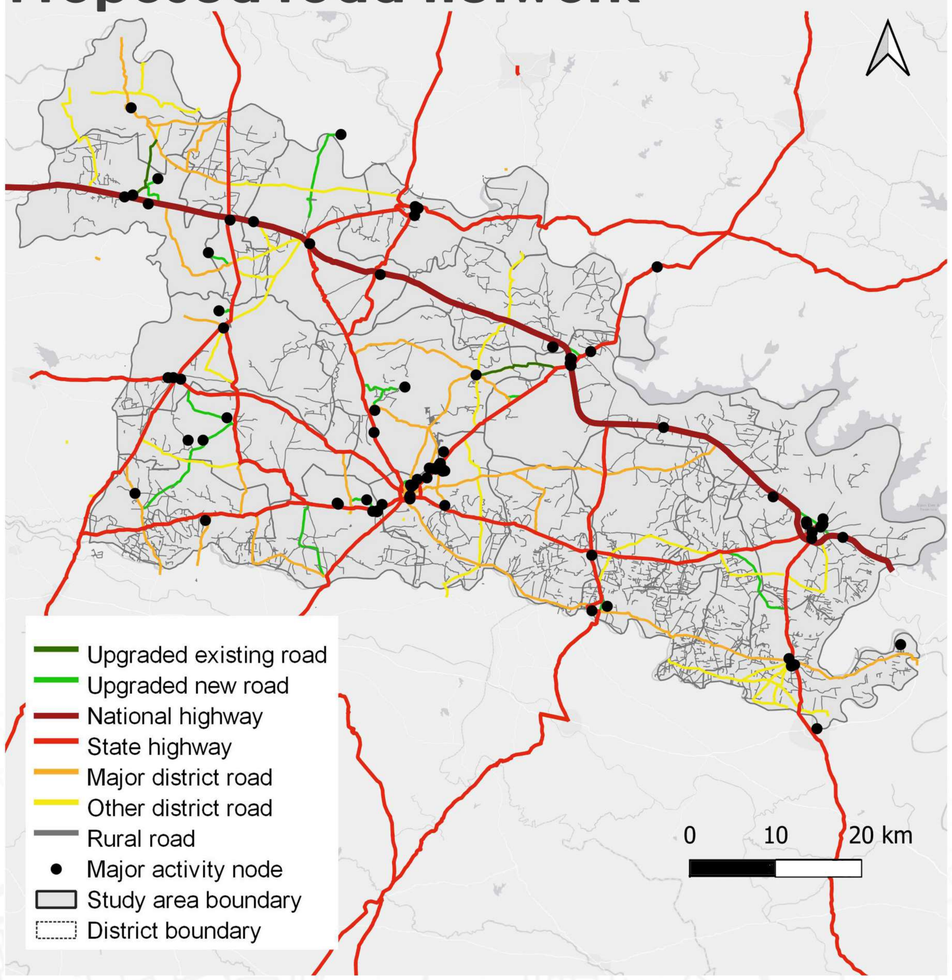
Methodology

- Proposed road network was developed using the shortest Route analysis From one loaction to another
- Considering the driving time as the major factor and the existing hierarchy of roads and other infrastructural facilities
- The unclassified road traces using google satellite imagery was also considered while developing new links for improving the connectivity in the study area

Major considerations

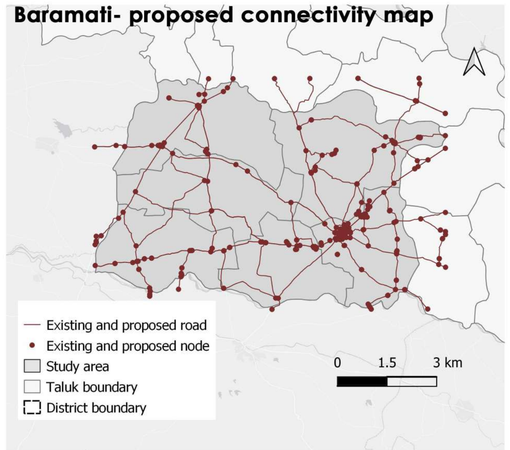
- Existing road network
- Tourist places
- Settlement hierarchy
- Potential towns
- Industries
- Proposed Social infrastructural facilities

