

## **M.Tech. in Urban Development and Management**

### **Second Semester Study Trips (4th to 8th March 2019)**

Organising unit/ agency/ collaborating agency

Indore: Indore Municipal Corporation and Indore Smart City Development Limited, Bio-Remediation and Landfill Site, Waste to Energy Plant, Plastic Waste Pellet Conversion Plant, Organic Waste to Gas Conversion Plant, Construction Waste to Tile Plant, Community Composting Pits, Plastic to Ethanol Conversion Plant, Waste Segregation and NEPRA Material Recovery Facility (MRF).

Number of teachers **coordinated** in such activities: 1

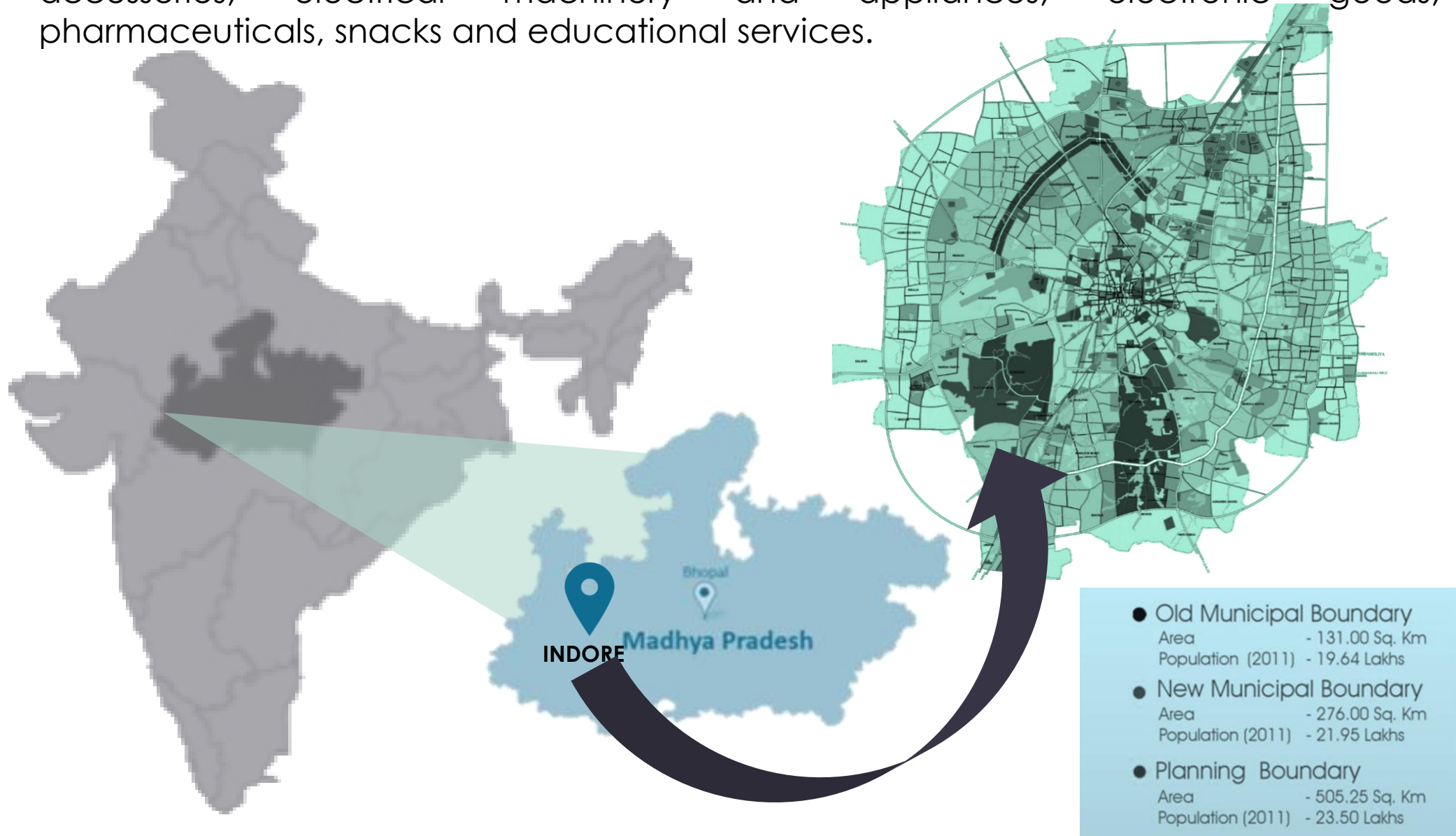
Number of students participated in such activities: 17



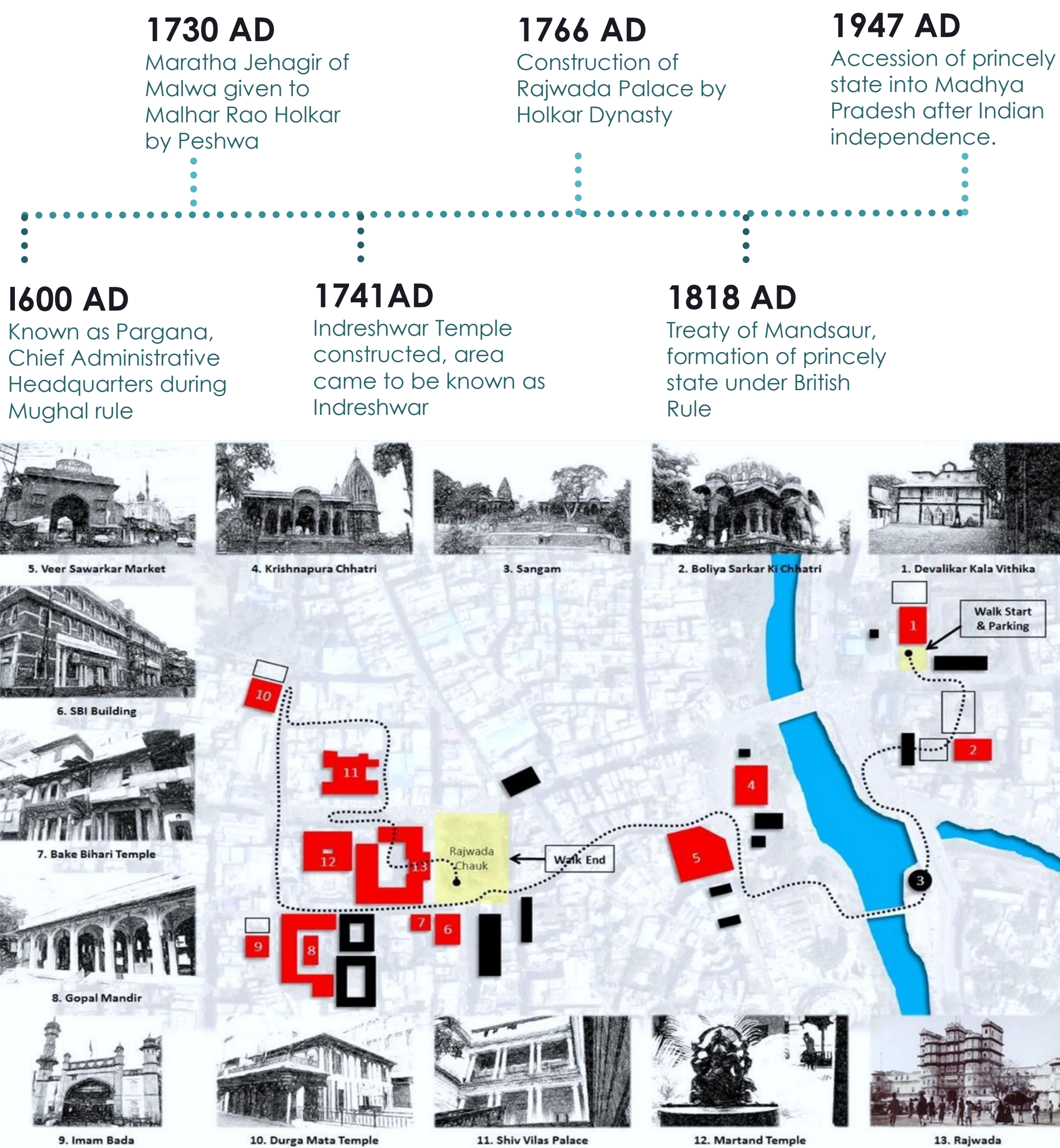
# DEMOGRAPHICS

## Introduction

Indore, located on the Western region of Madhya Pradesh is one of the most important commercial centres of the state. As the story goes, Malharro Holkar of the Holkar clan, received Indore as part of his booty in the conquest of Malwa in 1733. His descendants, who formed the core part of Maratha confederacy and later formed a princely state under British rule. Even in days of yore it was an important business hub. But today with the entry of the corporate firms and institutions, it has earned a major name in the commercial sector of the country. Indore is home to many industries such as cotton textiles, chemicals, machinery, iron and steel, food and edible oil, confectionery, paper and straw board, RCC pipes and poles, machine tools and accessories, electrical machinery and appliances, electronic goods, pharmaceuticals, snacks and educational services.



