Sustainable Urban Planning Strategies for Cities in Karnataka

9 January 2019
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Part 1
Developing a Proof of Concept Urban Observatory for Karnataka

Part 2
Pre-Feasibility Assessment of Sanitation Options for Cities
Part-I

Urban Observatory for Karnataka
Urban Observatories help address urban challenges by:

- Providing better insights into a problem or phenomenon
- Identifying its intensity, pattern, cause-effect loop to design appropriate response strategies

Objective of an UO: Geo-spatial data analyses and visualisation to enable data-driven decision-making
Urban Observatory Project by ESRI
Compare and contrast maps of cities around the world

Dublin Dashboard by Dublin City Council
Evidence informed analysis for decision making

City Dashboard for cities in UK
Aggregates simple spatial data for cities in UK

Urban Observatory at Newcastle
Aggregates data on air quality, traffic, from sensors
The UO platform developed by CSTEP makes Karnataka one of the first States in India to have a functioning observatory platform at a state level.
MoHUA initiatives

- Indian Urban Data Exchange (IUDX), 2018
- DataSmart Cities Initiative (under preparation)
- National Urban Observatory
• **Collates data**

   Ability to access and collate reliable data through crowdsourcing and from third party database and portals

• **Analyses data for informed decision making**

   Ability to generate spatial and temporal analysis and visualise data for informed decision making

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- **Noise pollution monitoring**
- **Air/water pollution mapping**
- **Pothole monitoring**
- **Mapping direction of city’s built growth**
  - Assessing future infrastructure/service delivery needs for a city
  - Assessing impact of new development/investments
  - Tracking compliance with city master plans
  - Aid in value-capture financing in a city
Urban Observatory for Karnataka: Components

- Urban Observatory for Karnataka
  - Bengaluru Dashboard
  - State Dashboard
Bengaluru Dashboard

Map noise pollution levels in different parts in Bengaluru in different times

Noise levels collected through Shabda app developed by CSTEP

Collation with noise levels reported by KSPCB monitoring stations

Analyses to show:
• Point wise noise pollution levels on a map
• Temporal variation of ward-wise noise levels
• Spatial analyses for noise levels in silent zones
Bengaluru Dashboard

Shabda application
Bengaluru Dashboard - Screenshots
Bengaluru Dashboard - Screenshots

The chart represents the share of various sources of noise levels observed in the city in the past 24 hours.

Source(s)
- CSTEP's Noise App
- KS PCB
Noise pollution effects are both health and behavioral in nature. This includes hypertension, high stress levels, hearing loss, sleep disturbances, annoyance, and aggression. The chart represents the share of various impacts reported due to noise levels across the city for the past 24 hours.
Bengaluru Dashboard - Screenshots

How loud is your city?
- Noise Observations Points (CSTEP)
- Noise Observations Points (KSPCB)
- Source of Noise
- User Perception

Ward Wise Noise Observations
- All day
- Day time
- Night time

Past Noise Trend

How Silent are Silent Zones

Description
Noise pollution effects are both health and behavioural in nature. This includes hypertension, high stress levels, hearing loss, sleep disturbances, annoyance, and aggression.

Explore the average noise levels in different wards in the city for the past 24 hours by clicking on each ward on the map.

Map Legend
- n/a (Data not available)
- <25 dB
- 25 - 50 dB
- 50 - 75 dB
- 75 - 100 dB
- > 100 dB

Source(s)
- CSTEP’s Noise App
- KSPCB

Data is retrieved from
Bengaluru Dashboard - Screenshots

Average Noise Observation (dB) by Date

Explore and compare the average noise levels in different wards in the city for a selected time period.

Source(s)
Data is retrieved from
- CSTEP's Noise App
- KSPCB
State Dashboard

Spatial analyses and visualization to indicate direction of built growth

Building permission issuance data from the KMDS application- Nirmana

Aggregation at ward level (quarterly in sq. m)

Spatial mapping to show intensity of built growth in each ward
Where is your city growing?

The images in this page present the ward-wise additions (in sq. m.) for which building permissions are issued in a city during a selected time period**.

The objective is to visualize and compare the emerging spatial direction of built growth in a city over time. The two parallel tiles shown help in comparison of spatial growth direction between two cities.

The information on building permission is sourced from the Nirmala online application developed by the Municipal Reforms Cell, Government of Karnataka.

Select the cities and move the slide bar to view the area additions during selected time period. Click on a ward to view the information for the ward.

**The time period used here are the four quarters in a year (Q1: January-March, Q2: April-June, Q3: July-September, Q4: October-December).

Total building area in a ward for which licenses are issued in selected quarter (in sq. m.)

