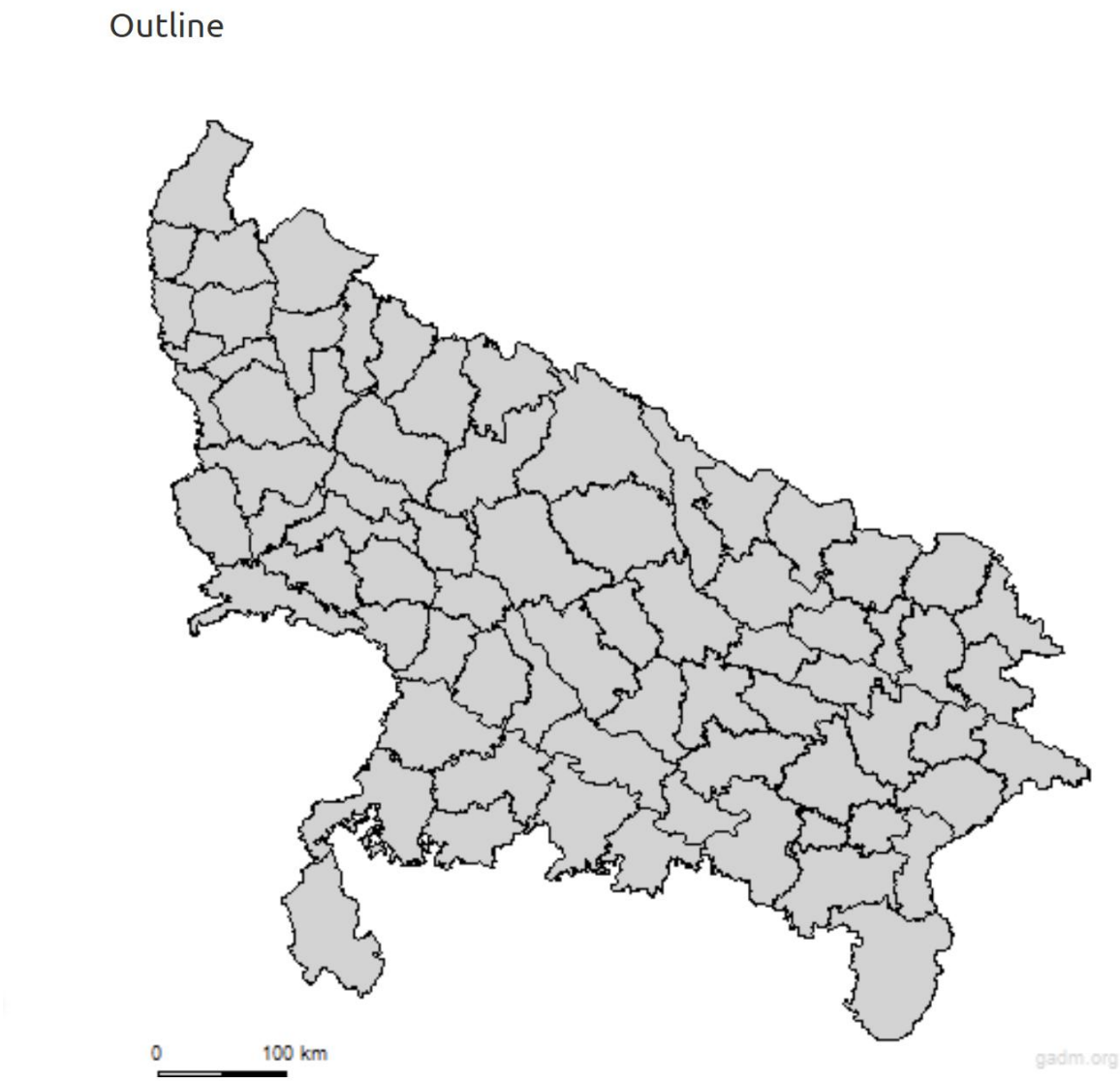
Week 1: Baseline Analysis – Agra



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1. City Selection & Justification

City Chosen: Agra

Why Agra?