## Historic Timeline of Indore city



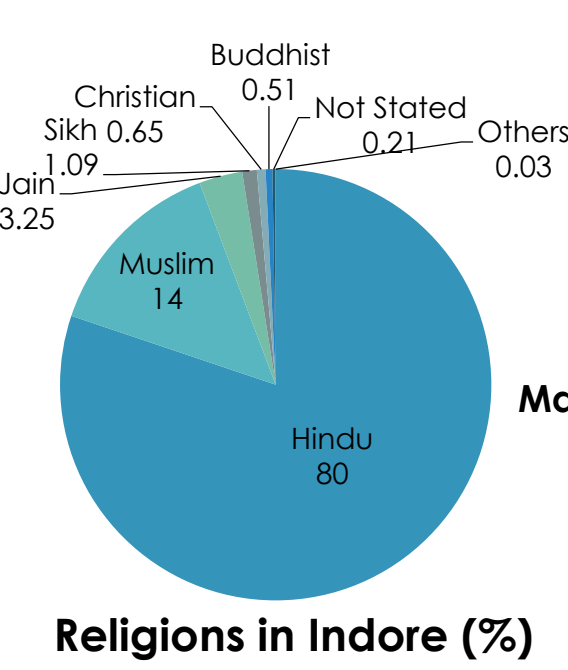
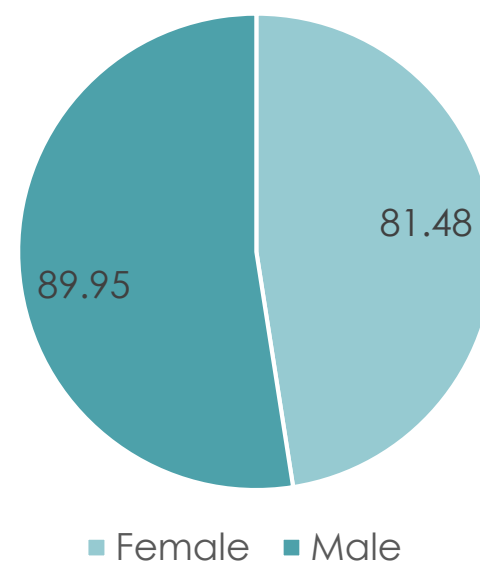
## Demographics of Indore

Indore city lies in the heart of Malwa. The extremities of this district measures from 220-20' N to 230-05' N. latitudes and from 750-26' E to 760-14' E. longitudes. It is bound in the north by Ujjain district, in the south by West Nimar district, in the north east by Dewas district and in the west by Dhar district. Physically the boundaries of Indore district stretch mostly along the natural features on three sides, viz. the Kshipra river in the north east, the Chambal in the west and the water-parting line of the Vindhyas in the south between the Karam and the Choral rivers, both flowing into the Narmada to the south.

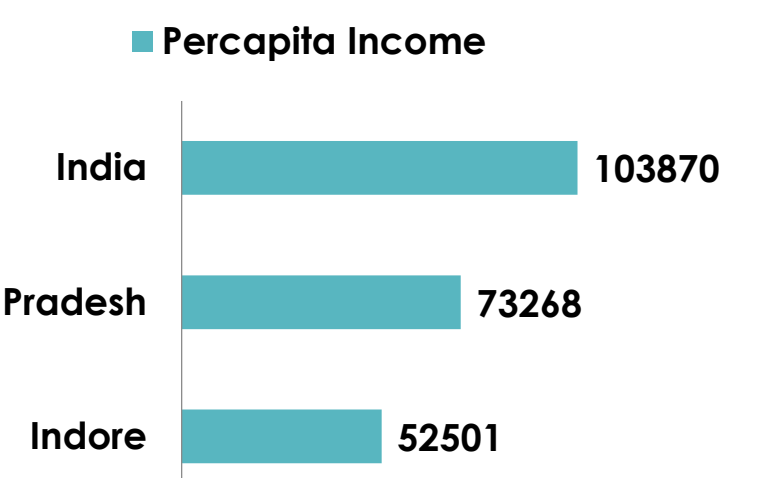
As per the Census 2011, its geographical area is 3898 sq. kms. Indore is situated at an altitude of 553 meters above sea level on the banks of two small rivulets, the Saraswati and the Khan. The whole of Indore district is situated on the plateau of Malwa, which is scarped by the Vindhyas in the south. The general height of the district is about 548.64 meters.

Indicator	City (Municipal Corporation)	State (Urban)	India (Urban)
Total Population	1964086	20,069,405	377,106,125
Total Population of UA (if)	2170295		
Share of ULB population in District Urban population (%)	80.90		
Population Growth Rate (AEGR) 2001-11	2.86	2.29	2.76
Area (sq. km)*	172.39		
Share of ULB area in district (%)* #	4.42		
Density of population (person per sq. km)*	11393		
Literacy Rate (%)	85.87		84.11
Schedule Caste (%)	15.40		12.60
Schedule Tribes (%)	2.61		2.77
Youth, 15 - 24 years (%)	19.68		19.68
Slum Population (%)	30.05		17.36
Working Age Group, 15-59 years (%)	65.07		65.27