Proposed road network



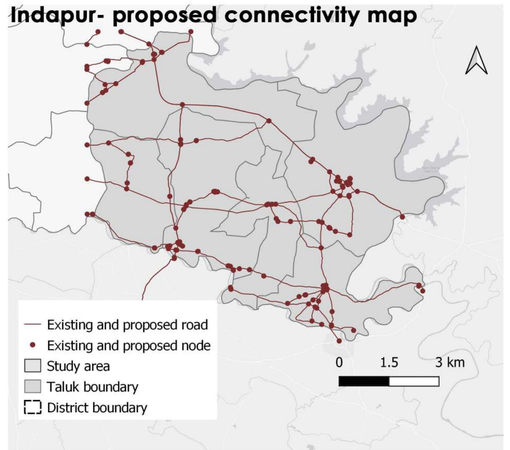
Connectivity indices

Baramati- proposed connectivity map



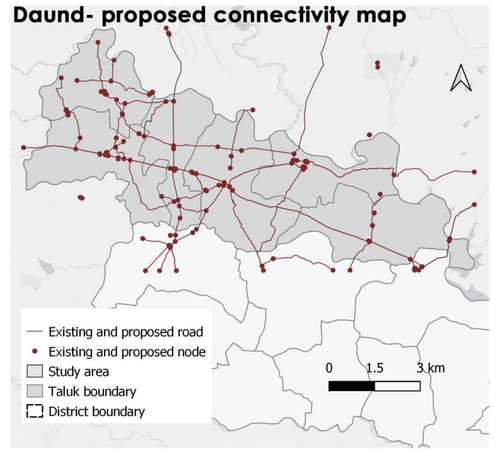
Number of links	Number of junctions	Number of nodes	
523	324	847	Number of Nodes= Number of junction + Number of links = 523 + 324 = 847

Indapur- proposed connectivity map



Number of links	Number of junctions	Number of nodes	
296	193	489	Number of Nodes= Number of junction + Number of links = 296 + 193 = 489

Daund- proposed connectivity map



Number of links	Number of junctions	Number of nodes	
224	161	385	Number of Nodes= Number of junction + Number of links = 230 + 418 = 648

Inferences

S.NO	NAME OF THE INDEX	INFERENCE	BARAMATI	INDAPUR	DAUND
1	Alpha index a=(e-v+1)/2v-5	Higher value indicates more connectivity (0.9- 0.28- lower value, 0.28-0.47- Moderate value, 0.47-0.66- Higher value)	0.375 Moderate	0.3 Moderate	0.29 Moderate
2	Beta index β=e/v	Higher value indicates more connectivity (0.1-1.37 - lower value, 1.37-1.64 - Moderate value, 1.64- 1.93 - Higher value)	1.57 Moderate	1.498 Moderate	1.43 Moderate
3	Gamma index γ=e/3(v-2)	Higher value indicates more connectivity (0.46-0.57 - lower value, 0.57- 0.68 - Moderate value, 0.68-0.79 - Higher value)	0.65 Moderate	5.98 Moderate	5.81 Moderate
5	Cyclomatic number μ = e-v+1	Higher value indicates more connectivity (1-4.66 - lower value, 4.66-8.32 - Moderate value, 8.32-12 - Higher value)	8.44 High	5.23 Moderate	4.89 Moderate
6	Aggregate Transportation score ATS=β+α+γ+μ	Higher value indicates more connectivity and efficiency (1.56-6.15 - lower value, 6.15-10.74 - Moderate value, 10.74-15.35 - Higher value)	13,56 Higher	7.45 Moderate	6.38 Moderate

- With further developments in road network it can be notices that the Aggregate transportation score for each taluk have increased which indicates the improvement in connectivity
- Since Baramati is assumed to have more developments in the future wrt the settlement pattern, higher preference in terms of proposing connectivity to the region was considered

Summary of proposal

Construction of new links

56M of roads are proposed for construction which would connect the major activity areas and developments

Improvement of existing roads

56M of roads are proposed for improvement of the existing roads to accomodate the increasing demand in the future
This is done by upgradation of the existing hierarchy of roads to one level higher based on the need and accesibilty to the major settlement areas and facilities
Ie,. Upgradation of other district roads to major district roads

Upgradation of the existing hierarchy of roads

Phasing and costing

PROPOSED ROAD NETWORK				
Proposal	*Type*	*Cost / length*	*Total length of road proposed*	*Total cost*
Road upgradation	Construction of new roads	Rs.3.5 crore per km	116.4 km	4.07 billion
	Improvement of existing roads	Rs. 1 Crore per km	18.32 km	27.5 crore

