

FINAL REPORT

**OPERATIONALISING URBAN SUSTAINABLE
DEVELOPMENT GOALS (SDGs) FOR BANGALORE**

Submitted by:



Indian Institute for Human Settlements

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Abbreviations

ASI	Archaeological Survey of India
BBMP	Bruhat Bangalore Mahanagar Palike (Greater Bangalore Municipal Corporation)
BDA	Bangalore Development Authority
BMP	Bangalore Mahanagar Palike (Bangalore Municipal Corporation)
BMTC	Bangalore Metropolitan Transport Corporation
BWSSB	Bangalore Water Supply and Sewerage Board
CDP	City Development Plan
CMC	City Municipal Council
CPCB	Central Pollution Control Board
GRIHA	Green Buildings Rating System India
INTACH	Indian National Trust for Art and Cultural Heritage
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
LCR	Land Consumption Rate
LEED	Leadership in Energy and Environmental Design
MoUD	Ministry of Urban Development
NSS	National Sample Survey
SDG	Sustainable Development Goal
SLBs	Service Level Benchmarks
TMC	Town Municipal Council

OPERATIONALISING URBAN SUSTAINABLE DEVELOPMENT GOALS FOR BANGALORE

Summary

Some of the challenges that Bangalore city may face with respect to the monitoring of the sustainable development indicators are as follows:

1. Most of the data is collected not by the city, but by the national data collection agency – Census of India. While this Census data is available at the sub-city level for some of the indicators, it is updated only every decade. This could be a limitation to use since the SDG process may require information every year.
2. Moreover, Census of India does not collect data on all indicators, but another National Sample Survey (NSS) that is conducted more often does collect more detailed information, they do not report data below the district level (which are large household surveys and reported as aggregate information at urban and rural scale but unit-level data can be extracted but will have limitations of sample size). While this may be alright for a city like Bangalore and Delhi, which are also a District and a State respectively, this may not be the case for other small and medium sized cities. Such information collection systems are costly to administer and there are no regular budgetary support for its administration, if such as system is planned regularly at the sub-national level.
3. Meanwhile, the Census data and the NSS data cannot necessarily be used to compare, as one is population data, while the other is derived out of a sample dataset.
4. Other areas such as cultural and natural heritage, are taken care by a national level institution (Archaeological Survey of India), and the spending is not necessarily year-marked by cities. Some budgetary allocation at city level is provided, which is either accessed through national allocations or operational expenses (of small value) supported through revenue budget at the city level. On investigating further, it was revealed that conservation-based activities are again administered at the sub-national level and city-level budgeting is hardly available or not possible to decipher in direct terms.
5. Some of the analysis requires particular analytical tools and datasets such as GIS, but the city may not necessarily have the capacities to conduct such assessments to derive the required numbers to report. Many indicators have been imputed after intense analytical work, using GIS-based techniques. There may be a need to motivate the cities to institutionalise partnerships with academic or consulting organisations that can provide such support of data collection, analysis and documenting information annually. Although this may require additional funds, that the city may not have.
6. There is considerable fragmentation in the planning and governing process in the city. The BDA (planning), the BBMP (municipal corporation), the BWSSB (water supply and sewerage), and BESCO (electricity) all have differing jurisdiction areas. The implementation and monitoring of data across multiple agencies in the future can become a roadblock for the SDGs. Bangalore has these multiple administrative boundaries. This in turn affects the data available, as the unit of enquiry often changes, and cannot be related across.
7. The Municipal Corporation of Bangalore (BBMP) is in the process of being trifurcated, after which this comparison will become even more difficult.
8. As the city grows, the metropolitan region (Bangalore Metropolitan Regional Development Authority, BMRDA) may become a more prominent and standardised unit of enquiry, although sufficient data for that region is not available currently.

Inputs from Stakeholder Consultations:

Stakeholder consultation was spread over a long period, where key sector experts (academia and non-academia) and appropriate government or government-interfaced institutions were interviewed. The main issues that were discussed during the consultation were centred on the usefulness of the indicator, data availability (and its quality) and how one could institutionalize data management systems at the city level. The key findings are listed below:

1. There is an existing system of data collation and publication that exists at the national, sub-national, district and rural/urban levels. However, most of the data collated does not match with the desirable indicators. The most prominent indicators being measured pertain to broad human development values (with intermittent frequency) or economic output. The sub-national statistical system does not have the institutional capacity to undertake a regular system of data measurement, collation and publication. For e.g., it was highlighted that the GIS capacity of city-based institutional system is poor and creation of data-based systems are costly. This discourages local governments to invest in building data-related capacities.
2. At times, most of the institutional innovation takes a long time to operationalize. By the time the system is operationalized, it becomes outdated and loses its relevance. It was highlighted that institutional agility is a serious problem in local government system. It was also highlighted that in multiple institutional set-ups, there is an inherent reluctance of sharing data and also, most of the data is not shared timely¹.
3. There was a need expressed to create a separate institutional set-up that regularly keeps a track of the desirable indicators and publishes those at regular intervals. It was also highlighted that the separate institutional set-up could be an independent/academic observatory with an established mandate to collect & publish data. Such a system was highlighted to have innovative capacities such as administering spot sample surveys for validation. It was also pointed out that this process of creating an independent institutional system, with adequate systems to measure indicators might require adequate and significant budgetary support.
4. It was also highlighted that historically, in India, there is a planning framework that is operational. The indicators should respond to the needs of the planning framework in order to be useful. Discussions on creating such a mechanism yielded the need to create performance appraisal mechanisms in government schemes/programs that creates a desirability of the indicators. It was also highlighted that large cities might still have institutional capacity to operationalize data-based systems but even in such bodies, it was noted that most of the innovation is driven by interested or senior officers, who are equally capable but soon are posted elsewhere and the established system loses relevance. In smaller cities, it was noted that capacities to create data-based measurement and analytical systems are severely limited.
5. There is a normative system of large scale household surveys that are administered in India. Some of these surveys are specifically commissioned at the sub-national level. However many times the survey instrument is in the nature of enumeration and an opportunity could

¹ It was highlighted that some of the line departments are not open to sharing data, as it is perceived that their performance will be evaluated based on the indicators. It was also indicated that in such an institutional system, data quality could be questionable.

be utilised in collecting information (at regular intervals) in line with the indicators that are required to be monitored. It was highlighted that such a system could be institutionalized for data collection purpose.

6. It was also highlighted that in principle, all kinds of information is available with the national or sub-national system technically. There is an institutional mechanism of Right to Information that exists, using which information can be accessed. However, on a regular basis, the data is normatively not available or is not updated. It was also recognized that in the Indian system, Mayor of the city is not in control of most of the institutional systems and it is the administrator who needs to be interested in building and sustaining institutional systems in line with the requirements of the indicator-based measurement system.
7. Most of the data related surveys are large scale surveys and involve huge financial implications. It was highlighted that the national and sub-national system should identify financial support (unambiguously) to manage and implement such systems. At present, need-based surveys are only institutionalized or announced on an ad-hoc basis and no institutional system exists for a regular collection of information.