- **Tourism-driven mobility:** Agra hosts iconic landmarks like the Taj Mahal, attracting millions of tourists annually, leading to high transportation demand.

- **Emerging metro city:** While smaller than major metros, Agra is undergoing rapid urbanization, presenting opportunities for innovative transportation solutions without legacy constraints.
- **Data availability:** Accessible data from Census 2011, RTO, and municipal records facilitate comprehensive analysis.
- **Challenges:** High two-wheeler usage, inadequate public transit infrastructure, and significant air pollution levels.
- **Opportunities:** Potential to introduce e-mobility solutions, formalize para-transit systems, and enhance last-mile connectivity.

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2. Population & Land Use

S.No.	Land use	Area (in ha)	Percentage (%)
1	Residential	9923.80	49.53
2	Commercial	544.17	2.72
3	Industrial	1606.31	8.01
4	Office	508.40	2.54
5	Tourism	178.18	0.89
6	Public & Semi Public	1763.40	8.80
7	Traffic & Transportation	2161.60	10.79
8	Recreation & Open spaces	875.40	4.37
9	Other Open Spaces	421.58	2.10
10	Other	2054.13	10.25
Total		**20036.97**	**100**

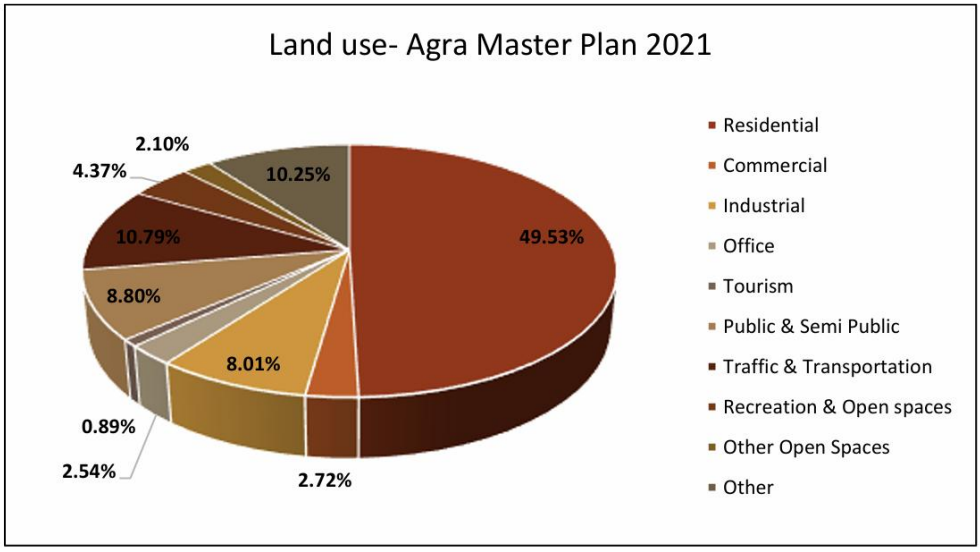

Figure 2: Land use as per Master Plan 2021

Agra city is governed by the Municipal Corporation and is part of the Agra Metropolitan Region. As per Census 2011:

- **City Population:** 1,585,704 (Males: 845,902; Females: 739,802)
- **Urban/Metropolitan Population:** 1,760,285 (Males: 939,875; Females: 820,410)

Indicator	Value
Total Population	4,418,797

Total Area (km²)	4,041
Population Density	1,094 per sq. km
Major Zones	Shahganj, Sadar Bazaar, Taj Ganj, Dayalbagh

Sources: Census 2011, Agra Development Authority

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3. Transport Network Overview

Infrastructure	Details
Total Road Length	Approximately 142 km within city limits, 75% being two-lane roads. Narrow streets cause congestion and vehicular pollution.
Public Bus Routes	UPSRTC operates around 22 intra-city bus routes.
Metro/BRT	Agra Metro (under construction): 29.4 km with 28 stations. Corridors: Taj East Gate to Sikandra (13.7 km), Agra Cantt to Kalindi Vihar (15.7 km).
Para-Transit	Significant use of e-rickshaws for last-mile connectivity; exact numbers unavailable.