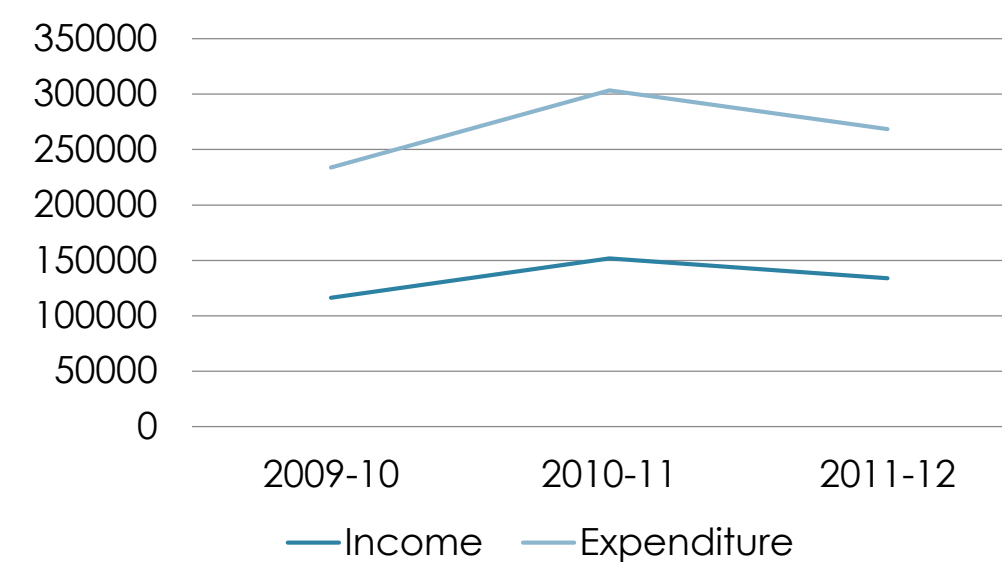
## Literacy rate %



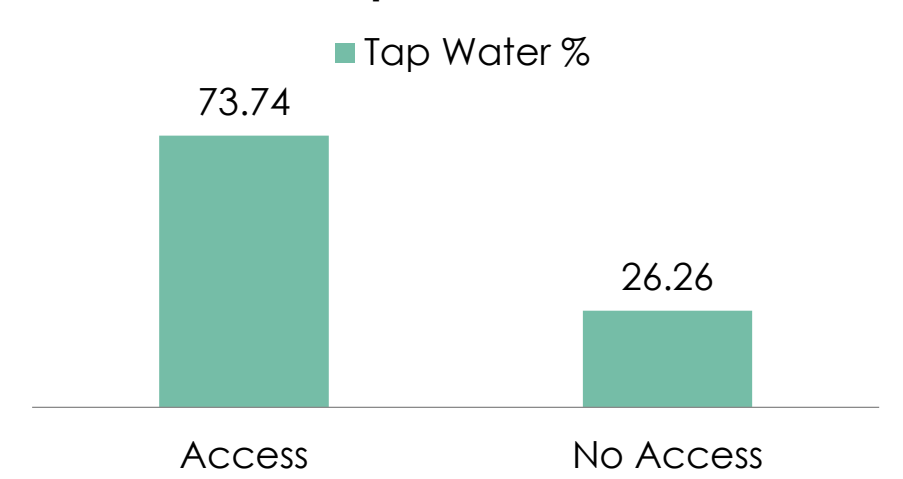
## Per capita Income



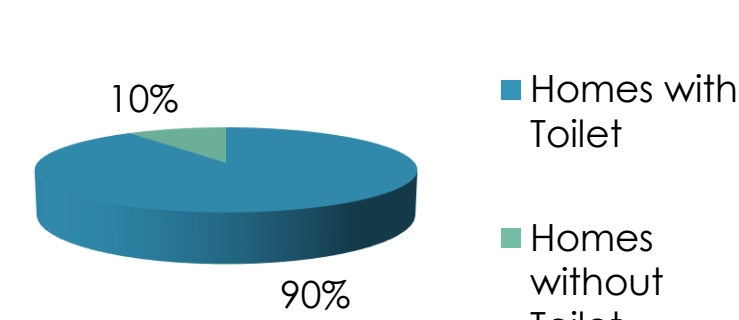
## Municipal Income & Expenditure



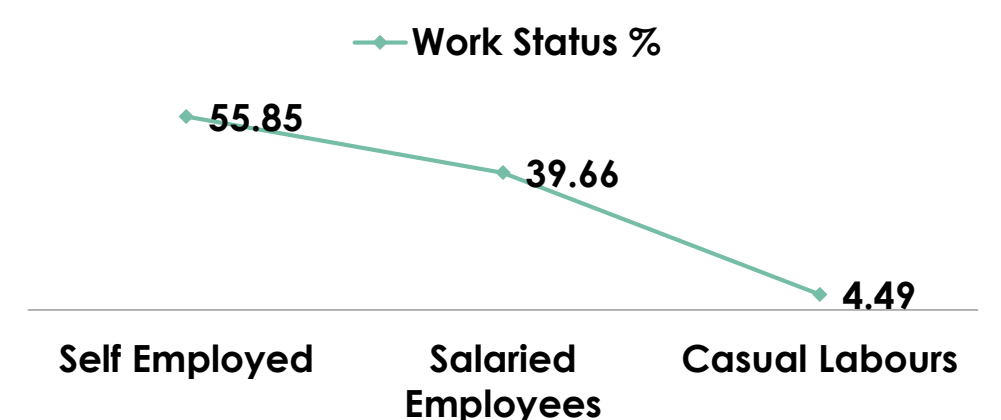
## Tap Water %



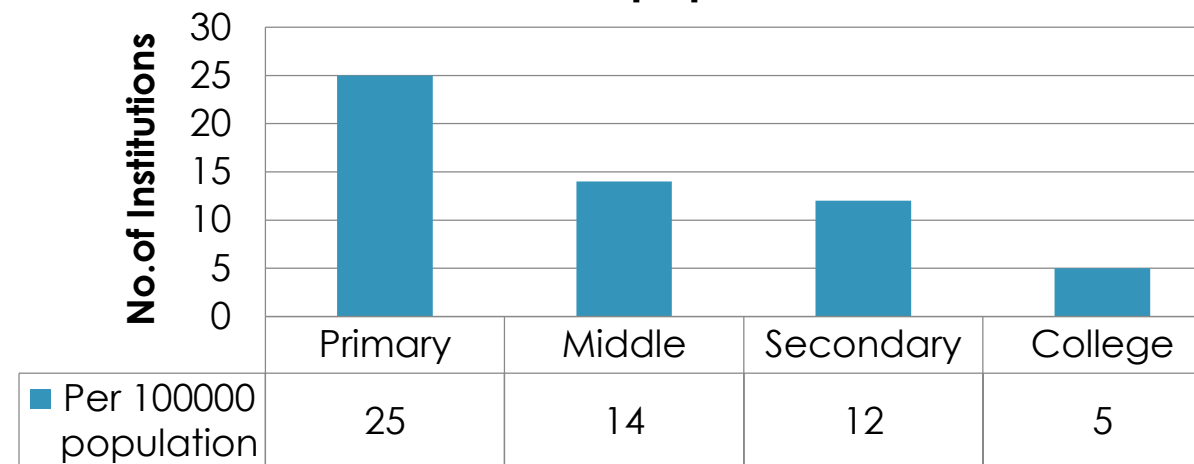
## Access to Toilet %



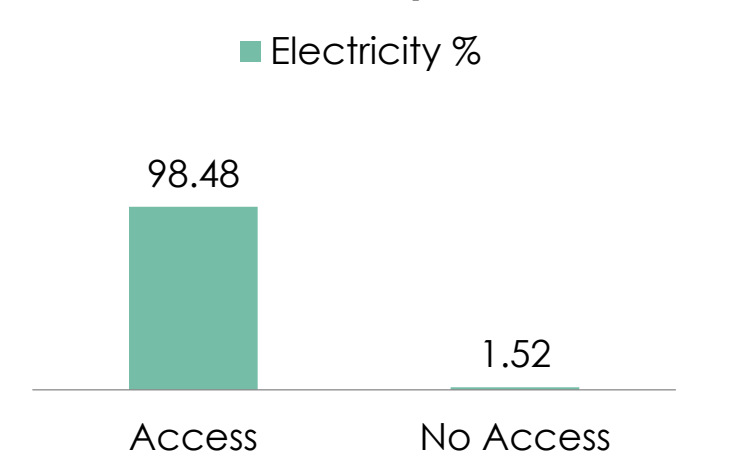
## Work Status %



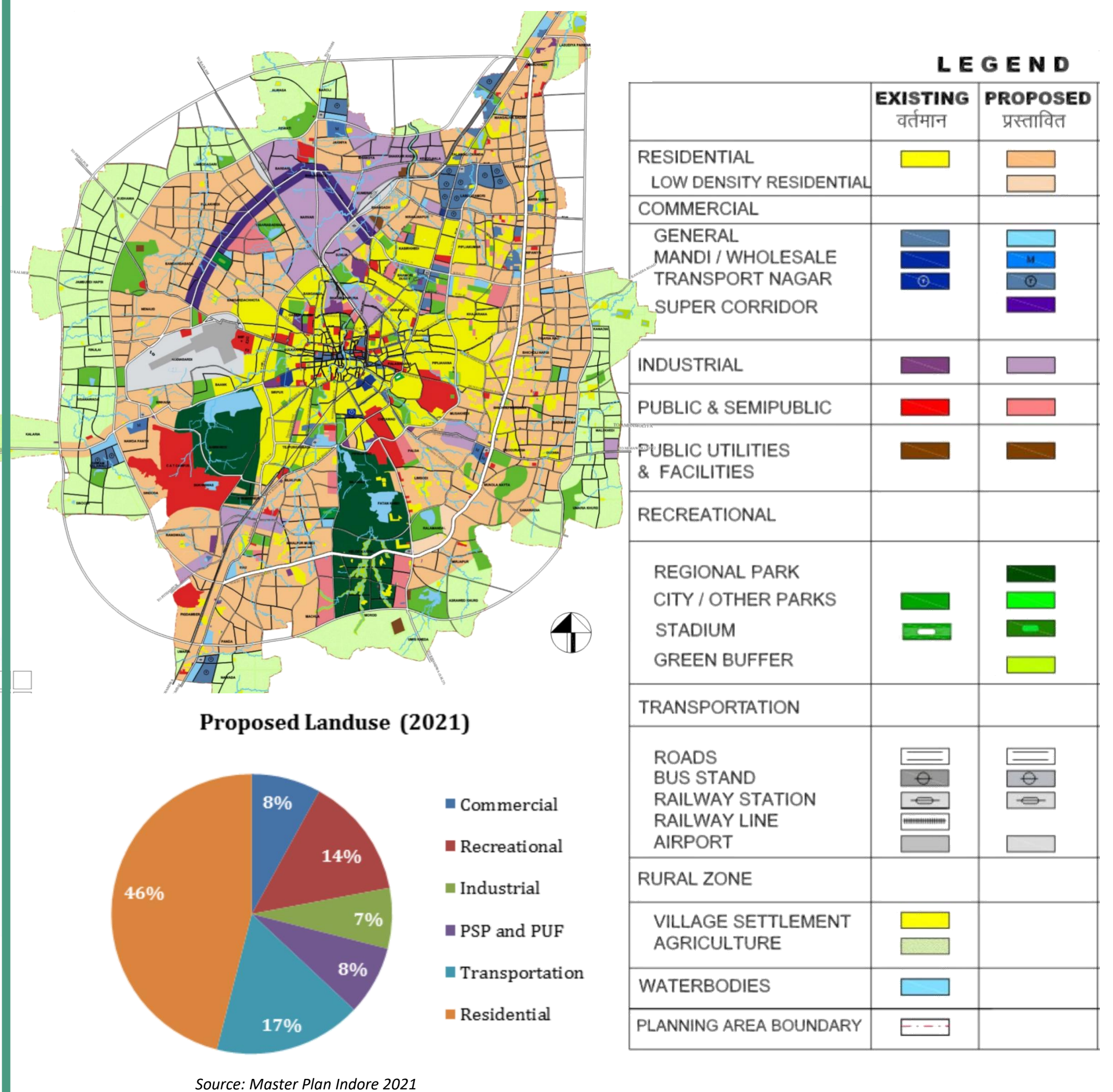
## Per 100000 population



## Electricity %

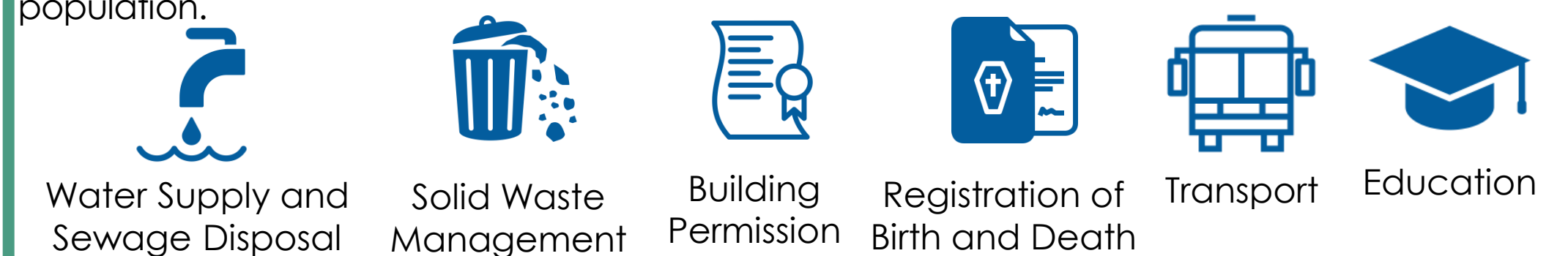


## Master Plan 2021 of Indore



## Governance Structure

Indore Municipal Corporation (IMC) is the governing body of the city of Indore. The municipal corporation consists of democratically elected Mayor who presides over Councilors. The Municipal Commissioner forms the administrative head. In accordance with the 74th constitutional amendment 25 seats out of 69 are reserved for women. At present, the municipal area is divided into 12 zones and 85 wards of various sizes and population.



Source: Indore Smart City Proposal

## FUNCTIONS CARRIED OUT BY STATE OF MADHYA PRADESH





# TRANSPORT

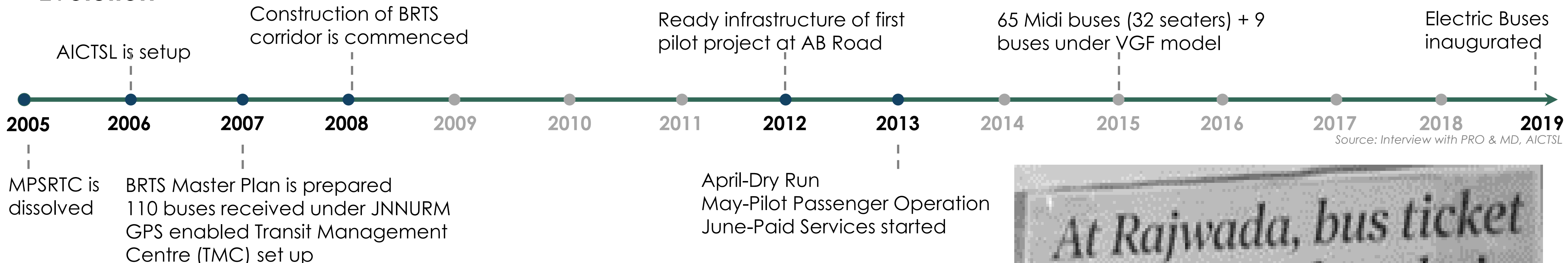
## Introduction

### BRTS Indore

Prior to 2006, the public transport available in the city was diesel fuelled tempos making it uncomfortable and unsafe to travel. The inter-city buses were run under Madhya Pradesh State Road Transport Corporation (MPSRTC), which in its last few months recorded debt of 800 crores while suffering monthly losses of over 5 crores. To counter these problems, Atal Indore City Transport Services Ltd (AICTSL) was set up, employing Public Private Partnership (PPP) model. It tried to solve problem of governance as well as finances. The first BRTS corridor become functional in 2013 on AB road. With other corridors proposed all along the city, BRTS in Indore is increasingly gaining popularity all over the country as an example of best practices in public transport.