Indicator-wise Update

Primary Indicators

11.1.1 Percentage of urban population living in slums or informal settlements

<p>Work done: Using Census of India 2011 and 2001 data, the proportion of population living in Slums in Bangalore is given below. Data for earlier years is not reliable.</p>
<p>Status of data: This data is publically available. This assumes the BBMP boundary. Data on slums was also collected during preparation of the City Development Plan (CDP) under Jawaharlal Nehru National Urban Renewal Mission (JNNURM)². As per CDP 2009, 0.14 million households and 0.7 million persons were living in declared and undeclared slums in Bangalore. However, there has been a continuous change in the area covered by the local government during the years 1991, 2001 and 2011. Hence, the data points are incomparable across the years, as the definitions and coverage of slums might vary across the sources. The earlier 2001 census data may not be comparable to the present city limits.</p>
<p>Challenges: The quality of the data could be questionable – more so because the definition of slums is very different and varies across sources. The overarching debate in literature points towards underreporting of slum data, with methodological variations (for estimation) across different sources. For e.g., the Census 2011 definition of slums is as follows: “a Slum, for the purpose of Census, has been defined as residential areas where</p>

² The National Urban Renewal Program was operational between 2005 and 2014. This program had two major components: urban infrastructure and basic services for urban poor. Cities accessing funds through this program had to prepare a city development plan (CDP) – which was a development plan & vision for the city.

dwellings are unfit for human habitation by reasons of dilapidation, overcrowding, faulty arrangements and design of such buildings, narrowness or faulty arrangement of street, lack of ventilation, light, or sanitation facilities or any combination of these factors which are detrimental to the safety and health”³. Expert consultation corroborated the unreliability of previous year’s data and emphasized on using the latest census data with caution. Experts viewed the reported slum data as being grossly underreported. Measurement of slum information has many political orientations- such as with regards to notified slums and those to which tenure has been allotted. In the latter case, physical situation can be slum-like but is not reported. There are slum boards in large cities but beneficiary assessment is hugely politicised. Measuring slum information needs to be contextual and a broad definitional consensus is desirable. Initiating a process in this direction would be a useful first-step, followed by (with adequate financial support) carefully designed and administered (contextual) surveys.

	1991	2001	2011
Percentage of urban population living in slums or informal settlements	N/A	8% ⁴	8.4%

11.1.2 Proportion of population that spends more than 30% of its income on accommodation

Work done: Assessed – we analyzed the NSSO (National Sample Survey Organization) 63rd round data on "Household Consumption of Various Goods and Services of India". This data has been reported for the year 2011-12 and was used to calculate the average expenditure on rent as a percentage of total monthly consumption expenditure. This survey is administered using a sample of households and we extracted unit level data from the India level data that was available for the larger Bangalore region (which includes component of Bangalore rural) and Bangalore urban region. It was not worthwhile to do assessment for other years due to data reliability issues and expert validation that little has changed in terms of proportional expenditure on rent with respect to overall expenditure. Initial expert opinion suggested an allocation of 15% from monthly per capita expenditure (in urban context) and 2011-12 survey data analysis revealed that, for Bangalore, it was 25.4%. However, this data is an average value and situation might change across expenditure classes (explained below).

Status of data: Among other sources, the information on housing expenditure is generally collected in India. What we have is the following:

- Quality of housing as published in the report titled "Key Indicators of Drinking water, Sanitation, Hygiene and Housing Conditions in India" by the National Sample Survey Organisation (NSSO, Government of India). This report contains information on the household level public facilities, particulars of the dwelling unit and the micro environment surrounding the dwelling unit and the household characteristics.

³ <http://pib.nic.in/newsite/PrintRelease.aspx?relid=72280>

⁴ http://censusindia.gov.in/Tables_Published/Admin_Units/Admin_links/slum1_m_plus.html; last accessed on 29th May 2015.

- There is also information on the construction/first hand purchase of houses or flats by the households during the last 365 days. This is based upon the sample survey of households.
- The census also collects and reports aggregated information on the housing stock and the quality of housing.

Challenges: This data is not available as it is, but will have to be calculated based on the sample survey reports and other assumptions by some experts. The sample survey reports are available for sampled households only and the results would be contingent on sampling design, though rigorous. It was also highlighted by experts that there is a need to distinguish between direct rents and imputed rents (rents together with buying other basic services due to location). For large expanding cities, when city infrastructure system is yet to keep pace with expansion of city boundaries, such a distinction becomes very critical. Expert opinion although broadly validated our earlier findings but the interesting debate is with regards to the urban poverty line and assessment of relative expenditure across different expenditure classes. In a paper titled, "Broadening poverty definition in India: Basic needs in urban housing" (Chandrasekhar and Montgomery 2010), and using NSSO data for 2004-05, it is stated that "renters devote between 11-17% of consumption expenditures to rent, an amount that tends to increase somewhat with the overall level of consumption. For owners, imputed rents are substantially larger in relation to consumption, reaching nearly 1/3rd of consumption expenditures among the better-off groups, and like actual rents, the imputed rents increase with the level of consumption". It was also pointed by experts that in large cities, only the upper two deciles (across expenditure classes) could be spending more than 30% of their overall expenditure on accommodation. However, to accurately estimate this opinion would require large sample sizes and such surveys could be costly to administer. The estimated value is provided below:

	1991	2001	2011
Proportion of population that spends more than 30% of its income on accommodation	0	0	0

11.2.1 Percentage of people living within 0.5 km of public transit [running at least every 20minutes] in cities with more than 500,000 inhabitants

Work done: *Percentage of people within 0.5km (radii) of public transit in the year 2014*

Status of data: *The computation of the number of people who have access to bus stops and metro stations, with reference to the population density of the ward. This methodology is based on estimation. However, the Government of India commissioned a study on urban transportation in 2008 (MoUD, 2008); which calculated (using survey data) several indices.*

*Two critical indicators – accessibility index⁵ (public transport and service) and service accessibility index⁶ has been calculated. The following data is available⁷:
Public transport accessibility index – 1.01 (Comparatively – the highest value was 3.15 (Pune)
Service accessibility index (% of work trips accessible in 15 minutes time) – 13.0 – the highest value was 94.1% for Gangtok*

Challenges:

1. *Percentage of people within 0.5km (radii) of public transit running at least every 20 minutes was the indicator provided, which was not possible to compute due to non-availability of the spatial data for the bus routes.*
2. *Unavailability of the appropriate GIS road dataset.*
3. *Unverified locations of bus stops*
4. *Availability of bus stops and metro station locations only for year 2014.*
5. *Unavailability of surveyed population around 0.5km (radii) of each public transit location.*
6. *Assumption of considering evenly distribution of population on each location within the ward.*
7. *Area falling under 0.5km (radii) may not be always accessible to the public bus and metro services*
8. *Unavailability of sub-meter spatial resolution satellite image*
9. *Assumption of equating 30mt extracted built-up area to each residential built-up area on ground.*
10. *Relevance of the indicator has been identified clearly, as many citizens are inclined towards using the public transit system. The huge unreliability of public transit system forces the user to switch to private transport. However, creating a measurement system that identifies the 20 min frequency (though desirable) is difficult on a regular basis. There are few and far between surveys of origin-destination undertaken by the government system, which measures this indicator and such surveys are costly to administer on a regular basis. There is clear support to use the 20 min frequency indicator but how do we develop a system to measure it might be something that needs to be thought through – technically and institutionally.*
11. *It was identified that bus stops are dynamically created and there is no institutional system that logically identifies their location. At times, it is bus stops are created on an ad-hoc basis and it then becomes irrelevant to measure this indicator.*

Percentage of people within 0.5km of public transit running at least every 20 minutes was the indicator provided, due to non-availability of the data for the bus routes, the proxy of bus stops and metro stations were considered.