Strategic Roads:

- Junction of NH-2, NH-3, NH-11, NH-93, SH-62, and SH-39.
- SH-62 connects to Yamuna Expressway enhancing Taj Mahal access.

Smart City Upgrades: Agra Smart City Project is upgrading 7 key intersections:

1. Hari Parvat Crossing
2. Babu Jagjivanram Crossing
3. Sai Ka Takiya Junction
4. Shastri Chowk
5. Bodala Choraha
6. Hotel Amar T-Point

7. St. Johns Crossing

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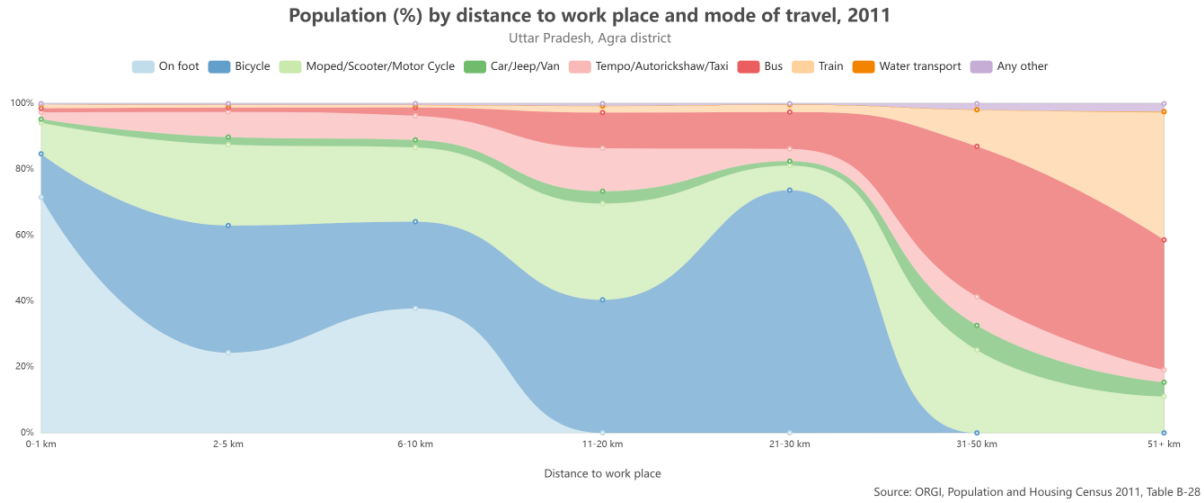
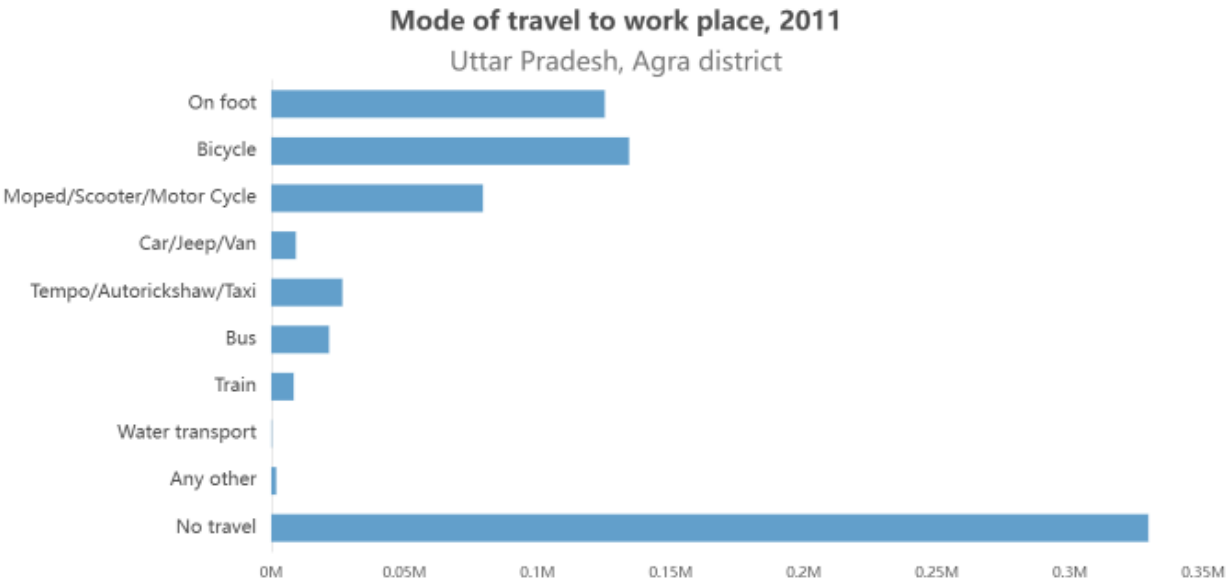
4. Vehicle Stock & Mode Share