**Tumakuru**

Total building area in the city for which licenses have been issued in the 1st quarter of 2017 is 44439 sq. m. Ward number 31 has recorded the maximum area for which licenses have been issued in this quarter (5893 sq. m.)

**Shivamogga**

Total building area in the city for which licenses have been issued in the 1st quarter of 2017 is 57453.49 sq. m. Ward number 5 has recorded the maximum area for which licenses have been issued in this quarter (14469.46 sq. m.)
The images in this page present the ward-wise additions (in sq. m.) for which building permissions are issued in a city during a selected time period**.

The objective is to visualize and compare the emerging spatial direction of built growth in a city over time. The two parallel tiles shown help in comparison of spatial growth direction between two cities.

The information on building permission is sourced from the NIRMALA online application developed by the Municipal Reforms Cell, Government of Karnataka.

Select the cities and move the slide bar to view the area additions during selected time period. Click on a ward to view the information for the ward.

**The time period used here are the four quarters in a year (Q1: January-March, Q2: April-June, Q3: July-September, Q4: October-December).

Total building area in a ward for which licenses are issued in selected quarter (in sq. m.)

- Tumakuru: Total building area in the city for which licenses have been issued in the 2nd quarter of 2017 is 40818 sq. m. Ward number 29 has recorded the maximum area for which licenses have been issued in this quarter (4899 sq. m.)

- Shivamogga: Total building area in the city for which licenses have been issued in the 2nd quarter of 2017 is 39439.75 sq. m. Ward number 1 has recorded the maximum area for which licenses have been issued in this quarter (7766.04 sq. m.)
The images in this page present the ward-wise additions (in sq. m.) for which building permissions are issued in a city during a selected time period.”

The objective is to visualize and compare the emerging spatial direction of built growth in a city over time. Two parallel tiles shown help in comparison of spatial growth direction between two cities.

The information on building permits is sourced from the NIRMALIA online application developed by the Municipal Reforms Cell, Government of Karnataka.

Select the cities and move the slide bar to view the area additions during selected time periods. Click on a ward to view the information for the ward.

**Time period used here are the four quarters in a year (Q1: January-March, Q2: April-June, Q3: July-September, Q4: October-December).**

Total building area in a ward for which licenses are issued in selected quarter (in sq. m.):

- Tumakuru
  - Total building area in the city for which licenses have been issued in the 3rd quarter of 2017 is 24342 sq. m. Ward number 29 has recorded the maximum area for which licenses have been issued in this quarter (3575 sq. m.)

- Shivamogga
  - Total building area in the city for which licenses have been issued in the 3rd quarter of 2017 is 30159.54 sq. m. Ward number 1 has recorded the maximum area for which licenses have been issued in this quarter (4842.44 sq. m.)
The images in this page present the ward-wise additions (in sq. m.) for which building permissions are issued in a city during a selected time period**.

The objective is to visualize and compare the emerging spatial direction of built growth in a city over time. The two parallel tiles shown help in comparison of spatial growth direction between two cities.

The information on building permission is sourced from the NIRMAN online application developed by the Municipal Reforms Cell, Government of Karnataka.

Select the cities and move the slide bar to view the area additions during selected time period. Click on a ward to view the information for the ward.

**The time period used here are the four quarters in a year (Q1: January-March, Q2: April-June, Q3: July-September, Q4: October-December).

Total building area in a ward for which licenses are issued in selected quarter (in sq. m.)

**Tumakuru**
Total building area in the city for which licenses have been issued in the 4th quarter of 2017 is 53088 sq. m. Ward number 31 has recorded the maximum area for which licenses have been issued in this quarter (5871 sq. m.)

**Shivamogga**
Total building area in the city for which licenses have been issued in the 4th quarter of 2017 is 40060.09 sq. m. Ward number 1 has recorded the maximum area for which licenses have been issued in this quarter (6179.31 sq. m.)
• The Proof-of-Concept Urban Observatory platform demonstrates features of data collation, analysis and visualisation through two selected themes/functionalities.

• These features can be extended to other themes for all cities in Karnataka.
Part-II

Pre- Feasibility Assessment of Sanitation Options for Cities
Background

- GoK policies for Sanitation
  - Urban Waste Water Reuse Policy: Preparation of IUWM plans for 10 cities
  - Faecal Sludge and Septage Management Policy: Phase-wise implementation of FSSM in combination with networked systems, with first phase focussing on AMRUT cities
  - State Sanitation Strategy: 100% sanitation coverage in all cities
Objectives

To facilitate implementation of UWWR Policy, FSSM Policy and the State Sanitation Strategy in an integrated manner

1. Identify cities and regions which would require priority attention due to high water-stress and growth pressure by 2020

2. Demonstrate a pre-feasibility assessment methodology for choice of sanitation systems for select cities which can help achieve objectives of stated policies
Methodology

Identifying regions facing varying levels of
1. Water Stress
2. Demographic & Economic Growth

Identification of Priority Regions and cities across Karnataka

Development and comparison of scenarios for sanitation system choices in select 4 cities

(Overlay Analysis in GIS)
Methodology

**Regions facing varying levels of water stress**

Weighted overlay analysis of possible criteria contributing to water stress, like
- drought vulnerability,
- over exploited regions of groundwater,
- water yield in river basins etc.

