

INDIAN CITIES TOWARDS SMARTNESS: A CASE STUDY OF GUWAHATI CITY

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ABSTRACT

Cities across the world have witnessed the positive impact of synchronized use of hard and soft infrastructure in improving the quality of services at a personalized level. The success has become an inspiration for others, pushed by the ever-increasing demand for improved quality of life in cities and personalized experience. The Government of India has launched an initiative to develop 100 Smart Cities—at least one in each state. Being the nerve centre and economic hub of the entire North-Eastern region of India, Guwahati city is a front runner in the selection process. In this study we have analysed the latest data collected from the city against each proposed component of the Smart City. We find that Guwahati city has already taken some initiatives to improve basic services through investment in infrastructure, implementing information and communication technology for transparency in financial management, etc. Analyses also led to preparation of a detailed list of measures specifically for Guwahati city, under each component of the Smart City, which, if taken, will transform Guwahati into a Smart City.

Keywords: Sustainable development, Urban Infrastructure, Urban governance, Smart City, Basic Services

1. INTRODUCTION

Cities are designed and required to function in real time but, carefully observing their conventional way of functioning, it has been found that, they hardly function in real time. Many cities across the world have used modern, reliable and robust Information and Communication Technology (ICT) and engineering solutions to improve their performance, even in times of crisis. (Kumar, 2013; MoUD., 2014; Glasmeier and Christopherson, 2015). *“Smart City is defined as a city where structure and function of various urban systems are clearly defined, simple, highly responsive and malleable via contemporary technology and design”* (Smart Cities, 2010; MoUD, 2014). In the 21st century, the requirements of Smart Cities has become even more challenging, due to the of addition of climate change and low carbon concepts, while meeting the ever-increasing demand of quality of life of its citizens (Panday, 2012; Smart Cities, 2010; MoUD, 2014). Recently, the erstwhile National Urban Renewal Mission narrative in India has given way to the Smart City narrative. Climate change will result in increasing frequency and magnitudes of extreme events, and there is a need for a systematic response that considers engineering, design, ICT and technical solutions to ensure smart and resilient cities. Smart Cities need to be responsive, wise and resilient, as no Smart City can afford to risk losses that could wipe away decades of progress. Cities today can perform smartly only if they are fully functional in all urban sectors, including energy, water, sanitation and mobility. Cities which are already struggling for adequate and efficient service delivery mechanisms first require the filling up of existing infrastructure gaps using innovative and smart interventions.

In India, we find that since 1981 the rate of decadal growth in population is gradually decreasing, while at the same time, the share of the urban population has actually been increasing. This trend of urbanization witnessed in India over the last few decades will continue till it reaches about 60-65%, the global average (MoUD., 2014). The current low base of urban population in India provides a tremendous potential to plan appropriate and smart urban infrastructure, laying the foundation for Smart Cities in India. This research studies Guwahati city, the gateway connecting the North-Eastern states of India. This city is also the largest in North-East and is a major economic hub attracting migrants seeking a better life and economic prospects. Considering its geographic location and

topography, proper functioning of the city is of utmost importance. Keeping the above-mentioned issues in the forefront, the objective of this study is to highlight the different initiatives taken by ULBs, and also the existing gaps in particular areas such as socio-economic, infrastructure and governance which must be filled in order to achieve the desired level of smartness.

2. METHODOLOGY

The methodology adopted in this study is shown in **Figure 1**. Authors tried to adopt a holistic framework by incorporating parameters that give local/regional diversification, flexibility and interdependency (flow of information with clarity) to be customized for use in other regions/cities (Parikh et al., 2015). This study is especially relevant in light of the Government of India’s ambitious initiative to develop 100 Smart Cities and rejuvenate 500 small cities and towns (MoUD, 2014). The literature on Smart Cities reveals that the Government of India has planned to adopt an approach of both developing new infrastructure or and upgrading that which is already existing ones. Methodology in this study is centred on collecting updated information from cities and analysing them with respect to **a) Physical, b) Economic, c) Governance and d) Social** infrastructure. Collected data are analysed to highlight the initiatives taken by Guwahati city that compliment the Government of India Smart City initiative and put forth the list of initiatives that will lead to the develop of smart **Physical, Economic, Governance and Social** infrastructure.