PHASE 1 - 2022
Upgradation of the existing networks through widening and improving the quality of roads in the study area

PHASE 2 - 2032
Development of addition or new roads in the study area as per the future demand estimated connecting the major actiivty nodes

PHASE 3 - 2042
Overall study/ analysis of the developed roads in terms of fulfilling the needs in the study area for the projected year

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Sub - Regional Plan: Pune District -2042

Sheet made by:
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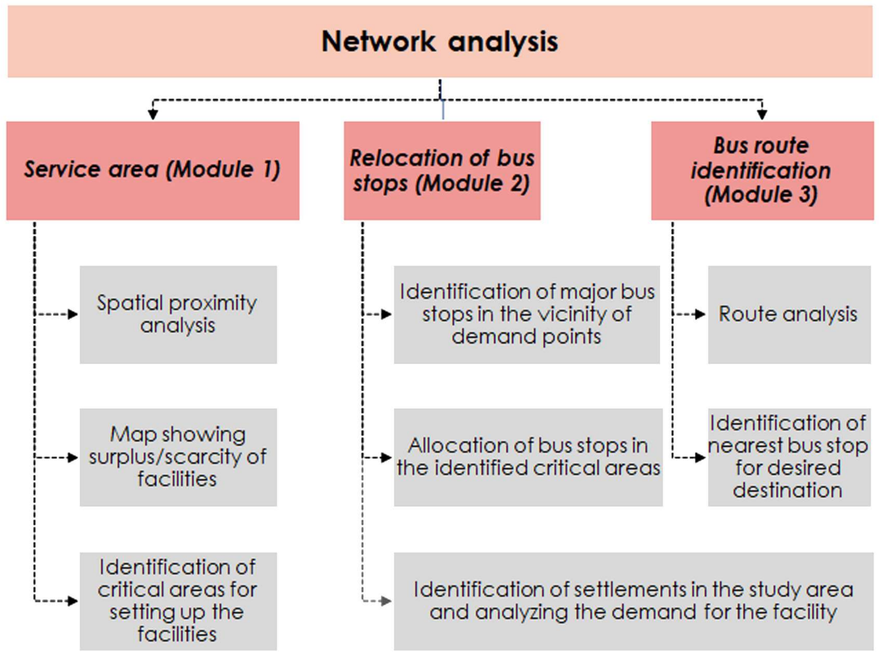
SHEET NO: **8.8**