**Regions facing varying levels of growth pressure**

Weighted overlay analysis of possible socio-economic criteria contributing to growth pressure, like
- growth of urban population,
- industrial area,
- proximity to industrial corridors etc.
Results: Priority regions and cities

- High priority regions lie mostly along the Bengaluru-Mumbai Economic corridor
- 8 class-I and 12 class-II are located in high-priority regions

<table>
<thead>
<tr>
<th>Class 1 cities</th>
<th>Class 2 cities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bengaluru, Hubballi-Dharwad</td>
<td>Doddaballapur, Gokak, Chintamani, Chikkaballapura</td>
</tr>
<tr>
<td>Vijaypura, Tumakuru</td>
<td>Nipani, Tiptur, Sira, Mulbagal</td>
</tr>
<tr>
<td>Gadag, Robertsonpet</td>
<td>Hosakote, Hiriyur, Challakere, Sidlaghatta</td>
</tr>
<tr>
<td>Chitradurga, Kolar, Bagalkot</td>
<td></td>
</tr>
</tbody>
</table>
Sanitation pre-feasibility assessment

Selection of cities

2 cities in very high water stressed region
- Kolar
- Chitradurga

2 cities in different geographic regions
- Udupi (Coastal city),
- Raichur (Northern Karnataka region)
Sanitation pre-feasibility assessment: Scenarios

• Three scenarios were designed for each city:
  
  ○ **Scenario 1**: Decentralised FSSM system using natural treatment technologies
  
  ○ **Scenario 2**: Decentralised FSSM system using mechanised treatment
  
  ○ **Scenario 3**: Centralised networked systems

• Techno-economic analysis done for each scenario
## Sanitation pre-feasibility assessment

### Baseline parameters

<table>
<thead>
<tr>
<th>Baseline parameters</th>
<th>Kolar</th>
<th>Raichur</th>
<th>Chitradurga</th>
<th>Udupi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated present population (2018)</td>
<td>1,69,207</td>
<td>2,84,221</td>
<td>1,67,975</td>
<td>1,93,196</td>
</tr>
<tr>
<td>No. of households</td>
<td>36,632</td>
<td>55,996</td>
<td>36,235</td>
<td>42,402</td>
</tr>
<tr>
<td>% of homes with toilets and storage</td>
<td>22%</td>
<td>20%</td>
<td>33%</td>
<td>82%</td>
</tr>
<tr>
<td>% of homes with toilets (but no storage/collection)</td>
<td>3%</td>
<td>5%</td>
<td>3%</td>
<td>0%</td>
</tr>
<tr>
<td>% of homes with sewerage system</td>
<td>68%</td>
<td>34%</td>
<td>51%</td>
<td>15%</td>
</tr>
<tr>
<td>% of homes with decentralised system</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>% of homes with no toilets</td>
<td>7%</td>
<td>41%</td>
<td>13%</td>
<td>3%</td>
</tr>
</tbody>
</table>
Sanitation pre-feasibility assessment

Guiding Assumptions

• Systems and their technologies chosen based on city’s physiology

• Unit costs, treatment efficiency and resource requirements vary across technologies

• Estimated plant capacity, water required vary based on type of system

• In each scenario, selected system serves 100% of the unserved population
## Results: Kolar

### Capital Costs

<table>
<thead>
<tr>
<th>System</th>
<th>FSSM system (natural treatment)</th>
<th>FSSM system (mechanised treatment)</th>
<th>Centralised Network system</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rs 3529</td>
<td>Rs 1674</td>
<td>Rs 1655</td>
</tr>
</tbody>
</table>

### Operation & Maintenance Costs

<table>
<thead>
<tr>
<th>System</th>
<th>FSSM system (natural treatment)</th>
<th>FSSM system (mechanised treatment)</th>
<th>Centralised Network system</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rs 299</td>
<td>Rs 186</td>
<td>Rs 187</td>
</tr>
</tbody>
</table>

### Land Requirement

- **Treatment for treatment (acres):**
  - FSSM system: 0.10 acres
  - FSSM system (mechanised treatment): 0.04 acres
  - Centralised Network system: 2.03 acres