The Bus stops and metro stations within the BBMP boundary were taken as public transit points. Area of about 0.5 km (radii) from each transit locations were considered for identification of population density residing there. Assumption of having equally distributed population density

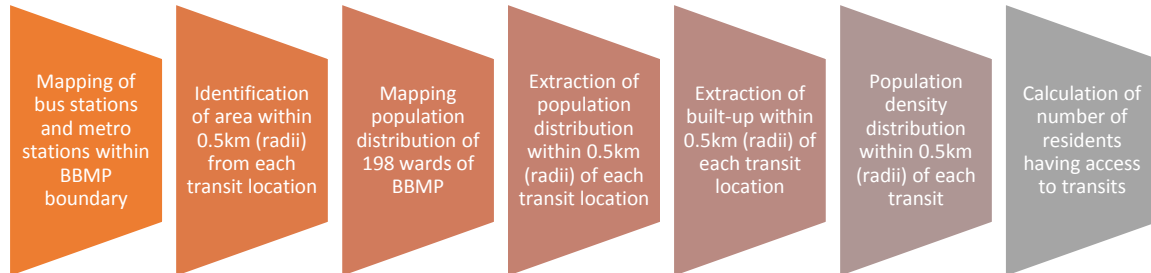
⁵ Public transport accessibility index is formulated as the inverse of the average distance (in km) to the nearest bus stop/railway station (suburban/metro).

⁶ Service accessibility index is computed as the percentage of work trips accessible within 15 minute time and 30 minute time for each city (Bangalore was studied extensively for this study).

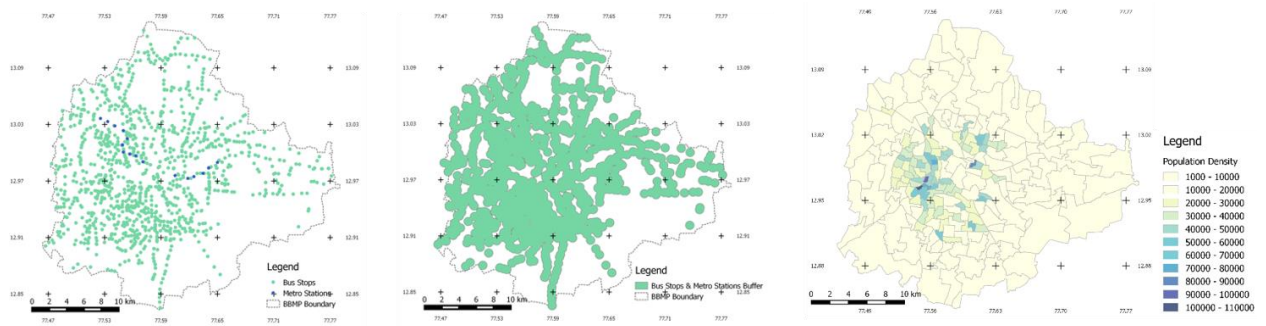
⁷ <https://casi.sas.upenn.edu/sites/casi.sas.upenn.edu/files/iit/GOI%202008%20Traffic%20Study.pdf>

was considered throughout the ward. Built-up area within each of these identified 0.5km area was extracted to arrive at the number of residents having access to these transits.

Methodology



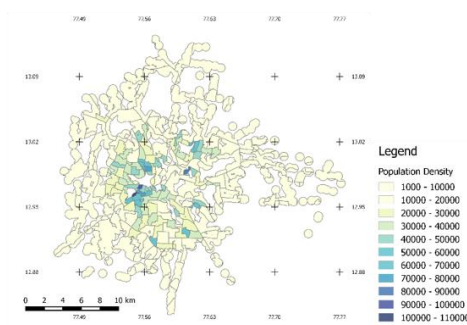
Maps depicting the methodology



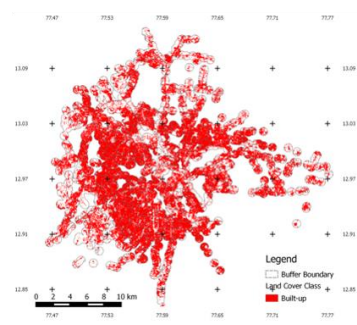
Mapping of Bus stations and Metro stations within BBMP Boundary

Identification of area within 0.5km (radii) from which transit location

Mapping population distribution for 198 wards of BBMP



Extraction of population distribution within 0.5km (radii) of each transit location



Extraction of Built-up within 0.5km (radii) of each transit location

No. of people having access to public transit within 0.5km = 3.6 million

% of people having access to public transit within 0.5 = $(3558081 / 8443675) * 100 = 42\%$

11.2.2 km of high capacity (BRT, light rail, metro) public transport per person for cities with more than 500,000 inhabitants

Work done: The only mass transit facility in Bangalore is the Bangalore Metro and the relevant information is provided below.
Status of data: 42.3 km of metro line (18.10 and 24.20 km- two lines) – as planned (http://bmrc.co.in/index.html) This came into being in 2011. Before this, Bangalore did not have any high capacity public transit system to report for. Expert consultation has indicated that out of the planned metro network, roughly 50% is operational.
Challenges: The Phase-1 network of Bangalore Metro consists of two corridors viz. East-West and North-South and right now the lines (mentioned above) are partially operational.

	1991	2001	2011
<i>km of high capacity (BRT, light rail, metro) public transport per person for cities with more than 500,000 inhabitants</i>	0	0	0.0002

11.3.1 Ratio of land consumption rate to population growth rate at comparable scale

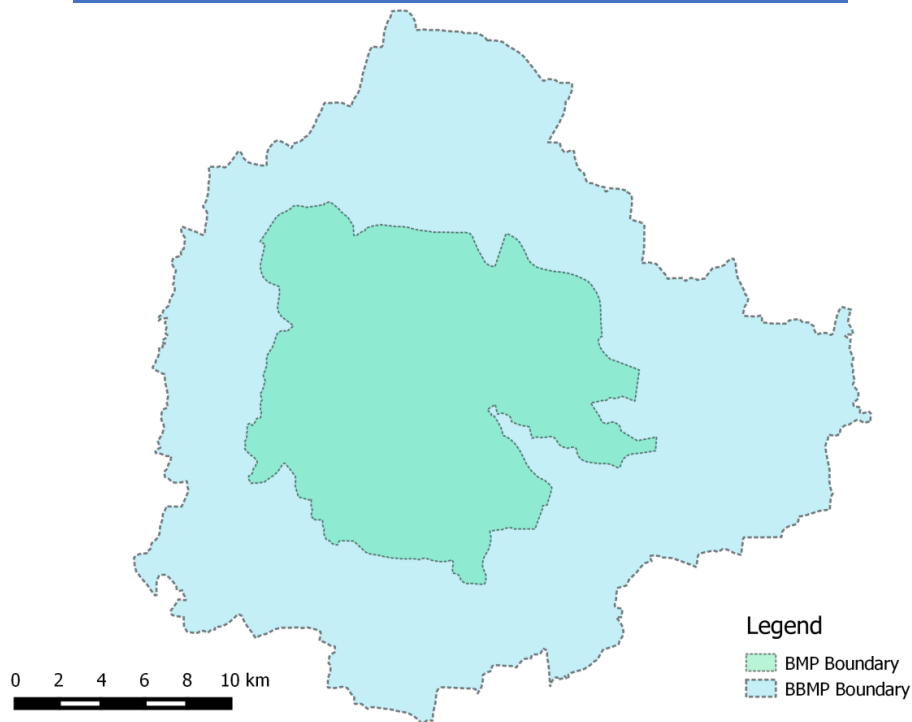
Work done: Calculated the LCR for three time period 1992, 2001 & 2011
Status of data: LCR values in tables with associated images is available (collected and analyzed at IIHS)
Challenges: The administrative division for the Bangalore for 1992 & 2001 were BMP with 226 sq.km later it was expanded to BBMP – Bruhat Bangalore Mahanagara Palike with 198 wards. Hence the LCR for 1992 & 2001 are calculated using the BMP boundary and the 2011 LCR is calculated using BBMP boundary. Administrative boundary changes with time.

