

## Abstract

Initiatives to plan for sustainable transportation and identify infrastructure challenges require access to meaningful, dynamic, and timely datasets regarding urban development and transportation system. Yet, there are key information gaps in rapidly urbanizing countries like India.

This project addresses these challenges by leveraging multiple urban data sources, ranging from conventional data source such as socioeconomic data and satellite images to emerging "urban big data" sources such as geo-tagged social media data, citizen-created maps, and real-time traffic data. The objective for this project is the innovative and effective integration of these available data together to capture urban development and transport in fast-growing Indian cities.

## Motivation

### Urgent need for developing more sustainable transport and land use

National Urban Transport Policy (2006), Jawaharlal Nehru National urban Renewal Mission (2006), 100 Smart City Initiative (2015), etc.

- Moving people instead of cars
- Encouraging integrated land use and transport planning
- Encouraging greater use of public transport and non-motorized modes

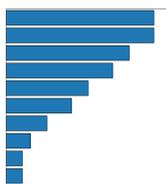
### Huge uncertainties in estimating urban transport activities in India due to lack of reliable and detailed data

- National-level studies point to the magnitude of transport problem, but all rely on scarce data and generous assumptions.
- Very few city-level studies used household surveys to look at travel behavior and the influence of urban form.

### Emerging urban data sources that reflect city spatial-temporal dynamics about people, their movement, and activities

e.g. public transit smart card data, mobile phone data, location-based social media data, real-time information

### Recommendations to improve future model projections



Source: survey from ITEM workshop (2014)

## Urban data sources we collect

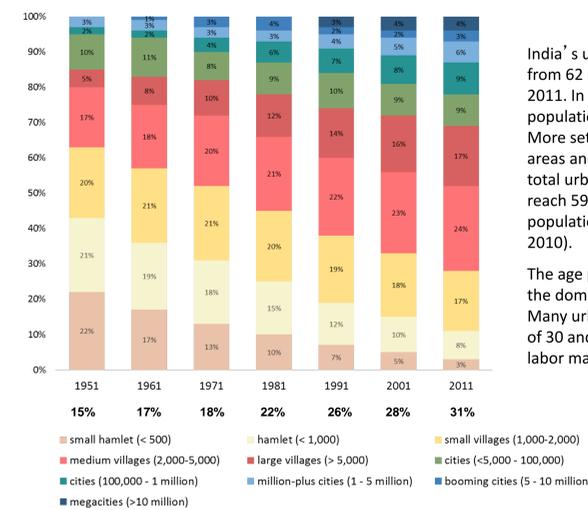
	Urban data	Applications	Limitations
<b>Decades</b>	Remote sensing	Track urban growth and expansion	Coarse spatial resolution
<b>Annual</b>	Census, government documents, travel survey	Social-economic indicators Travel behavior information	Not timely updated, time consuming, costly, extensive labor work
	OpenStreetMap (OSM)	Road network and Point of Interest (POI); a basis for building multimodal urban network model	May not be representative, digital divide
<b>Daily</b>	Real-time traffic (Google traffic)	Visualize traffic information. Can be used to map where and when traffic congestion happens in cities	No specific information about number of vehicles on the roads, and speeds.
<b>Hourly</b>	Social media data (Twitter)	mapping urban activity and mobility Sentiment analysis can be used to understand travel behavior and how city residents think about the places they live and work	May not be representative if information is biased by self-selection
<b>Minutely</b>			

## Urban development: Landsat satellite imageries

### Research questions

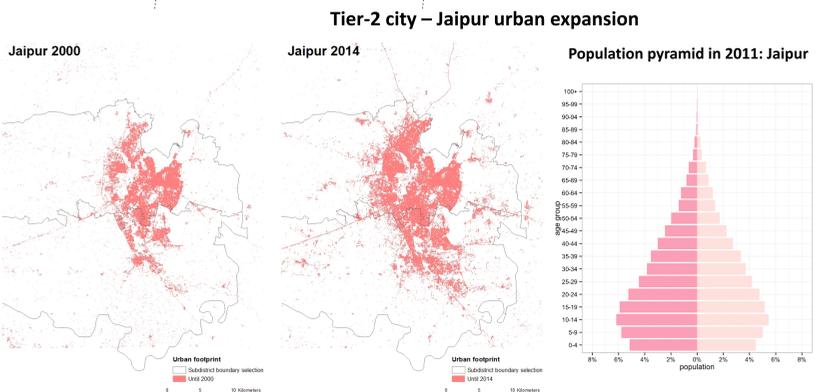
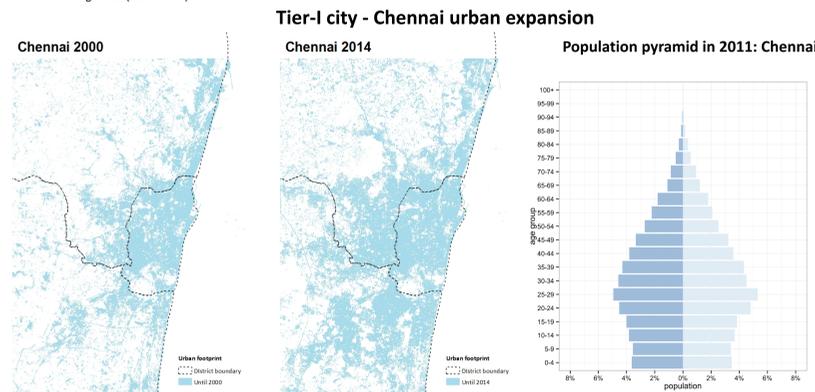
1. Does urban development take place in substantially different form?
2. How do transport and land use policies shape these trends?
3. What are the impacts of different urban development patterns on urban travel?