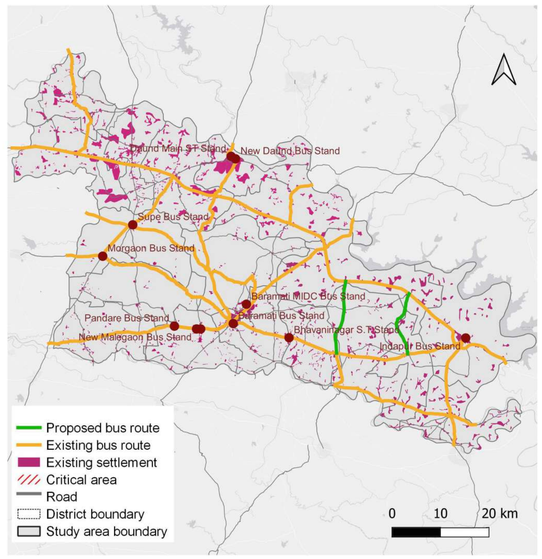
Sector: Transportation

PROPOSALS : PUBLIC TRANSPORTATION

Modules adopted



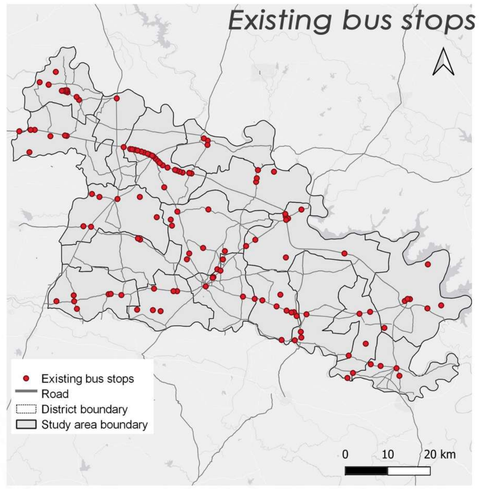
Module 3: Bus route identification

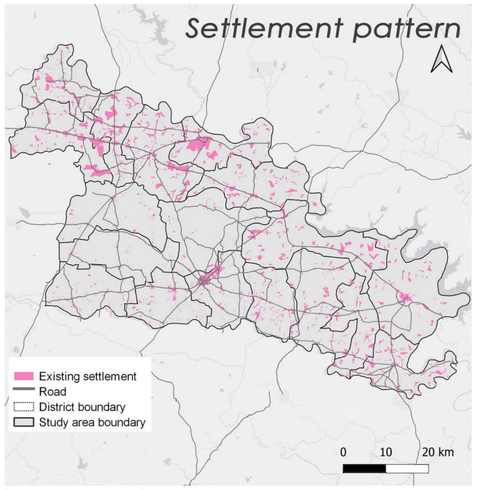


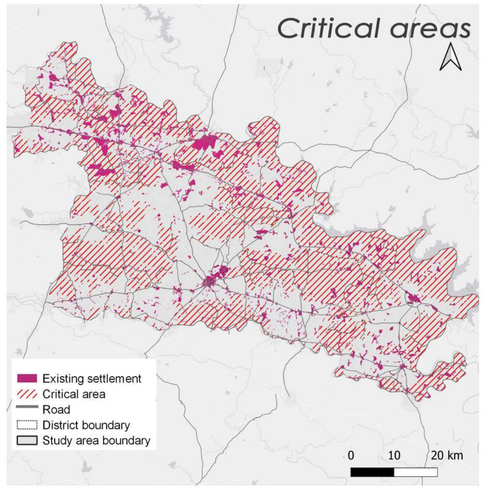
The bus route was identified based on the demand locations analysed through the settlement pattern and using route analysis tool in QGIS , unclassified roads digitised from google earth was included to optain the optimum route to connect to the isolated settlements.