Source: Draft DPR, Interview with PRO & MD, AICTSL

### Evolution

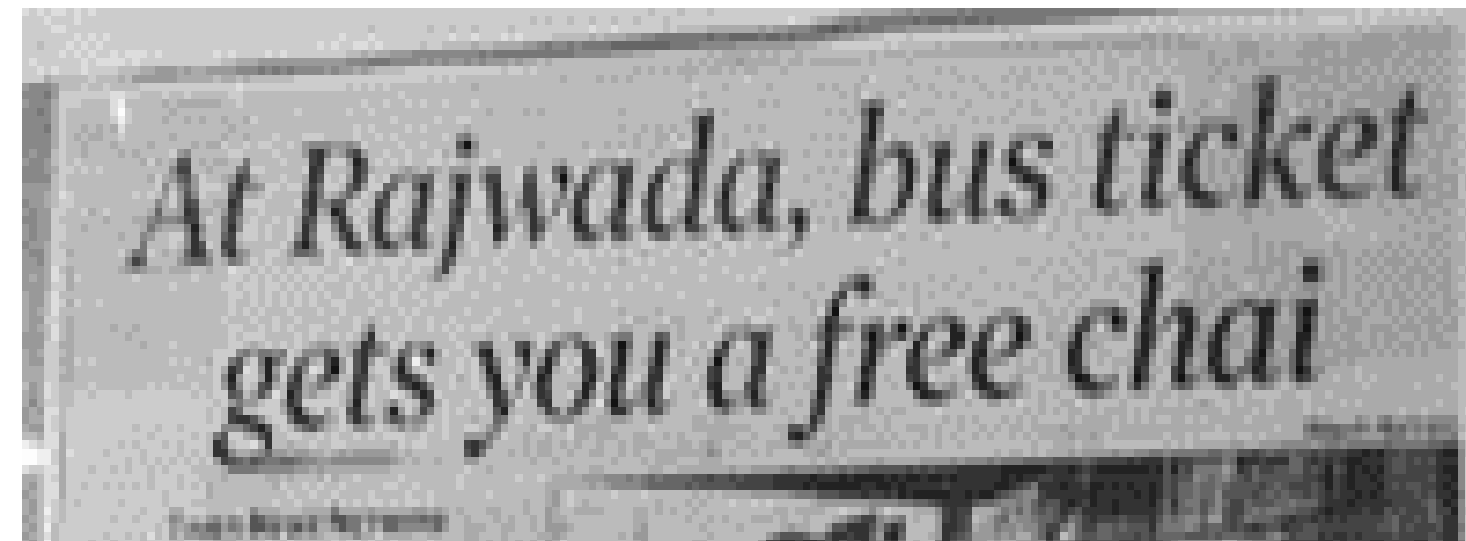
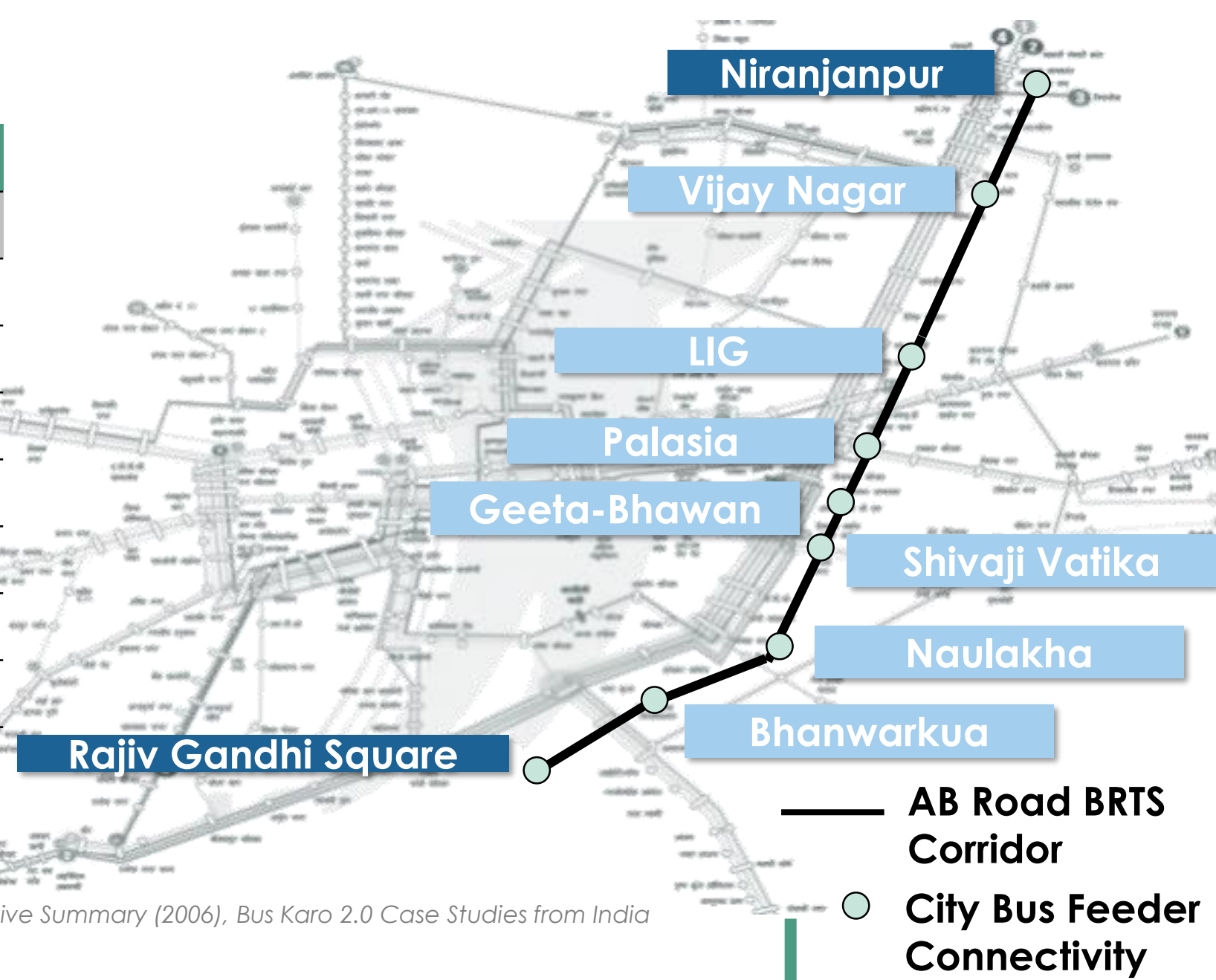


### Proposed BRTS Corridors

Corridors	Distance
AB Road Corridor	23.80 Kms
Eastern Ring Road Corridor	23.65 Kms
M.R. 10 Corridor	8.71 Kms
River Side Road Corridor	14.50 Kms
Western Ring Road	15.90 Kms
Badaganpti to airport	5.30 Kms
RW2 Ujjain Road to airport	9.50 Kms
Other road ( M.G, RNT, YN )	19.10 Kms

The Pilot Project of AB Road is done till now which is 11.46 Kms, with 21 Stations and 40 Buses.

Source: DPR on Indore Rapid Transit System under JNNURM- Executive Summary (2006), Bus Karo 2.0 Case Studies from India



### Initiatives & incentives to promote BRTS

- One month free trial with zero tickets was run to train the inexperienced BRTS workforce as well as to promote the public transport use among users.
  - To encourage public transportation usage, AICTSL integrated every age group and asked feedback for improved user service.
  - Use of social media for continued public engagement and information dissemination.
  - People travelling to and from Rajwada area in city buses are being treated with a tea for free of cost.
  - A Bio crux (plastic bottle collecting) machine was installed in the bus depo, which provides Rs. 5 ticket which can be utilised to travel in I-bus within 24 hrs.
  - The Bio crux machine if used will reward some points on your mobile number which can be further used for purchasing bus tickets.
- Source: Site visit (08/03/2019)

## Characteristics

### Bus Stop Details



Closed corridor bus stop



Ticket Counter, CCTV Surveillance



Token System for entry



Public Announcement and Display system

Source: Site visit (08/03/2019)

- Token system for closed corridor and print ticket system for open corridor system. (Minimum fare : Rs 5 and Maximum Fare Rs. 15, for BRTS corridor)
- Automated gate opening system.
- Walk Button at pedestrian crossing junctions.
- Solar Street Lights.