The indicator was calculated for Bangalore for 3 time period – 1992, 2001 and 2011.

In January 2007, the Karnataka Government issued a notification to merge 100 wards of the erstwhile Bangalore Mahanagara Palike with seven City Municipal Councils (CMCs), one Town Municipal Council (TMC) and 111 villages around the city to form a single administrative area. The process was completed in April 2007. Hence the boundary for Bangalore is BMP with 226 sq.km with 100 wards; it was renamed as Bruhat Bangalore Mahanagara Palike (BBMP) with 198 wards and an area of 685 sq.km. Hence the LCR was calculated for 1992 and 2001 using BMP boundary and the 2011 LCR was calculated using the BBMP boundary.

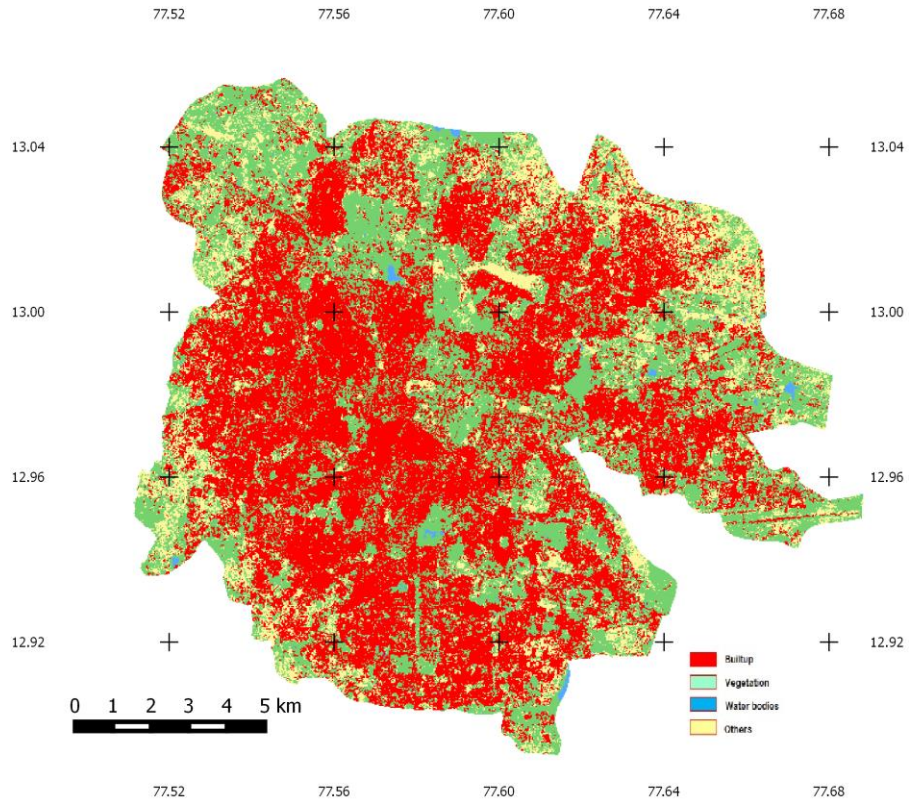
Area in Hectares (in '000)			
	BMP	BMP	BBMP
	1992	2001	2011
Built-up	10.2	12.1	34.1
Vegetation	7.8	5.1	18.4
Waterbodies	0.15	0.21	2.7
Others	3.4	4.1	13.2
Total	21.6	21.6	68.5

	1992	2001	2011
Population (in millions)⁸	3.3	4.3	8.4
LCR	0.006	0.005	0.008
Administrative Division	BMP	BMP	BBMP
Area in sq.km	226	226	685

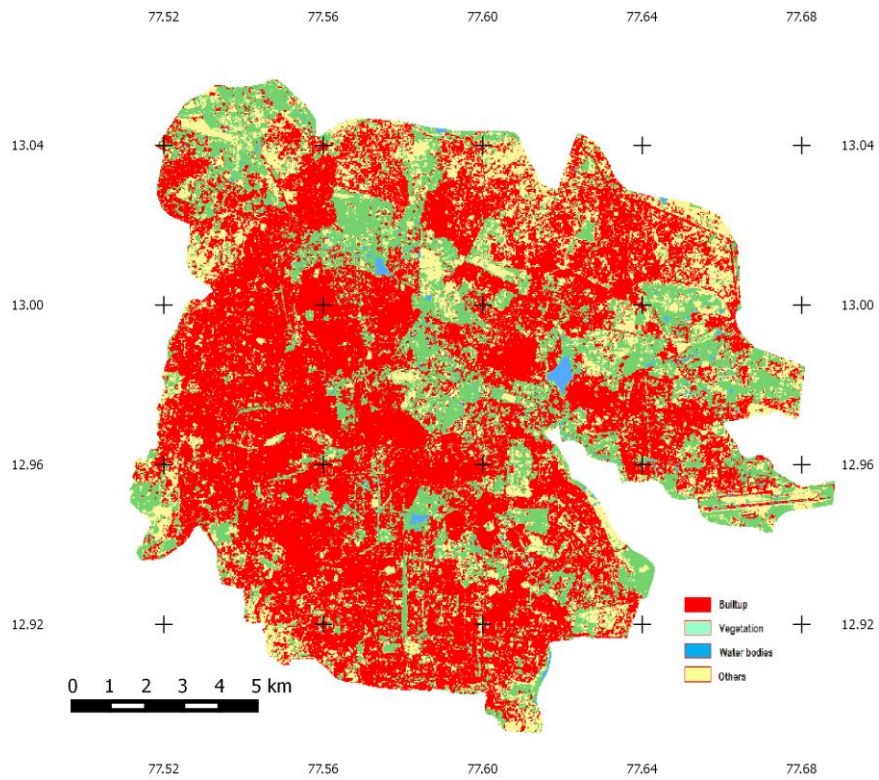


⁸ In 1992 and 2001, the administrative boundaries were different from 2011 and therefore, graphical representation would not have been comparable and hence, not reported