Module 2: Relocation of bus stops

Factors considered



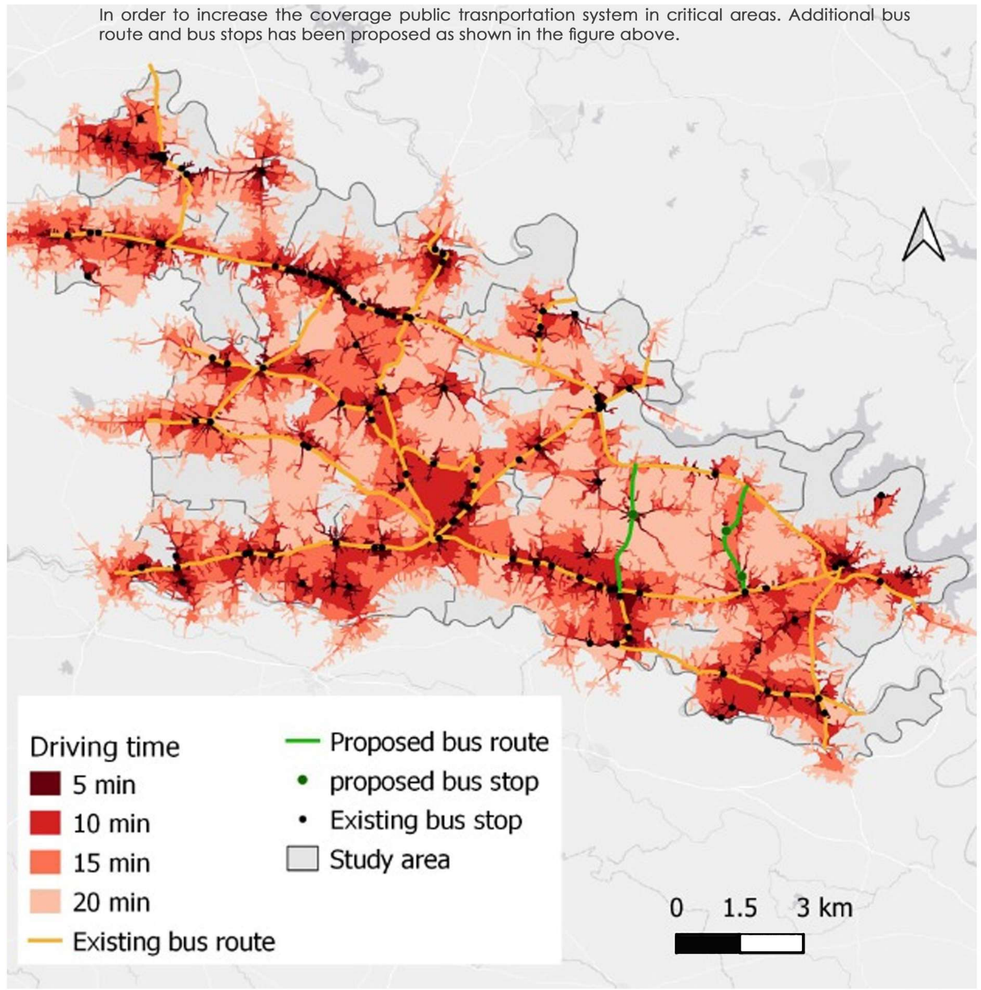




- The initial buffer of service area wrt time was considered from the existing bus stops which helped the location allocator to come up with important bus stops (depending upon the number of facilities in and around the bus stops and the distance between the facilities and the bus stops).
- These facilities were taken as demand points using which location allocator optimized the most important bus stops.
- Later the settlement patter was taken into consideration for obtaining the demand locations for developing the bus stops/ stands .
- All bus stops that were within the buffer generated were manually shifted outside the buffer also taking into consideration the distance between two bus stops does not get drastically reduced since there will be a possibility of evolving traffic jams in between the two bus stops.

Proposed bus stops

In order to increase the coverage public trasnportation system in critical areas. Additional bus route and bus stops has been proposed as shown in the figure above.



Phasing and costing

PROPOSED PUBLIC TRANSPORTATION SYSTEM				
Proposal	*Type*	*Cost / length or number*	*Total length / number of bus stops proposed*	*Total cost*
Bus route development	Construction of new bus routes	1.7 crore	31km	52. 7 crore
Bus stop development	Construction of new bus stops	Pre fabricated Steel bus stop shelter Rs. 1.5 lakh / piece	3 bus stops	4.35 lakhs

TOTAL ESTIMATED COST

57.07 crores

TOTAL ESTIMATED COST
Bus route development

52.7 crores

TOTAL ESTIMATED COST
Bus stops

4.35 lakhs

PHASE 1 - 2022

Establish rationalized city bus network, improving existing bus stops conditions according to the norms and implemenetation of one bus stop in most critical area

PHASE 2 - 2032

Adding a city bus network to establish high frequency network and based on success rate of phase 1 bus stop further 2 bus stops will be developed.

PHASE 3 - 2042

Overall development and policy level interventions to increase the dependence on public transportation system.

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Sub - Regional Plan: Pune District -2042

Sheet made by:
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SHEET NO: **8.9**

Sector:
Transportation

PROPOSALS:ELECTRIC VEHICLES

ELECTRIC MOBILITY

The development of electric powered or electri driven vehicles that moves away from the traditional vehicles set up that makes use of fossil fuels and oils.Vehicles using an alternate power source like fully electric vehicles, hybrid electric vehicles, hydrogen fuel-powered vehicles area classified under e-mobility.

Why switch to electric vehicles?

- Reduced emissions
- Energy efficiency
- Low maintenance
- Cheaper to refuel

Increase in population + Increased in number of vehicles → Increase in emission (environmental degradation)

Electric vehicles are the key technology to decarbonise road transport, a sector that accounts for 16% of global emissions.

Electric vehicle policy of Maharashtra

The Maharashtra electric vehicle policy 2021 was announced by the state environmnet minister Aaditya Thackeray
The objective of the policy is to accelerate the adoption of EVs such that they contribute 10% of new vehicle registration by 2025.
Under the policy, incentive swill be given to the buyers of electric vehicles.
The policy also states that atleast 25% of teh urban fleet aggregates / operators in Maharashtra will be electric by 2025

DEMAND INCENTIVES

Vehicle type	Demand incentives (INR)
2-wheelers	29,000 TO 44,000
3-wheelers	57,000 TO 92,000
4-wheelers	1,75,000 TO 2,75,000

Demand incentives are available upfront to end consumers theough vehicle manufacturere or dealer

CHARGING INFRASTRUCTURE INCENTIVES

Public charging stations (PCS)	Incentives per PCS unit
Slow	INR 10,000
moderate / fast	INR 5,00,00

- First 1 lakh e vehicles to be registered in the state to be eligible for last user grant- max 15% of vehicle cost
- E vehicles exempted from road tax and registration fees
- E-manufacturers will be allowed to create charging stations at existing petrol pumps, subject to safety clearance
- First 250 charging stations to get a 25% capital subsidy from state-max limit of Rs 10 lakh/ station
- Low electricity cost for charging stations. Tariff on par with residential- non-commercial rates