### Buses

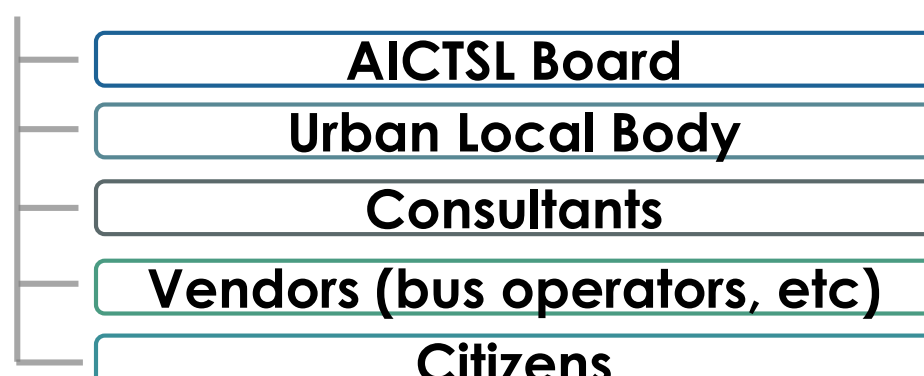


iBus entering bus stop

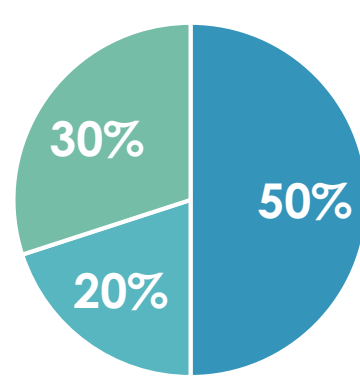
Image Source: <https://www.itdp.org/2014/06/26/indore-ibus-and-brt-best-practices-topics-of-indian-brt-workshop-2/>

- Specially designed buses known as i-buses run on the BRTS Corridor (AB Road.)
- Around 40 Buses in operation.
- Fully automated doors and seamless access for all.
- Male and female sections segregated.
- Dustbins provided.
- Reserved seats for elderly and differently abled.

### Stakeholders



### Finance



Total cost – 868.15 crores  
Percentage money funded

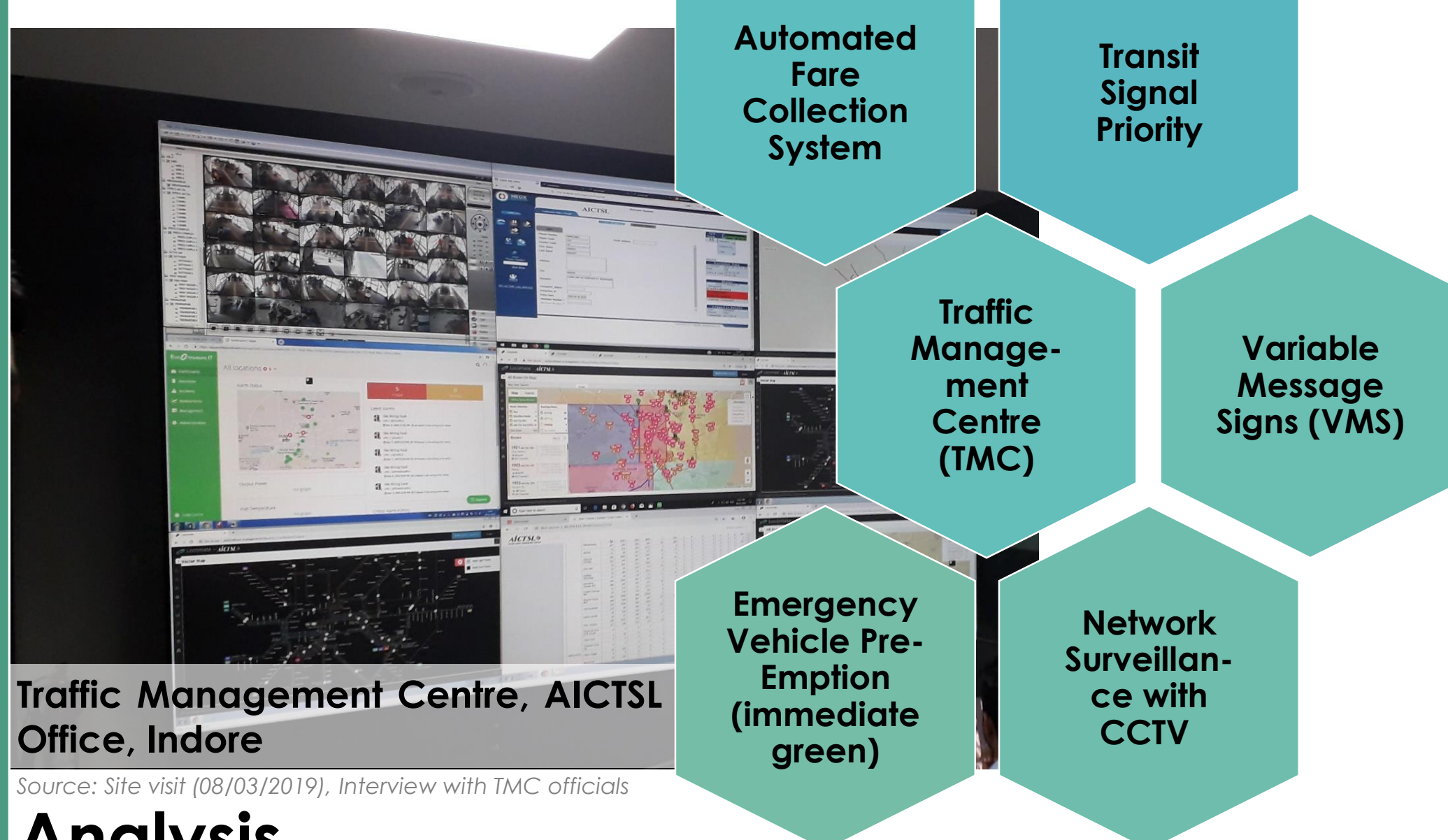
- Central Government under JNNURM
- MP Government under JNNURM
- AICTSL contribution which is shared with IDA, MPPWD, IMC

Source: DPR on Indore Rapid Transit System under JNNURM- Executive Summary (2006)

## Transport in Indore

Indore is fastest growing Tier II city of India and is the commercial capital of central India. The rapid industrial and commercial development coupled with the rise of population has resulted in large scale increase in traffic in the city. This has led to number of problems like delay, congestion, accidents, pollution, etc. To solve these problems, the transportation projects in the city of Indore are aimed towards increasing the use of public transport. The measures taken for the same include implementation of traffic streamlining, improvement of parking and pedestrian facilities. The important intervention towards achieving this aim include Bus Rapid Transit System (BRTS) in Indore. In order to catalyse this process other interventions undertaken include Automatic Fare Collection systems, traffic signal prioritisation along BRTS corridor, streamlining of fare collection, integration of fares and extension of services to Radio Taxi, parking tariffs, etc. Consumer services and mobile based application for seamless access to BRTS services have developed.

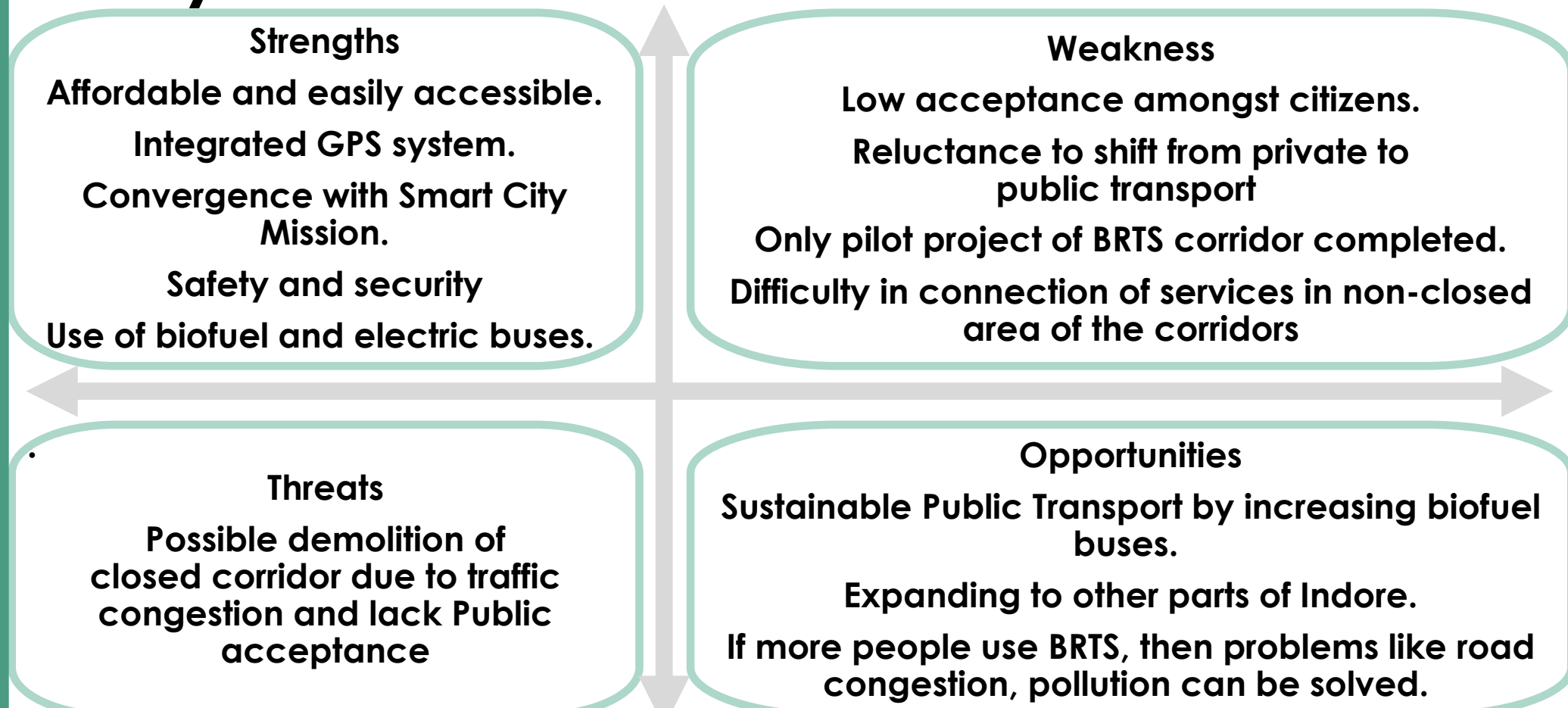
## Intelligent Transport System



Traffic Management Centre, AICTSL Office, Indore

Source: Site visit (08/03/2019), Interview with TMC officials

## Analysis



Other types of city buses used on normal bus routes:

- City Bus (under JNNURM)
- Midi Bus (32 seater, for demand areas)
- Feeder Bus (connecting BRTS to other places)
- Sky Bus (intercity and interstate)

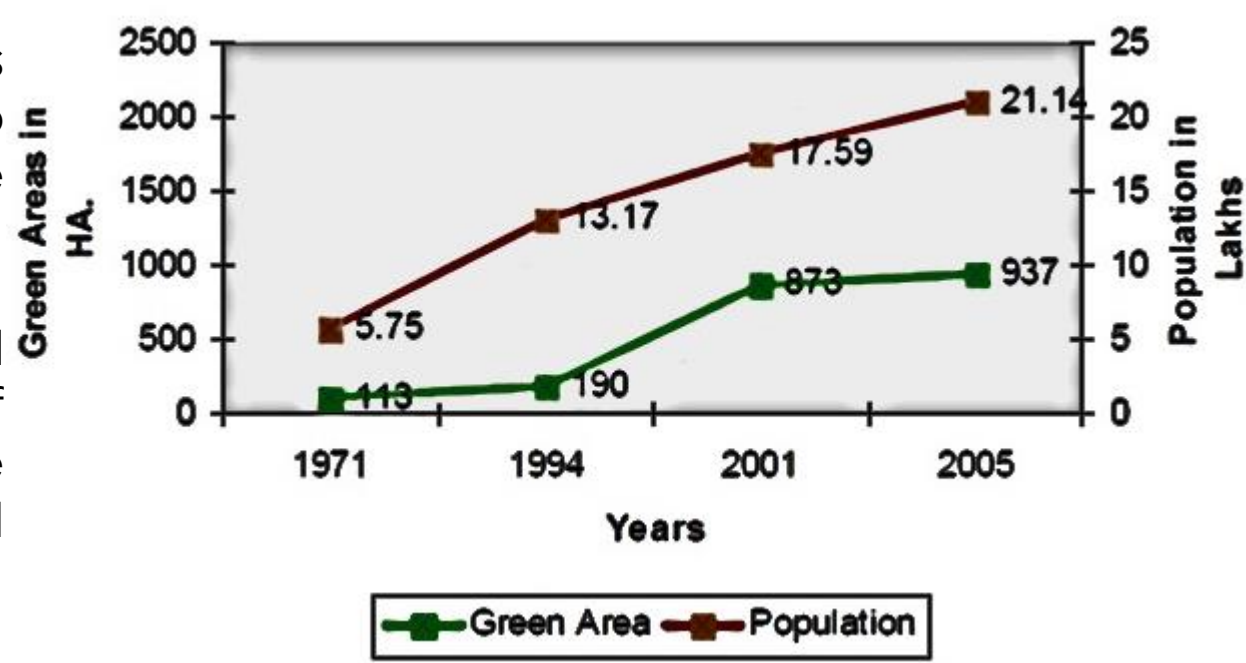
Source: Interview with PRO & MD, AICTSL



# ECOLOGY AND ENVIRONMENT

## Introduction

- The environmental conditions of Indore and its effects is due to rapid increase in urbanization leading to increase in population density which has surpassed the available infrastructure.
- The current sewerage system is 200 km in length, and average depth of 5-8 m. The logging and dumping of MSW leads to generation of harmful gasses like methane which in turn effects the environment and harmful diseases.
- The green house gas (GHG) emission from urban transport in 2025 will be 372,976 metric tonnes of CO2 which is equivalent to 2.5 times the emission in 2012.



Population Growth vs Green Space  
Source: Indore City Development Plan Under JNnURM

Year	Existing		Proposed	
	Public/Semi Public	Recreational	Public/Semi Public	Recreational
1991	12.69%	7.31%	11.67%	11.67%
2001	11%	8%		
2006	12.69%	7.31%		
2021			7.91%	14.15%

Existing and Proposed spaces as per Development Plan  
Source: Indore City Development Plan Under JNnURM  
Slum Free City Plan for Indore Metropolitan Area Under RAY, 2013

## Analysis Of Kahn River

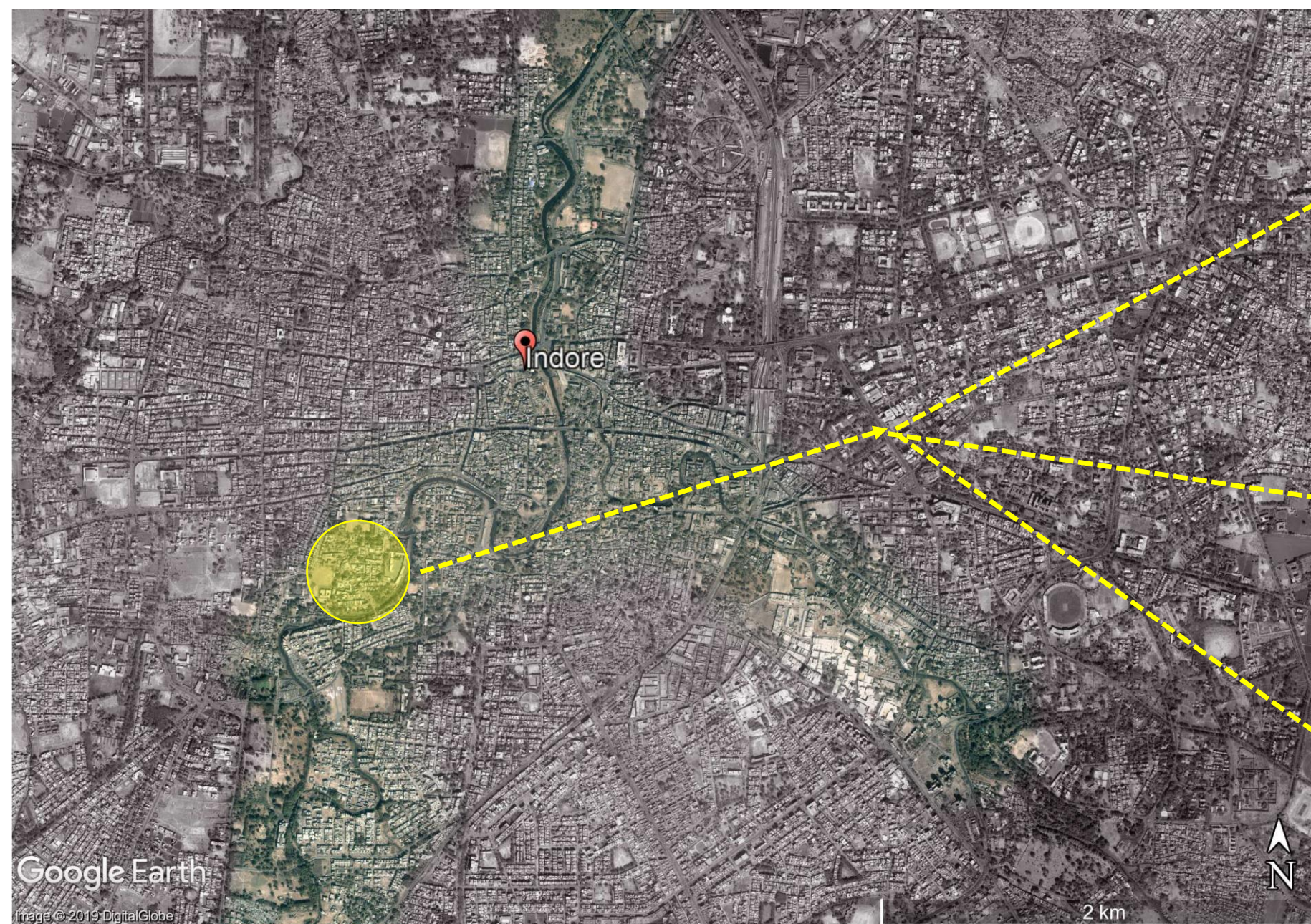
- Kahn River has a stretch of 21 km and runs all through Indore. In today's scenario the maximum depth of water is around 1 foot and breadth is not more than 10 feet as opposed to earlier when the breadth ranged between 32-98 feet. It is the biggest source of contamination for the Kshipra which is the main source of water supply for Ujjain.
- The combined total capacity of the existing sewage treatment plants is not more than 90 MLD. In other words, 190 MLD of untreated sewage is added each day to the Kahn river, which eventually pours into the Kshipra.
- Projects for the revival of the Kahn were chalked out in 1992, 2006 and 2011. But, none of them came to pass.