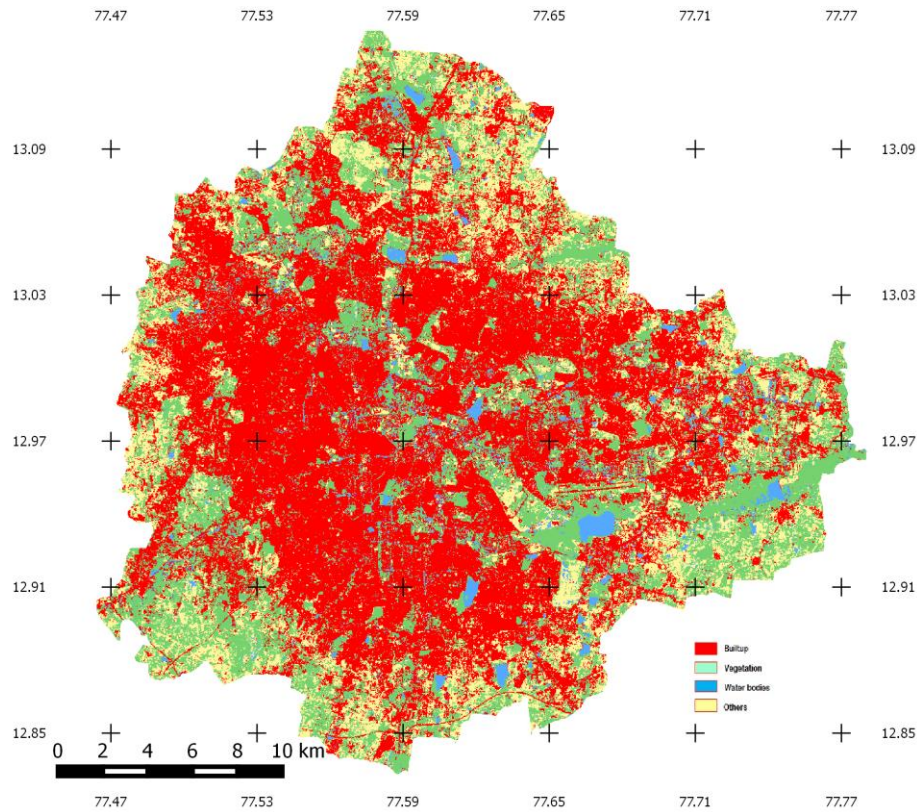
Administrative Boundary for Bangalore



Land-use Land-Cover for BMP - 1992



Land-use Land-Cover for BMP – 2001



Land-use Land-Cover for BMP – 2011

11.3.2 Cities with more than 100,000 inhabitants that implement urban and regional development plans integrating population projections and resource needs

Work done: Assessed and completed.
Status of data: This indicator read at the city level is an absolute indicator. Since Bangalore has an urban and regional development plan that integrates population projections, this will be a yes .
Challenges: Discussing the quality of these plans is under question, as the latest master plan is still work in progress. Master Plan 2015 ⁹ is the latest approved plan that is operational and Master Plan 2035 ¹⁰ is under preparation. This indicator is highly relevant but needs to be developed in the context of how well the plans have been implemented in the past and how these plans are aligned with the city development plans and other interventions.

11.4.1 Percentage of budget provided for maintaining cultural and natural heritage

Work done: The available data and its analysis is presented below. The data provided below is the nominal investment planned during the first period of the city development

⁹ <http://bdabangalore.org/Masterplan2015.html>

¹⁰ <http://bdabangalore.org/townplanning.html#TPM-RMP>

plan. On looking into the city budget documents more closely, expenditure on maintaining cultural and national heritage is difficult to segregate as most of the expenditure allocated is on ad-hoc basis and as per need. Moreover, the budget heads are different for different activities. For example, maintaining a lake which has a cultural and heritage value is reported under the environment head but what component of allocation corresponds with the cultural & heritage part is difficult to ascertain. . We also closely looked at the projects funded through the national urban renewal mission (2005 – 2012) and against as planned by the city development process, not a single heritage conservation project was proposed or executed¹¹.

Status of data: Bangalore is an important center as a cultural and heritage spot and as a transit hub for other tourist destinations in South India. The City has many heritage buildings and sites that reflect its culture and heritage. The local government has recognized the importance of Bangalore emerging as an important tourist center and therefore has an actionable plan to conserve its heritage. Major headings of expenditure are available across renovation of Heritage Buildings, development of Cultural Centers and Convention Centers. Further, the Department of Archaeology, Heritage and Museums¹² is a regional department and controlled by the State government. On doing quick estimation of its budgetary allocation (planned and unplanned) as a percentage of total state budget, we found that the allocation was roughly of the order of 0.02%¹³. Evidently, the below reported expenditure plan has a larger allocation but it was a plan and how much has been implemented is difficult to ascertain (as most of the interventions depend on political and financial situation of the local government at that time). This allocation was planned to be implemented through the national urban renewal mission.

Challenges:

To validate the available data from the city development plan, we intend to meet experts from the local heritage conservation department and local heritage conservation institute like INTACH. Upon consultation, the publicly available information in the city development plans were the ones that were considered to be planned for conservation. However, it was unclear about the cut-off data for their inclusion in the heritage plan. Further, there is huge institutional allegiance problem in this regard as most of the sites that have been identified are maintained at the sub-national institutional level and not at the city level. There are two sites which have been declared as national heritage and come under the patronage of the national Archaeological Survey of India, for which budgetary allocations/support comes from the central pool of funds.

¹¹ <http://jnnurm.nic.in/wp-content/uploads/2014/08/Karnataka1.pdf>

¹² <http://www.karnatakaarchaeology.gov.in/Report.html>

¹³ Using the annual report of 2012-13 and comparing it with the State budget (<http://www.karnatakaarchaeology.gov.in/Files/annual%20report-english-2012-13.pdf>)

<i>Head (Heritage Conservation) All figures in US \$, in millions¹⁴</i>	<i>2005-06 to 2007-08</i>	<i>2008-09</i>	<i>2009-10</i>	<i>2010-2011</i>	<i>2011-2012</i>
<i>CapEx</i>	8.1	4.0	4.0	5.4	5.4
<i>OpEx</i>	0.6	0.3	0.3	0.4	0.4
<i>Total (A)</i>	9.1	5.0	5.2	6.9	7.1
<i>Total sectoral investment (B)</i>	3523.5	1889.4	2338.0	1856.9	1734.6
<i>(A)/(B) * 100</i>	0.3%	0.3%	0.2%	0.4%	0.4%

Source: City Development Plan, 2009

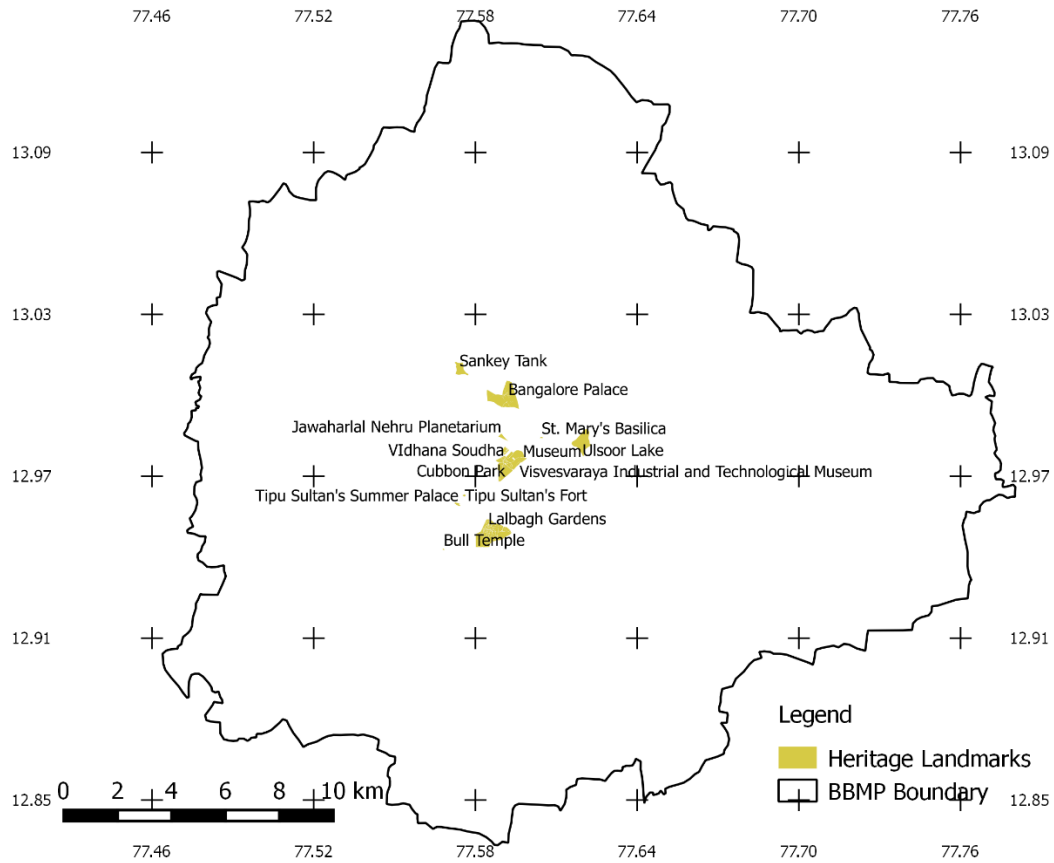
	1991	2001	2011
Percentage of budget provided for maintaining cultural and natural heritage	N/A	N/A	N/A