Demand assessment

38% increase in 2 wheelers is estimated by **2042**

CATEGORY	2018-19	2041-42
2- wheeler	289965	399052

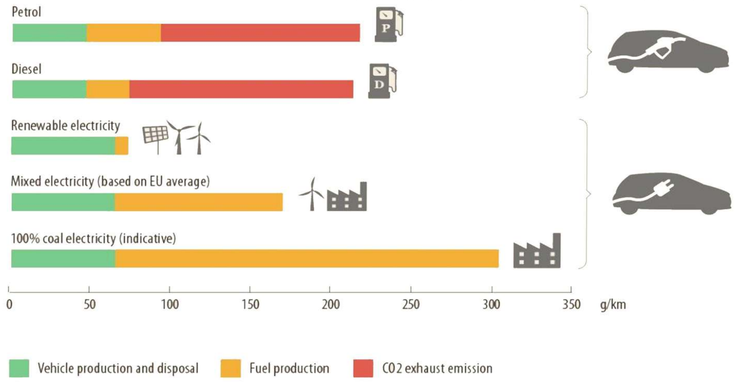
45% increase in 4 wheelers is estimated by **2042**

CATEGORY	2018-19	2041-42
4 - wheeler	40333	58365

25% increase in IPT vehicles is estimated by **2052**

CATEGORY	2018-19	2041-42
IPT Vehicles	3008	3775

Emission calculation



Executio model is achieved proposed fleer and the required infrastructure is asedon the public-private partersip. Role of each stkeholder will be defined. E-vehcle manufacture will be encourgaed to provide charginginfrastructure. AMC's role will be t allocate the land and the pwered connection. RTO can reuce the registration cost of the E-vehicles. Traffic police will ensure that the operators provide services directed under MVact and traffic laws. Banks under PMMY scheme should provide loans at low-interest rates and SHGs to aware operators about E-vehicle

	By 2032		By 2042		Observations
Scenario 1	Inflation in Purchase cost, O&M and Parking Cost and **No Subsidy**				
	13% of 2W 8% of 4W	12% of Private Vehicle	30% of 2W 24% of 4W	20% of Private Vehicle	Willingness to purchase an e-4W is less due to high purchase cost.
Scenario 2	All Inflations as above with **20% for E-2W and E-4W**				
	14% of 2W 9% of 4W	13% of Private Vehicle	33% of 2W 27% of 4W	22% of Private Vehicle	Willingness to purchase an EV is increase with Increase in Subsidy.
Scenario 3	2W - **20% Subsidy for EV** and 4W - **25% Subsidy .** Both ICEs - **5% Increase in Tax with 2X Parking Cost for ICE**				
	16% of 2W 9% of 4W	15% of Private Vehicle	50% of 2W 33% of 4W	32% of Private Vehicle	Disincentivizing ICE - **Increasing Road tax and Parking Cost - Significant change**
Scenario 4	2W - **20% Subsidy, Zero Parking for EV and 10% Tax Increase for ICE** and 4W - **25% Subsidy, 2X Parking Cost and 15% Tax increase for ICE**				
	18% of 2W 47% of 4W	16% of Private Vehicle	63% of 2W 35% of 4W	40% of Private Vehicle	**Parking Charges is creating significant impact.**

TO ENCOURAGE ELECTRIC 2-WHEELER

Considering 20% subsidy (FAME Subsidy) and Zero Parking Cost for Electric vehicles and disincentivizing fuel-powered vehicles by increasing the tax by 10% and increase in registration cost can also be considered for 2-Wheelers.

TO ENCOURAGE ELECTRIC 4-WHEELER

Considering 25% subsidy (State Subsidy) and Electric vehicles and disincentivizing fuel-powered vehicles by increasing the tax by 15%, doubling the parking cost and increase in registration cost can also be considered for 4-Wheelers.

PHASE 1 - 2022

Regularising the current operation of auto rockshaws and integrate it with the PT system. Introduction of E-Autos in the city core area.

PHASE 2 - 2032

Intorduction of policies for exchanging conventional autos of more than 10 years to E- autos.

PHASE 3 - 2042

Focusing on development and upgradation of services infrastructure. 10% of fleet will be replaced with the E-autos

B.Planning IV Year, VII Semester
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Sub - Regional Plan: Pune District -2042

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SHEET NO: **8.10**

Sector: Transportation