## Sources of pollution

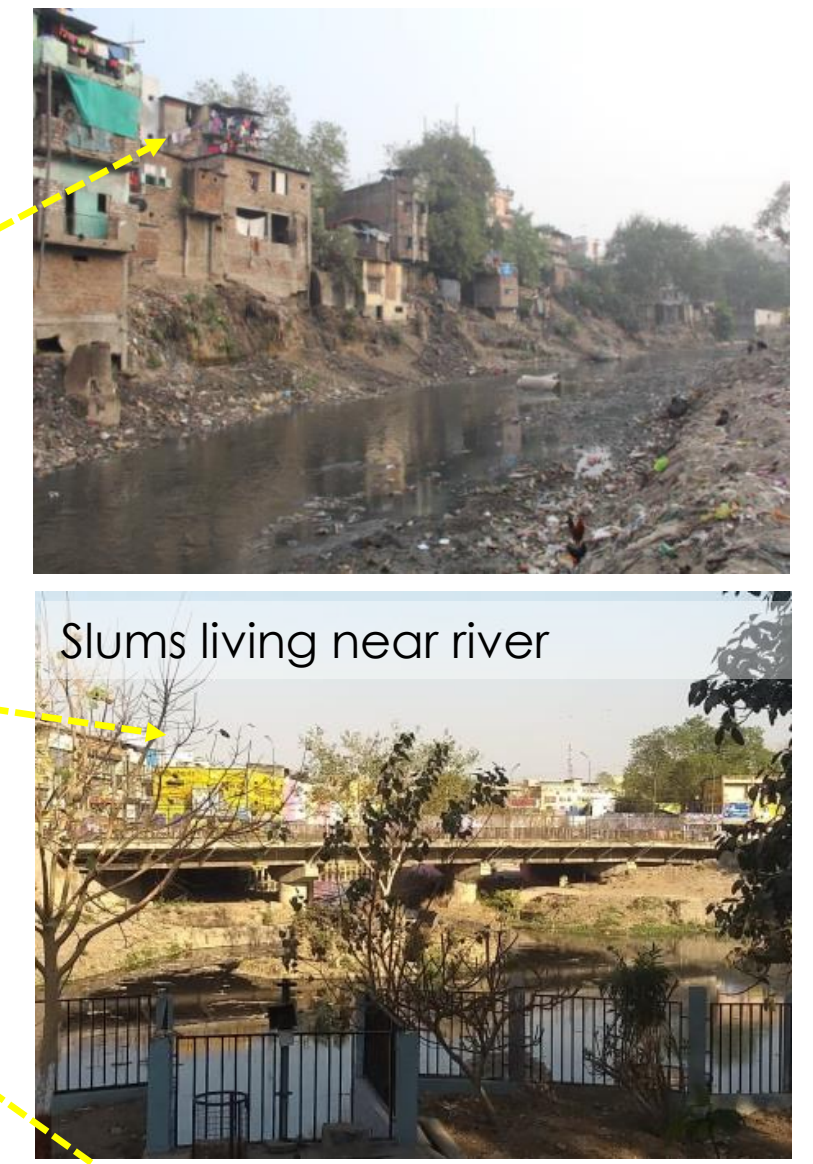


## Impacts of pollution

- The river has turned to a black nallah for the non-rainy part of the year.
- The river has become a huge channel which carries sewage and disposal and is largely a dumping site
- It is the source of contamination of ground water and water borne disease such as malaria
- Huge amount of algal growth and has adverse effect on aquatic life.



Map of core area of Indore city with highlighted part of river and its surroundings as in 2001  
Source: Google Earth



Slums living near river



Waste Disposal in river



Desilting of River Bed and Ghat Rejuvenation

Laying of Sewer-lines by Trenchless Technology along River Banks for Trapping of Sewage flowing into the Rivers

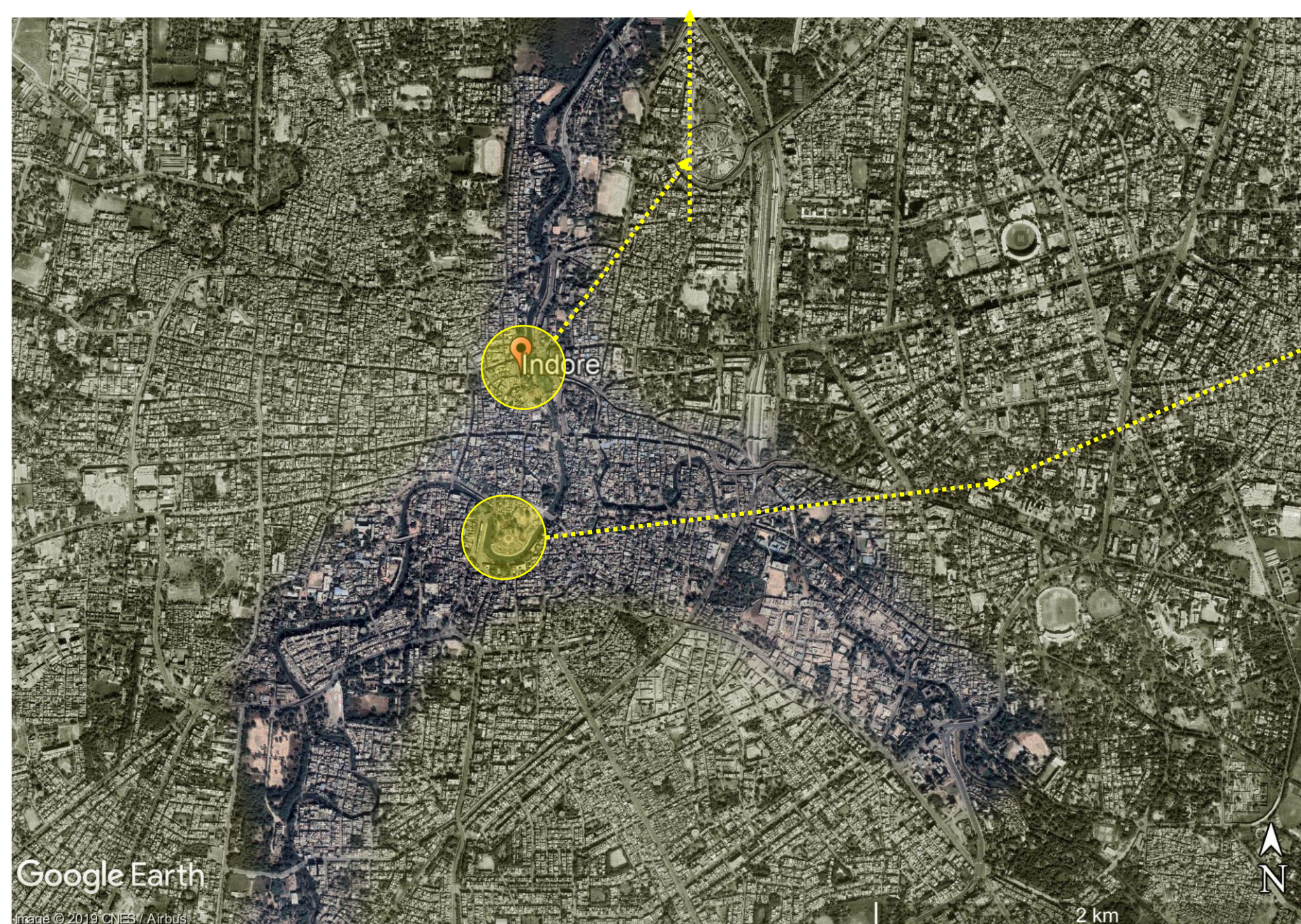
## Addressing Challenges

- River rejuvenation with the objective of keeping river clean through diversion of sewers, reconnecting city to the river and creating urban environment and public space like gardens, jogging track and walkways following proposals are being headed by Indore Municipal Corporation with budget of 2347.67 crores
- Catchment Area Conservation and treatment in Rural
- Catchments of Up-Streams and Down Streams
- Pollution Control through tapping of Sewage Discharge in River
- Effluent treatment of Industrial Waste
- Rehabilitation of Slums along River
- River Front Development and Conservation in Urban Areas
- The Project will impact the city with ground water recharge, creation of city-level recreational space will improve the environment and aesthetics.
- Cleaning of water and riverbed will reduce the BOD of River water and will improve the efficiency of water discharge.

Park near Krishnapura Chhatra with the area of 4000 sqm.



Source: International Journal of Current Research



Map of core area of Indore city with highlighted part of river and its surroundings as in 2019  
Source: Google Earth



Clearance of Slum



Plantation with Fencing on both sides of the Rivers' location

## Conclusion

- The city doesn't have any hierarchy of recreational spaces and lacks in city parks and regional parks.
- Increasing the number of parks and public spaces will help in reducing the concentration of suspended particulate matter and capacity enhancement of surface water bodies of the city would help in controlling the pollution with overall conservation.
- The poor water quality and issues of water logging leads to threats of health and vector borne diseases. The poor conditions of slums adds to the situation.