11.4.2 Percentage of urban area and percentage of historical/cultural sites accorded protected status

<p>Work done: Calculation of spatial area by identification and mapping of historical/cultural sites as declared by ASI (Archaeological Survey of India is the national government authorized agency to recognize historical/cultural sites accorded protected status. It maintains a list of sites accorded protected status¹⁵.)</p>
<p>Status of data: 14 sites have been identified and mapped for spatial area calculation, as highlighted in the city development plan.</p>
<p>Challenges: using information of sites, the percentage of historical/cultural sites accorded protected status will be estimated using GIS techniques/methods. Although only the ASI sites are accorded protected status by the central government, but for this indicator we are considering the sites identified in the city development plan as also protected – to preserve historical and cultural values. This will also ensure that historical parks and gardens that are protected are also included in the assessment. The city development plan does not explicitly distinguish between protected sites, tourism or cultural centers. There will be some level of overestimation in this indicator, but we consider it to be marginal.</p>

¹⁴ Exchange rate: 1 US\$ = 63.5 INR

¹⁵ http://asibengalurucircle.org/list_of_monuments.html



Heritage Landmarks in Bangalore

List of the Heritage Landmarks

1. *Bangalore Palace*
2. *Tipu's Fort Palace*
3. *Tipu Sultans' Summer Palace*
4. *Vidhana Soudha*
5. *Cubbon park*
6. *Attara Kacheri (High Court)*
7. *Seshadari Iyer Memorial Hall*
8. *Museum*
9. *Ulsoor lake & Sankey Tank*
10. *Lalbagh Gardens*
11. *Visvesvaraya Industrial & Technological Museum*
12. *Jawaharlal Nehru Planetarium*
13. *Bull temple*
14. *St. Mary's Basilica*

Area in sq.km covered by the Heritage Landmarks =2.9 sq.km

Built-up area for Bangalore in 2011 = 345.3 sq. km

% of area covered by the heritage locations with respect to urban = $2.97/345.35 \times 100 = 0.85\%$

	1991	2001	2011
Percentage of urban area and percentage of historical/cultural sites accorded protected status	N/A	N/A	0.9%

11.5.1 Number of people killed, injured, displaced, evacuated, relocated or otherwise affected by disasters

<p>Work done: Mortality in Bangalore is primarily due to traffic related accidents (Data provided below). There is no mortality related events due to floods, drought, extreme heat, earthquake or cyclones. Although urban flooding, drought and extreme heat are key risks in the city.</p>
<p>Status of data: Bangalore does not suffer from extreme high intensity hazards, so physical injuries are not recorded. This would have been a better indicator if losses due to hazards were measured, as the capital losses during low intensity yet high frequency hazards would be much higher. The primary risks that the city faces are those from floods, water scarcity, and associated heat hazards. Increasingly, heat island effect has also been observed (Ramachandra & Kumar, 2010). All these are exacerbated by growing populations of which more and more living in slums get greatly affected. Bangalore city has a 180 km long primary and secondary storm-water drainage system, which often fails to take the load of the rains due to silt and garbage causing blockage. A provision of Rs 45 million has been made for the flood-management fund with 12 squads on call, of which six are rain and flood relief squads; 20 personnel have been assigned in each squad. The Jawaharlal Nehru Urban Renewal Mission (JNNURM) project was launched in December 2005 and Bangalore has been allocated a budget till 2017 (Gupta & Nair, 2011). These are merely response systems, but there are no early warning systems in place, nor any long term planning to mitigate the impacts.</p>
<p>Challenges: Bangalore, unlike some other cities in India, does not have a District Level Disaster management Authority, and also does not have a Disaster management plan. It also does not have any institutional mechanism of recording losses during intensive or extensive events. There are no instances of people being relocated post an extreme event by the city, although there may have been voluntary relocations, which are harder to measure. There have been other evictions (from low lying lake beds that often got flooded during extreme rains), but the motivation was not to reduce risk, rather other developmental priorities. We could identify the key mortality risk in cities and monitor it. In the case of Bangalore, traffic related fatality has been identified as the key mortality risk and therefore data has been reported in that regard.</p>

	1991	2001	2011
Number of people killed due to accidents	N/A	N/A	757 ¹⁶

¹⁶ http://www.bangaloretrafficpolice.gov.in/index.php?option=com_content&view=article&id=55&btp=55

11.5.2 Number of housing units damaged and destroyed

Work done: Around 134 locations have been identified within the city as being low-lying and prone to floods (Gupta & Nair, 2011). Housing damage is not extensive and has limited implications.
Status of data: Like the previous indicator (11.5.1), there is no data that is collected for housing damages with flood or rain events.
Challenges: Even though the climatic impacts in Bangalore are not as intensive, they do have far reaching impacts on losses. Other than floods, the other major exposure that the city has is to water scarcity, which often does not affect capital assets, but does affect revenues and functioning of many systems. This remains undocumented. But it is observed in other ways. The lakes of the city have been largely encroached for urban infrastructure. As a result, in the heart of the city only 17 good lakes exist as against 51 healthy lakes in 1985. According to a study (Sudhira, Ramachandra, Raj, & Jagadish, 2003), the water bodies of the city have reduced from 3.40% (2324 ha; 5742.7 acres) in 1973 to just about 1.47% (1005 ha; 2483.4 acres) in 2005, with built-up area during the corresponding period increasing to 45.19% (30,476 ha; 75,307.8 acres) from 27.30% (18,650 ha; 46,085.2 acres).

	1991	2001	2011
Number of housing units damaged and destroyed	0	0	0

11.6.1 Percentage of urban solid waste regularly collected and recycled (disaggregated by E-waste and non-E-waste)

Work done: Through various government documents, estimate of urban solid waste collection and recycling was reviewed.
Status of data: Local governments are required to collect information as per the Service Level Benchmarks (SLBs) provided by the Ministry of Urban Development (see below). This process has begun since 2009. However, the disaggregation by e-waste and non e-waste is not available. Consultation in this regard (disaggregation) is planned for this week.
Challenges: Difficult to estimate the collection quality, but one could fairly assume that the coverage improved only in the first decade of 2000s. The generated estimate is 380 gm per capita per day. The erstwhile non BBMP areas has a collection efficiency of 80% while the core has an efficiency of 100% (source - CDP 2009). Against an installed capacity of 1000 TPD, the generation is roughly 1700 TPD. Estimated treatment shortfall is 1000 TPD at present.