Source: ORGI, Population and Housing Census 2011, Table B-28



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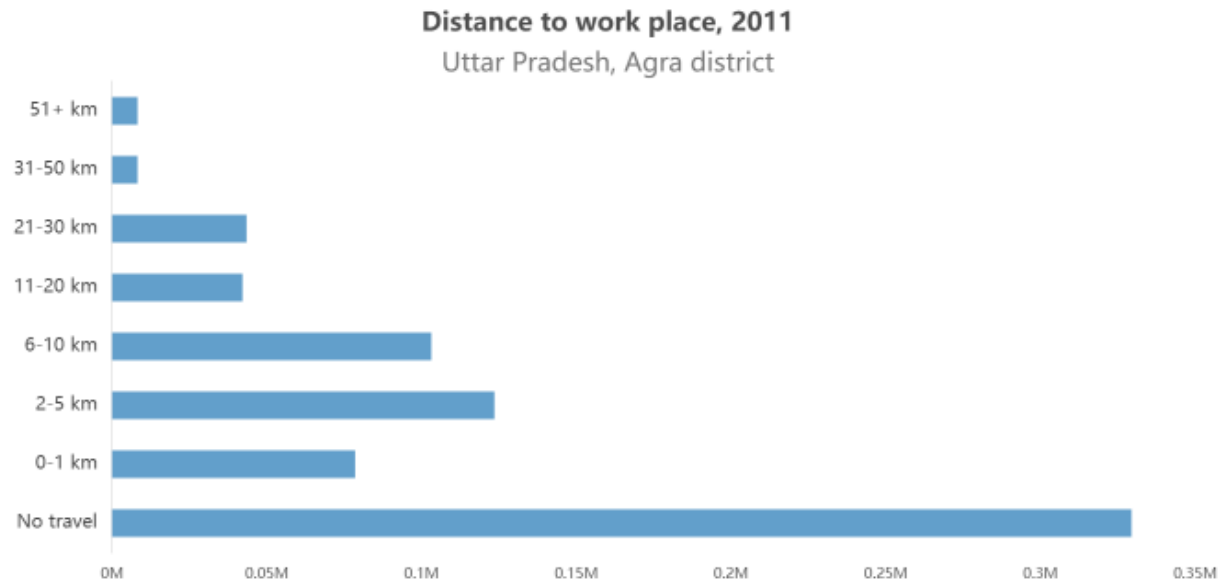

Source: ORGI, Population and Housing Census 2011, Table B-28

Vehicle Stock:

Vehicle Type	Count
Two-Wheelers	450,000
Cars	220,000
Three-Wheelers	85,000
Buses	1,200

Mode Share:

Mode	Share (%)
Two-Wheelers	35
Cars	20
Three-Wheelers	25
Buses	5
Walking	10

Cycling	5

Average Vehicle Kilometers Traveled (VKT) per Year:

Vehicle Type	VKT
Two-Wheelers	5,000
Cars	10,000
Three-Wheelers	12,000
Buses	40,000

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5. Emissions Estimation (Annual)