- **Treated wastewater generated (tonne/yr):**
  - FSSM system: 5,805 tonnes
  - FSSM system (mechanised treatment): 5,805 tonnes
  - Centralised Network system: 7,05,138 tonnes

- **Treated sludge generated (kl/ year):**
  - FSSM system: 6,530 kl
  - FSSM system (mechanised treatment): 6,530 kl
  - Centralised Network system: 1,322 kl

### Legend

- Toilet CAPEX
- Storage CAPEX
- Conveyance CAPEX
- Treatment CAPEX
- Contingency
Results: Chitradurga

### Capital Costs

<table>
<thead>
<tr>
<th>System</th>
<th>FSSM system - natural treatment</th>
<th>FSSM system - mechanised treatment</th>
<th>Centralised Network system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land requirement for treatment (acres)</td>
<td>0.32</td>
<td>0.05</td>
<td>1.84</td>
</tr>
<tr>
<td>Treated wastewater generated (tonne/yr)</td>
<td>13964</td>
<td>13964</td>
<td>22,24,979</td>
</tr>
<tr>
<td>Treated sludge generated (kl/year)</td>
<td>15,710</td>
<td>15,710</td>
<td>4,172</td>
</tr>
</tbody>
</table>

### Operation & Maintenance Costs

<table>
<thead>
<tr>
<th>System</th>
<th>Toilet CAPEX</th>
<th>Storage CAPEX</th>
<th>Conveyance CAPEX</th>
<th>Treatment CAPEX</th>
<th>Contingency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centralised Network system</td>
<td>473</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSSM system - mechanised treatment</td>
<td>283</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSSM system - natural treatment</td>
<td>284</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Results: Raichur

### Capital Costs

<table>
<thead>
<tr>
<th>System</th>
<th>FSSM system - natural treatment</th>
<th>FSSM system - mechanised treatment</th>
<th>Centralised Network system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land requirement for treatment</td>
<td>1.04</td>
<td>0.19</td>
<td>6.21</td>
</tr>
<tr>
<td>(acres)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treated wastewater generated</td>
<td>59,145</td>
<td>59,145</td>
<td>75,61,889</td>
</tr>
<tr>
<td>(tonne/yr)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treated sludge generated</td>
<td>66,539</td>
<td>66,539</td>
<td>14,179</td>
</tr>
<tr>
<td>(kl/year)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Operation & Maintenance Costs

<table>
<thead>
<tr>
<th>System</th>
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<th>FSSM system - mechanised treatment</th>
<th>Centralised Network system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centralised Network system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSSM system - mechanised</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>treatment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSSM system - natural</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>treatment</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- Toilet CAPEX
- Storage CAPEX
- Conveyance CAPEX
- Treatment CAPEX
- Contingency
## Results: Udupi

### Capital Costs

<table>
<thead>
<tr>
<th>System</th>
<th>Cost (Lakhs Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centralised Network system</td>
<td>11244</td>
</tr>
<tr>
<td>FSSM system - mechanised</td>
<td>844</td>
</tr>
<tr>
<td>FSSM system - natural treatment</td>
<td>749</td>
</tr>
</tbody>
</table>

### Operation & Maintenance Costs

<table>
<thead>
<tr>
<th>System</th>
<th>Cost (Lakhs Rs/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centralised Network system</td>
<td>1104</td>
</tr>
<tr>
<td>FSSM system - mechanised</td>
<td>570</td>
</tr>
<tr>
<td>FSSM system - natural treatment</td>
<td>570</td>
</tr>
</tbody>
</table>

### Table

<table>
<thead>
<tr>
<th>Category</th>
<th>FSSM system - natural treatment</th>
<th>FSSM system - mechanised treatment</th>
<th>Centralised Network system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land requirement for treatment (acres)</td>
<td>0.19</td>
<td>0.09</td>
<td>4.86</td>
</tr>
<tr>
<td>Treated wastewater generated (tonne/yr)</td>
<td>22,572</td>
<td>22,572</td>
<td>46,08,185</td>
</tr>
<tr>
<td>Treated sludge (generated (kl/year)</td>
<td>25,394</td>
<td>25,394</td>
<td>46,08,185</td>
</tr>
</tbody>
</table>

**Legend**
- Toilet CAPEX
- Storage CAPEX
- Conveyance CAPEX
- Treatment CAPEX
- Contingency
Recommendations & Conclusions

- Decentralised FSSM systems are recommended for water-stressed regions
- Lower land and water requirements for Decentralised FSSM systems
- Need to invest in greywater management systems alongside FSSM
- Potential for revenue for networked systems from waste water reuse
- A list of strategies and technologies can be accessed in a toolkit format, available in the following link (http://cstem.cstep.in/uoapp/#/state)
Thank You