Service Level Benchmarks in Solid Waste Management Sector

Household level coverage of solid waste management services	100%
Efficiency of collection of municipal solid waste	100%
Extent of segregation of municipal solid waste	100%
Extent of municipal solid waste recovered	80%
Extent of scientific disposal of municipal solid waste	100%
Efficiency in redressal of customer complaints	80%
Extent of cost recovery in SWM services	100%
Efficiency in collection of SWM charges	90%

Source: MoUD, 2010

	1991	2001	2011
Percentage of urban solid waste regularly collected and recycled	N/A	N/A	80-100 ¹⁷

11.6.2 Level of ambient particulate matter (PM 10 and PM 2.5)

Work done: PM10 values are extracted from the Annual Report released by Central Pollution Control Board (CPCB) and from the other publication reporting CPCB data.
Status of data: CPCB is the responsible organisation for data collection and dissemination of air pollution data in the country. The real time air pollution levels for all the stations in the country are reported on their website.
Challenges: The air pollution data for the Bangalore city that is publicly available is only available from 1999-2000 onwards. SO _x , NO _x , CO and other related values should also be included in the indicator list, as those are also showing increasing trends in the case of Bangalore.

Unit	1990	2000	2011
PM10 - Unit Microgram/Cubic Meter		80	94
PM2.5 – Unit ¹⁸ Microgram/Cubic Meter	N/A	N/A	N/A

¹⁷ Identification of recycling category is not followed. However, service level benchmarks assessment is being implemented in the city.

¹⁸ A system has been recently set up to measure PM 2.5 (<http://aqi.iitk.ac.in:9000/>), with very limited coverage in Bangalore and further, very limited coverage in all the states of India. However, in the next few years, it is envisaged that this system would gradually expand and be more representative.

11.7.1 Area of public space as a proportion of total city space

Work done: Area of public and green space as a proportion of total city space
Status of data: The proportion of the open spaces, vegetation and waterbodies with the total city space is computed.
Challenges: <ol style="list-style-type: none"> 1. The classification was derived from coarser resolution satellite image (Landsat 30m resolution) that may combine the small footprints into larger pixel. A better resolution (around 1m spatial resolution) satellite image can provide better detailed classes. 2. Misclassification of some of the ground features may be possible due to high resolution image which is very low in case of high resolution satellite image. 3. This classification does not include ground verification which can enhance the accuracy of extracted classes. 4. The built-up classification at present includes road at present due to signature overlap. Road can be extracted better with high resolution satellite image or with digitized road dataset. 5. There is no way to distinguish between the publicness of vegetation and open spaces, as most of the analysis is based on 30 m resolution extracted data. 6. With regards to sidewalks and streets, better resolution data would enable possibility of measurement and government systems like the national remote sensing agency has the capacity to measure it. However, the data is not publicly available.

The Land-use Land-cover classification was carried out using satellite image of 30m resolution (Landsat) for 1992, 2001 & 2011. The classification was computed for 4 classes Built-up, vegetation, waterbodies and others. The area of the different classes of Land-use is:

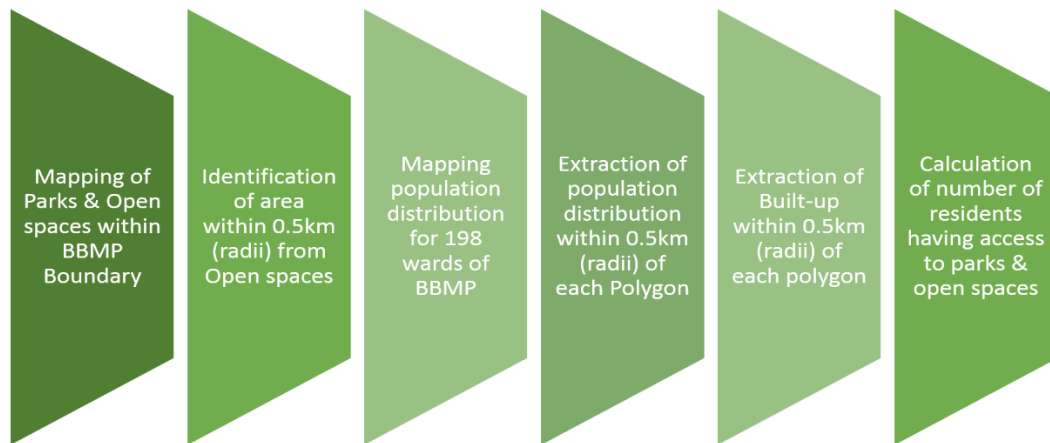
Land-use Land-cover in Sq. km			
	1992	2001	2011
Built-up	132	170	341
Vegetation	365	243	184
Waterbodies	16	13	27
Others	172	258	132
Total	685	685	685

Proportion of Public & Green spaces		
1992	2001	2011
80.7%	75.1%	50.2%

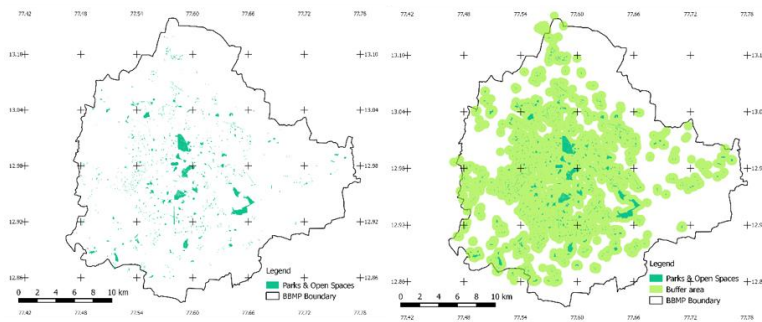
11.7.2 Proportion of residents within 0.5 km of accessible green and public space

Work done: Estimation of residents within 0.5km of accessible green and public spaces
Status of data: Estimation was carried out considering the classification of green and public spaces as per city development plan. <i>As per plan the green and public spaces includes parks, green spaces, sport area, playgrounds, cemeteries and burial grounds.</i>
Challenges: <ol style="list-style-type: none">1. <i>Unavailability of the GIS dataset for green spaces and public spaces of the city.</i>2. <i>Locations covered in the green and public spaces need ground verification for better accuracy.</i> <i>Due to unavailability of population per building it is assumed that population distribution is same throughout the ward for the calculation of population density.</i>3. <i>Area falling under 0.5km (radii) may not be always accessible to the public.</i>4. <i>Unavailability of higher resolution satellite image</i>5. <i>Assumption of equating 30mt extracted built-up area to each residential built-up area on ground.</i>6. This data is created using the proposed land use plan and shape files has been used to extract information. The available data has parks, open spaces, green spaces, cemetery and burial ground all clubbed and extraction of segregated information will require a process of digitisation – a longer time and costly process.