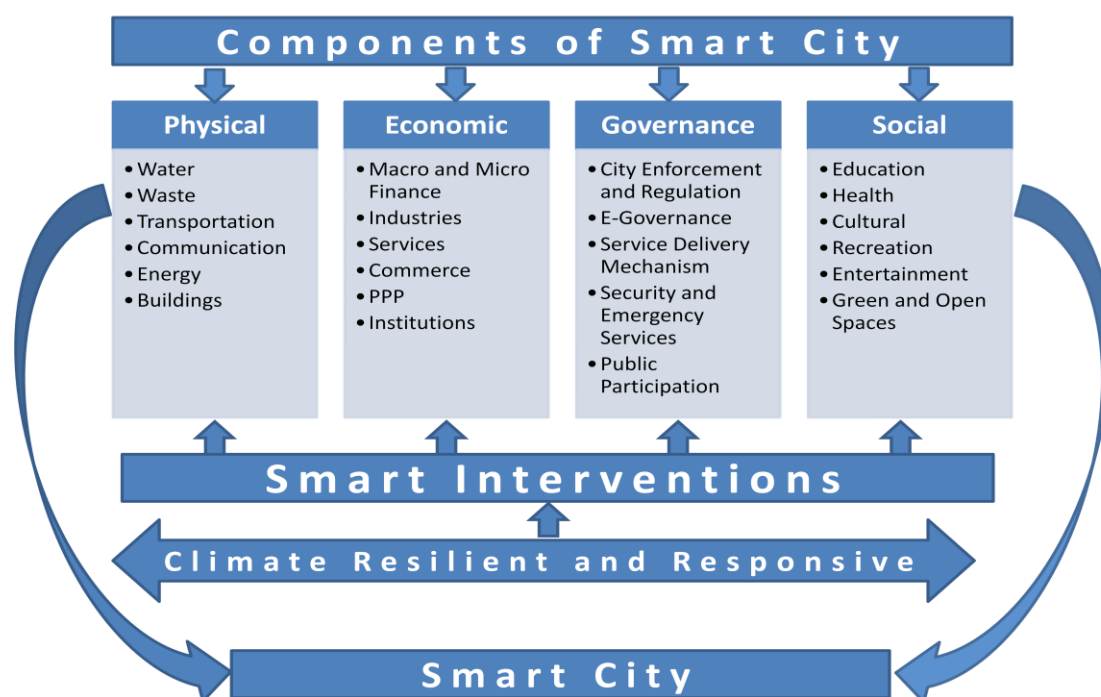


Figure 1: Methodology of the study

3. DISCUSSION

3.1. City profile

Guwahati city is the gateway to the North-Eastern part of India, located between 91°33'18.141" E and 91°10'41.005" E Longitude and 25°59'33.183" N and 26°15'50.945" N Latitude (CDP-Guwahati, 2006; Master Plan-Guwahati, 2009). Guwahati is a major commercial and educational hub of North-Eastern India and hosts premier Indian institutes such as the Indian Institute of Technology Guwahati (IITG), Gauhati University, and Cotton College. Geographically, Guwahati lies between the banks of the Brahmaputra River, which was once known as "Pragjyotishpur" and the foothills of the Shillong

plateau, with LGB International Airport to the west and the town of Narengi to the east (CDP-Guwahati, 2006; Master Plan-Guwahati, 2009). The urban growth of the city has taken place gradually and North Guwahati has come up on the northern bank of the Brahmaputra River. Overall, the city has uneven topography surrounded by hillocks from the Southern and Eastern sides. The central part of the city has small hillocks such as Sarania hill, Nabagraha hill, Nilachal hill and Chunsali Hill. The major water bodies are Deepor Beel, Silpukhuri, Dighali Pukhuri, Borsola Beel and Silsako Beel (CDP-Guwahati, 2006; Master Plan-Guwahati, 2009).