### Distribution of population by settlement size (1951-2011)



India's urban population has soared from 62 million 1951 to 377 million in 2011. In 2011, 31% of the total population in India lives in urban areas. More settlement has become urban areas and the trend will continue. The total urban population is projected to reach 590 million or 40% of the total population in 2030 (Sankhe, Vittal et al. 2010).

The age pyramids of Indian cities show the dominance of younger generation. Many urban residents are below the age of 30 and they are actively involved in labor market.



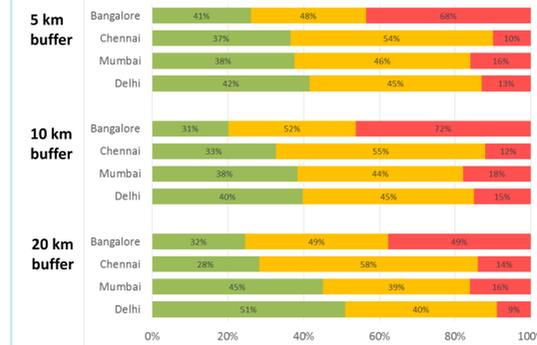
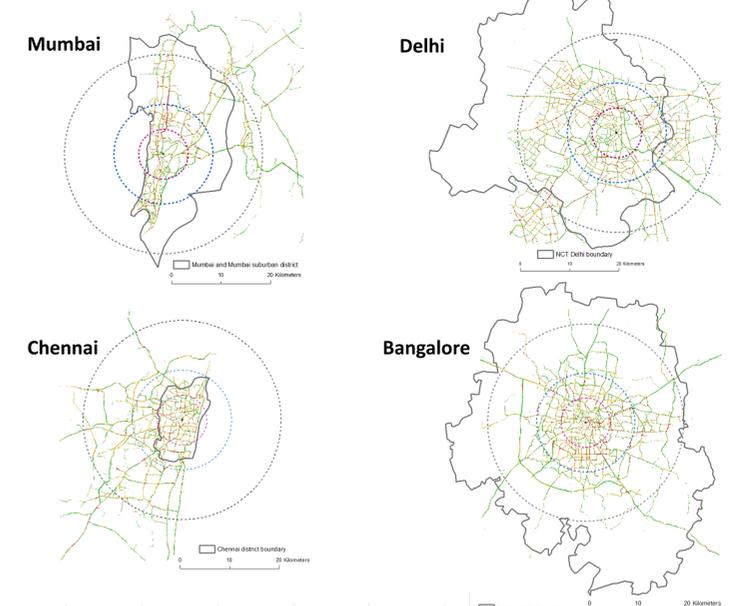
	Chennai			Jaipur		
	2001	2011	Growth (%) 01-11	2001	2011	Growth (%) 01-11
Population	6.7 million	8.7 million	32%	2.3 million	3.1 million	31%
Urban area (sq. km2)	386 km2	615 km2	59%	118 km2	206 km2	75%
Population density (person/km2)	16,995	14,140	-16%	19,683	14,787	-24%
Household having at least 1 car	8.2%	13.2%	60%	6%	12.5%	108%
Household having at least 1 scooter	30.8%	46.6%	51%	27.5%	45.7%	66%
Car ownership (per 1000 people)	23	47	104%	13	32	146%

## Urban congestion: Google traffic images

### Research questions

When and where does congestion happen in different Indian cities?

19:30 Wednesday May 6, 2015



The snapshot images at every 30 minutes show traffic intensity (red for congested, orange for slow down, and green for free flow at different time of the day.

The percentage of the three congestion levels (red, yellow and green colors) within each buffer area is computed for four cities.

19:00-21:00 are night peak hours for these four cities. Bangalore and Chennai have higher percentage of orange and red road segment than Mumbai and Delhi.

## Mobility pattern and travel attitude: geotagged tweets

### Research questions

1. mapping large-scale human mobility patterns
2. understanding the sentiment and attitude on urban issues