Methodology

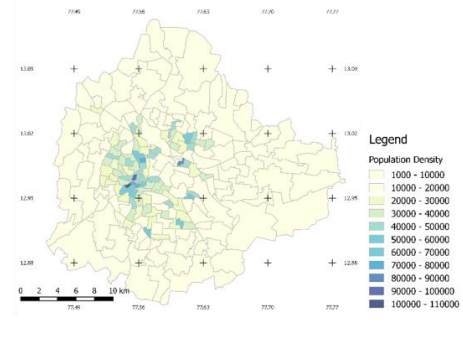


Maps depicting the methodology

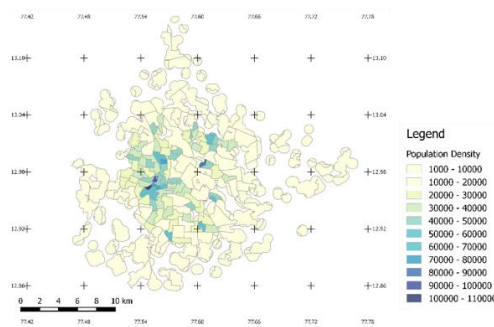


Mapping of Parks & Open spaces within BBMP Boundary

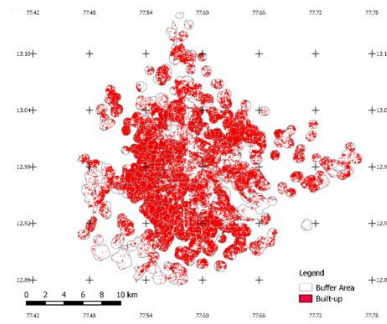
Identification of area within 0.5km (radii) from Open spaces



Mapping population distribution for 198 wards of BBMP



Extraction of population distribution within 0.5km (radii) of each Polygon



Extraction of Built-up within 0.5km (radii) of each transit location

No. of people having access to public transit within 0.5km = 3.6 million

% of people having access to parks & Open spaces within 0.5km = $(3638467 / 8443675) * 100 = 43\%$

Secondary Indicators

11.a.1 Cities with more than 100,000 inhabitants that implement urban and regional development plans integrating population projections and resource needs

Work done: Discussed before as 11.3.2

Status of data: Yes

Challenges:

11.a.2 Ratio of land consumption rate to population growth rate at comparable scale

Work done: Discussed before as 11.3.1

Status of data: Yes

Challenges:

11.b.1 Percent of cities with more than 100,000 inhabitants that are implementing risk reduction and resilience strategies aligned with accepted international frameworks (such as the successor to the Hyogo Framework for Action on Disaster Risk Reduction) that include vulnerable and marginalized groups in their design, implementation and monitoring

Work done: Assessed - No
Status of data: This indicator read at the city level is an absolute indicator (yes/no). Since Bangalore does not have a disaster management plan, only a Climate Change Action plan at the state level, the answer to this will be a No. But Bangalore has recently been selected as one of the 100 Resilient Cities, and the assumption is a resilience plan / strategy will be prepared over the next two-three years. Assessing the quality of that is not possible at this point in time.
Challenges:

11.b.2 Population density measured over continuous urban footprint

Work done: This data is available for the years 1990, 2000 and 2010. Some projections for the future are also made.
Status of data:
Challenges: This is collected for the BBMP area for now, and may not be comparable information if it undergoes the trifurcation / change in boundaries in the future. This data is collected and distributed every 10 years and not annually/five yearly, as maybe required by the SDG process.

Description	Unit	1990	2001	2011
People				
Population	million	3.3	4.3	8.5
Decadal Population Growth	per cent	30	31%	98%
Area and Land Use				
Area	sq. km.	276	226	741
Population Density	people / sq. km.	11,948	19,065	11,371
Proportion of State Population	per cent	7%	11%	14%

11.c.1 Percentage of financial support that is allocated to the construction and retrofitting of sustainable, resilient and resource-efficient buildings

Work done: We have collected national level estimates for expenditure on enhancing building sector efficiency (under the national mission for enhanced energy efficiency and sustainable habitat). However these numbers are managed at the national level and therefore local estimation is not possible. Moreover the missions devoted to building

sector efficiency have been not operationalized fully during till 2011. The period between 2007-2012 saw initiation of many energy conservation programs. However, these initiatives/programs have a central government ownership but are equally applicable for all settlements. These initiatives are Standards and Labelling of Equipment & Appliances, Energy Efficiency in Buildings (a national energy conservation building code (ECBC) has been prepared for the design of new commercial buildings), energy efficiency in industry and measures related to improving efficiency in residential lighting. In addition, there is a huge program on agricultural and municipal demand side management. There has been no project implemented under the national urban renewal mission that has retrofitting as a key component. . Even the city budget sheets do not have a separate line item that identifies retrofitting in buildings. However, at first level look at data, there is hardly any expenditure for enhancing buildings and most of the projects are aimed at infrastructure provision (which is in the nature of bulk categorization). However, we are collating the number of buildings that are certified as efficient using certifications like LEED¹⁹ and GRIHA²⁰. Looking at the repository of LEED and GRIHA, we found that only 7 buildings are certified in Bangalore with a LEED rating and out of a total of 625 projects submitted for evaluation with the GRIHA rating systems (covering an area of 22 million sq. m.), only 21 building types have a GRIHA certification. Out of these, the configuration is as under – residential (out of 11 in the state, 4 are in Bangalore), commercial (out of 8 in the state, 7 are in Bangalore), institutional (out of 14 in the state, 9 are in Bangalore) and mixed types (out of 3 in the state, 1 is in Bangalore). Even in the space of certified buildings, most of the expenditure is in the private space – for which expenditure data is not available. We tried to look at the budget documents closely for extracting information relevant to manage implementation of building bye laws but the staffing budget is available at the aggregate level and therefore, it was difficult to isolate. .

Status of data: Expenditure for the city is available for the following composition: administration, education, public health, housing, land acquisition, loans/debts, slum clearance, grants, electricity charges, public works, others. It is difficult to justify one expense as 'sustainable' and another not, since almost all the expenses of the city are towards improvements, except those that are towards salaries. But excluding salaries from sustainability may not make sense either, as that is an investment into institutional capacity.

Only recent annual data is available in the public domain on the BBMP website. There are secondary pieces of work on city's budgetary allocation for the year 1988-1996 (Public Affairs Centre, 1997 and 1999). But the time period in between (1996-2009) is not yet found in the public domain. Search of secondary sources is on-going.

We have in the present, an overall estimate of expenditure on key sectors till 2006-07. Individual yearly budget needs to be analyzed to get a sense of allocation to sustainable development - capital and revenue both separately. We tried analyzing the split but in the context of the building sector, it was difficult to identify and ascertain.

¹⁹ <http://in.usgbc.org/leed>

²⁰ <http://grihaindia.org/>

Challenges: The municipal budgets are not explicit about this information. Even expert validation was not possible, as this aspect is difficult to ascertain. .

	1991	2001	2011
<i>Percentage of financial support that is allocated to the construction and retrofitting of sustainable, resilient and resource-efficient buildings</i>	N/A	N/A	N/A

11.c.2 Sub-national government revenues and expenditures as a percentage of general government revenues and expenditures

Including for buildings; own revenue collection (source revenue) as a percentage of total city revenue

There are clearly changes that have taken place in the area of the local city government. The below estimates (revenue/expenditure – including capital as a percentage of state government budget) have been calculated without adjusting for area increase of the local city government. In that case, the most recent estimate of 2011 seems to be useful indicator.

	1991	2001	2011
Revenue	1.9%	3.6%	13.0%
Expenditure	1.7%	3.2%	11.8%

	1990	2001	2011
Own revenue/Total revenue	65.5%	63.6%	53.0%

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