Vehicle Type	CO_2 Emissions (g/km)	$PM_{2.5}$ Emissions (mg/km)	Total VKT (km/year)	CO_2 Emissions (tons/year)	$PM_{2.5}$ Emissions (kg/year)
Two-Wheelers	40	20	2.25×10^9	90,000	45,000
Cars	180	25	2.2×10^9	396,000	55,000
Three-Wheelers	95	45	1.02×10^9	96,900	45,900
Buses	822	100	48×10^6	39,456	4,800

Assumptions:

- **Emission Factors:** Based on ICCT India (2021), IPCC (2019), and TERI.
- **E-rickshaws:** Mostly electric; emissions considered negligible.

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6. Transit Accessibility Map

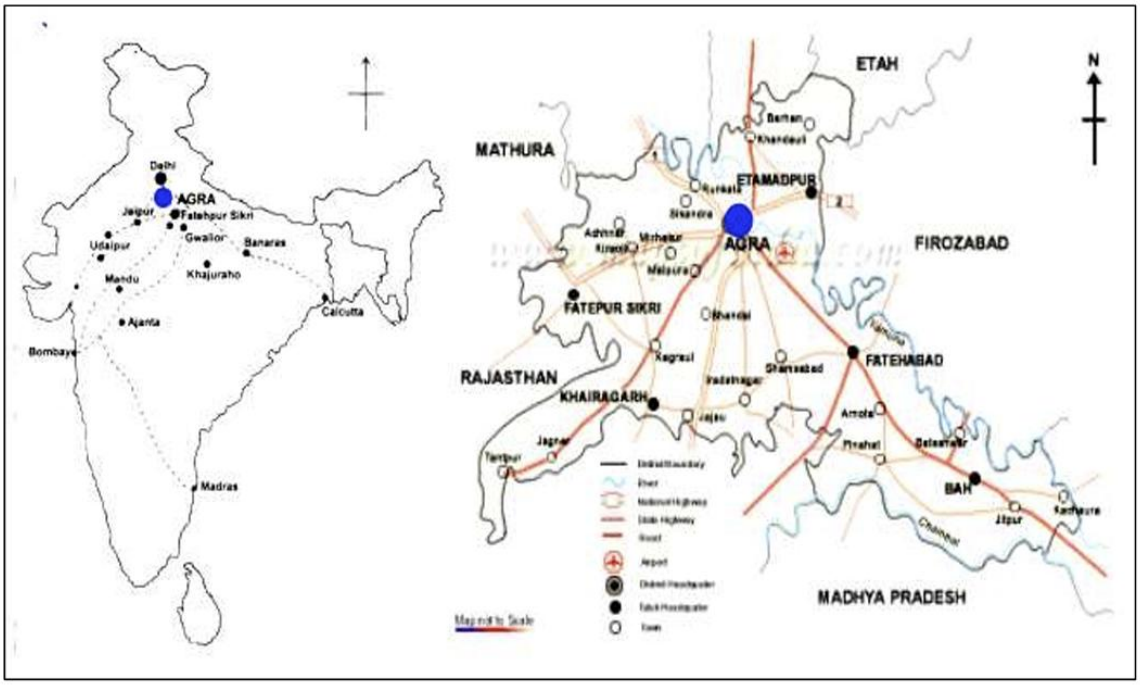

Figure 3: Agra city-Regional Setting

Figure 4: Agra District Map

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7. Key Observations

- **Low Public Transit Share:** Overreliance on two-wheelers and unregulated e-rickshaws.

- **High Emissions:** Private vehicles are significant contributors to CO_2 and $PM_{2.5}$.
- **Accessibility Gaps:** Outlying areas (e.g., Kheria, outer Dayalbagh) lack adequate transit coverage.

- **Sources:**
    - Census 2011
    - Agra Development Authority
    - ICCT India Emission Factors (2021)
    - IPCC 2019 Guidelines
    - TERI Transport Emissions Data
    - MoRTH, UPMRC, UPSRTC, OpenStreetMap, Smart City Agra