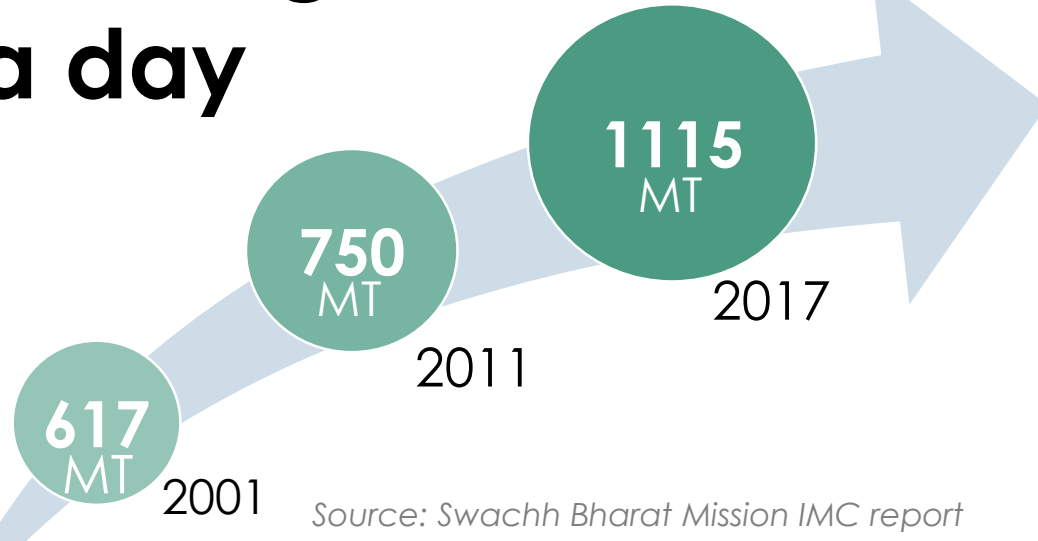


# SOLID WASTE MANAGEMENT

## SWM System structured across



## Amount of Solid waste generated in a day



## Swachh Sarvekshan 2019

Star rating under Garbage free city certification program of the MoHUA ★★★★★

ODF status ODF ++

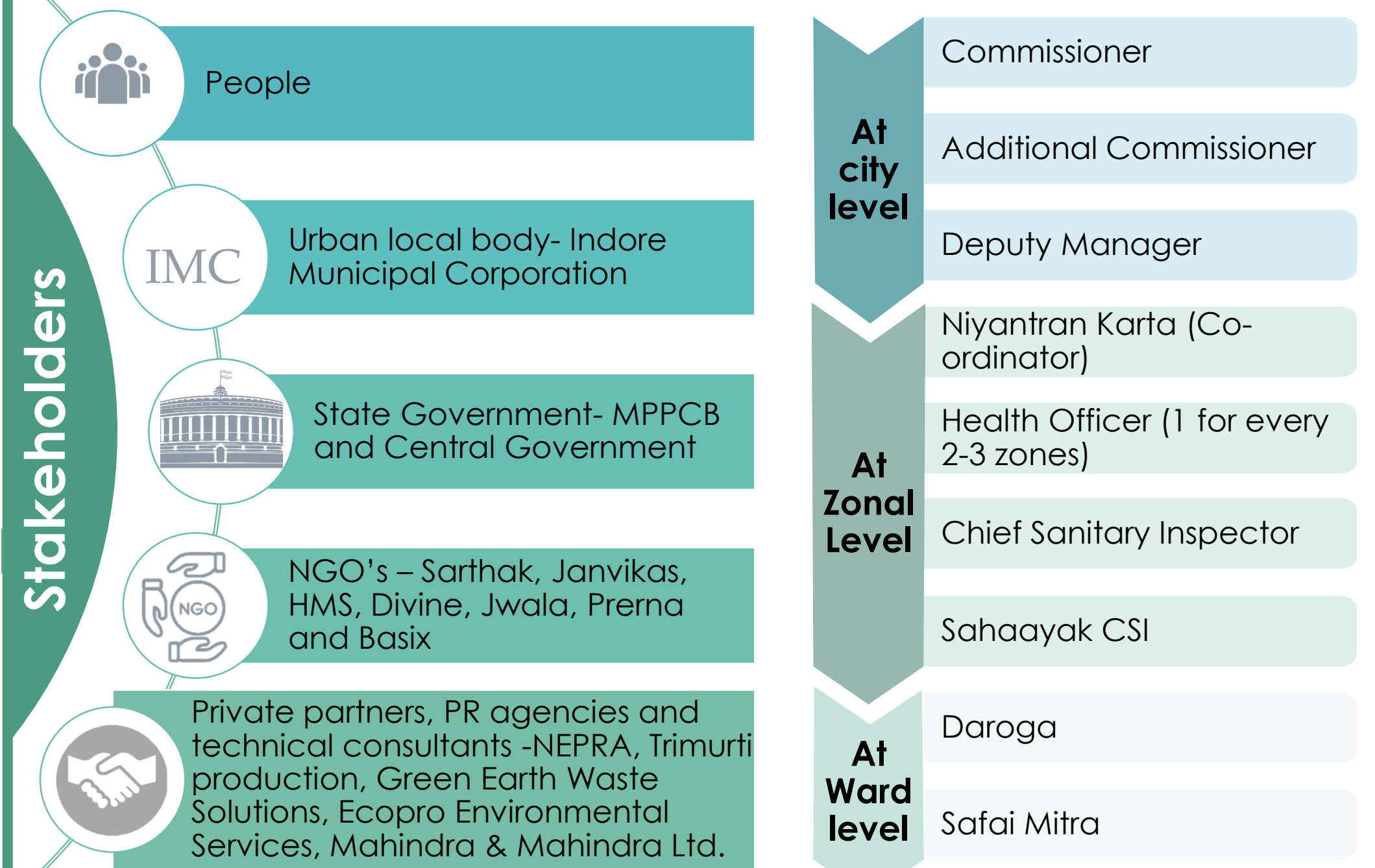
All India rank SS2019 #1 SS2018 #1 SS2017 #1

- Door-to-door collection achieved in 100% wards.
- 100% segregation of waste at source.
- Twice a day sweeping by IMC staff in commercial areas with dustbins located at every 100 metres.
- Financially sustainable model of IMC to recover O&M cost of SWM through property tax and user charges.
- Removal of stray cattle and their shelters in IMC limits.
- Special permission from Zonal CSI have to be taken for bulk generation of MSW during social gatherings and events.
- Regular and mechanised cleaning of streets to make them dust free.



Bioremediation at Landfill site

## Stakeholders involved



Segregated waste collection in partitioned tippers



Provisioning of separate dustbins at frequent intervals in public spaces



There are two separate hoppers for dry waste (Blue colour) and wet waste (Green). The segregated MSW is compressed into respective containers



## Integrated SWM Process Flow

### Waste Segregation and Door to Door Collection

- Waste generators classified as domestic (25 kg /day), semi bulk (25-100 kg/day) and bulk generators (>50 kg/day).

### Transportation in Partitioned Tippers to any of the 8 Garbage Transfer Stations (GTS)

- Separation for wet and dry waste and additional bin for Hazardous Waste from Domestic Generators
- Waste from bulk generators is collected through the Bulk Collection System ; two vehicles are deployed to collect wet waste and dry waste separately.

### Segregated and Compressed waste is sent to the respective Disposal Site /Trenching Ground

- Wet waste is off loaded to Composting Plants
- Dry waste is off loaded to the Material Recovery Facility
- Domestic Hazardous Waste is sent straight from the GTS to the Common Biomedical Waste Facility (CBWTF) to be incinerated

### Recovery of Resources from the segregated waste

- Wet waste is converted to Compost
- Wet waste from bulk generators such as Choitram Mandis and Hotels is converted into Biogas at the Bio-methanation Plant established and operated by Mahindra & Mahindra Ltd. Mumbai Biogas used to fuel AICTSL buses
- Dry waste is segregated in 13 different categories and recycled.
- Plastic waste collected at plastic waste collection centre is disposed off by two different methods:
  - (i) Sold to cement plant at Neemuch and
  - (ii) Sold and used by M.P. Rural Road Development Board for construction of roads. Ten roads have been constructed with in Municipal Corporation by using plastic waste.
- Plastic Waste is also converted into pellets which are further converted into derivatives such as Plastic Pipes (agricultural uses)
- In some cases such as the one managed by Trimurti Production and Green Earth Waste Solutions plastic is converted to crude oil, petrol or diesel with carbon as residue, also re-used in the ink industry.
- Construction and Demolition Waste is used to manufacture Paver blocks.



Composting of wet waste



Plastic waste converted into pellets, further used for making pipes



Bio-methanation plant practising conversion of wet waste from bulk generators into biogas



Construction and demolition waste treatment plant

### Disposal of remnants in Devguradia Sanitary Landfill Site

- Two engineered landfill of 6.25 acre each has been constructed and are used as and when required.
- Bioremediation of 200,000 MT waste dump on 5 acre land has been achieved





# SOLID WASTE MANAGEMENT

## Challenges and tackling mechanisms

Challenges	Tackling Mechanisms
Lack of responsible behaviour from city dwellers	Strong awareness campaign
No door to door waste collection	Door to door collection mechanism strengthened
Issues with Outsourced Agency's functioning	New private partners with technical expertise
Open dump points, poor condition of garbage containers, onsite burning of waste	Installation of separate bins across the city based on frequency and load and strict regulations and heavy spot-fines
Manual attendance system and high absenteeism of staff	Biometric attendance system and incentives to staff
Insufficient supervision and monitoring	GPS enabled monitoring system
Insufficient vehicle as well as staff	1300-1400 new vehicles and hiring of Safai Mitras
Lack of tools, machinery and proper infrastructure	Huge investment in SWM infrastructure
Unscientific Disposal Site	Sanitary & Scientific Landfill Site
Lack of trust for Indore Municipal Corporation	Active Feedback mechanisms to build trust

## Initiatives for behaviour change



IEC initiatives including banners, hoardings and wall graffiti targeted to create a behavioural change and to generate awareness on segregation and safe disposal of waste



Advertisements displayed across public spaces such as bus-stops and even public buses to inculcate a spirit of competitiveness within the citizens, in order to create an impact on individual practices of waste management.



Waste to Energy Plant managed by Trimurti Production and Ecopro Environmental Services converting plastic to crude oil, petrol or diesel

- Street play
- Road rallies
- Public Awareness
- Meetings with RWAs
- Interaction with SHGs and Mohalla samiti
- Talk shows
- Radio jingles
- Street play

Initiatives undertaken for behaviour change

- Pamphlet distribution
- Flags, wall paintings and hoardings
- Regular public feedback
- Awareness campaigns in schools
- Interactions with bulk generators such as hotels
- Thematic drives such as "dabba gang" of 180 members of Basix, children group "vanersena"

## Public Participation

People are made aware and spread the knowledge of waste segregation and their disposal techniques

Access to proper complaints and feedback systems on Indore 311 application

Composting of wet waste at household level also incentivised by IMC as concessions in user charges and composting bins at subsidised rates.

Responsible behaviour with ownership towards the cleanliness of the city.



Parks are maintained by Nagar Palika Nigam, Indore and in-situ composting is practised

Home composting practices with compost-bins provided by IMC at subsidised rates

## ICT based interventions

GPS used for monitoring of SWM vehicles.	Sensors and RFID used for monitoring of bins.	Heat sensors used for waste treatment(energy) operations
Control room for monitoring of all the SWM activities.	Drone camera for monitoring operations at the landfill sites.	Grievance redressal through easy to operate mobile app.



Old people too contributing in cleaning the city.

## Analysis

<b>Strengths</b> Innovative solutions coupled with transparent monitoring and governance mechanisms for effective implementation of government policies	<b>Weakness</b> Lack of inclusion of provisions for collection and processing of e-waste
<b>Threats</b> Change in bureaucracy and performance of stakeholders involved may lead to a failure of the entire value-chain of SWM processes.	<b>Opportunities</b> The current systems have achieved a certain level of services which can further be strengthened and replicated by creating networks at regional level with symbiotic relationships

## Way Forward

IMC is now working on implementation of the 3R's

- Minimise the amount of waste produced
- Awareness campaigns
  - IEC activities
  - Workshops
  - Citizen involvement

Reduce

- Use materials more than once
- Making handicrafts
  - Refurbishment of waste products

Reuse

- Processing of waste
- Waste to energy
  - Wet waste to compost
  - Plastic waste to irrigation pipes

Recycle