In 2011, the city had a population of around 1 million, spread over an area of 264 sq km (Census-2011, GOI). The population in the Guwahati Metropolitan Area (GMA) has grown at a very high rate for 4 decades, i.e., from 1971 to 2001. However, in the last decade, 2001 to 2011, the decadal population growth has declined drastically and stands at 8.7% (Census-2011, GOI). For administrative purposes, the city has been divided into 60 wards and Guwahati Municipal Corporation (GMC) maintains infrastructure and basic urban services. Since the city is a major economical hub in entire North-East, there has been a huge migration of population, leading to a large slum population and settlements in the city (31.1% BPL population in 2011) (Census-2011, GOI).

Local physiographic conditions of the city show that the resilience of the city towards disasters is important for itself as well as other North-Eastern states. The city itself is surrounded by hillocks and lies in seismic Zone V, making it more prone to earthquakes and landslides. Recently, the city was hit by an earthquake of 7.8 magnitude on the Richter scale, with its epicentre 34 km from Lamjung, Nepal. Also, its location on the banks of Brahmaputra River makes it highly vulnerable to floods. It has been observed that there is a huge growth in the population in the age group of 15-64 years (working class) and 65+years (old people), putting lot of stress on health care and basic services (CDP-Guwahati, 2006; Master Plan-Guwahati, 2009). There are a large number of informal settlements and slums on government land, especially on land belonging to the railways, and hilly and marshy areas. In this context, if any hazard strikes the city, and if the city is not smart enough to handle it, then a hazard can become a disaster. **Figure 2** shows the location of the city in India.

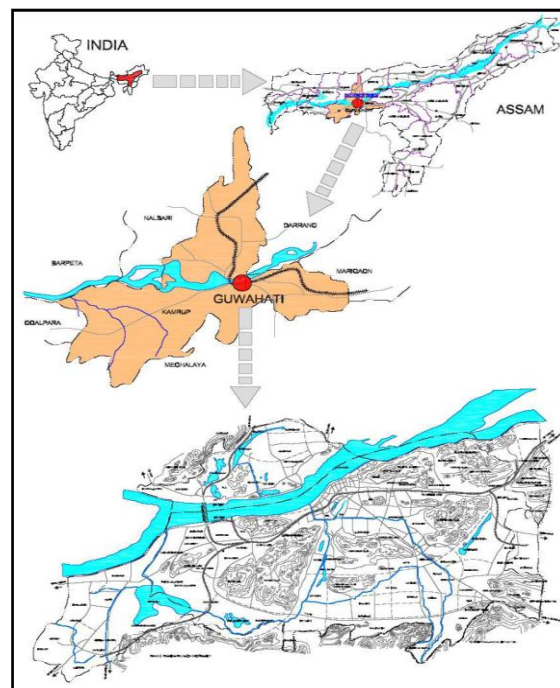


Figure 2: Guwahati city map
(Source: CDP-2006, Guwahati)

3.2. Land Use

Guwahati city is the only major economic hub in the entire North-East. Abrupt changes in land use patterns have resulted in increased deforestation and expansion of slum areas. The primary factors responsible for such rampant change in land use patterns are:

1. A rapid increase in employment opportunities due to growth of industries and other secondary and tertiary activities.
2. Immigration and encroachments by economically weaker sections of society on hills or fragile ecosystems, seeking opportunities for better urban services, education and medical facilities.

A large floating population ranging between 150,000 and 200,000 further puts pressure on its existing infrastructure (CDP-Guwahati, 2006; Master Plan-Guwahati, 2009). All this has fuelled unplanned and rapid urban growth in the city. This rampant transformation of land use and land cover in the city could harm the ecology and environment of the region. **Figures 3a & 3b** show the land use pattern of Guwahati city in 2001 and the proposed plan for 2025 (CDP-Guwahati, 2006; Master Plan-Guwahati, 2009). It has been estimated that approximately 50 sq km of land is required by GMA for the undertaking of various urban activities by 2025. Having analysed the land use pattern of Guwahati city, we have found that there will be a drastic increase in residential, commercial, public and semi-public spaces. This suggests that, not only the economy, but the city's population is also growing rapidly, and if its urbanization is not guided smartly, in a sustainable direction, then this could exert an excessive strain on the existing natural resources and urban quality of life in the city.

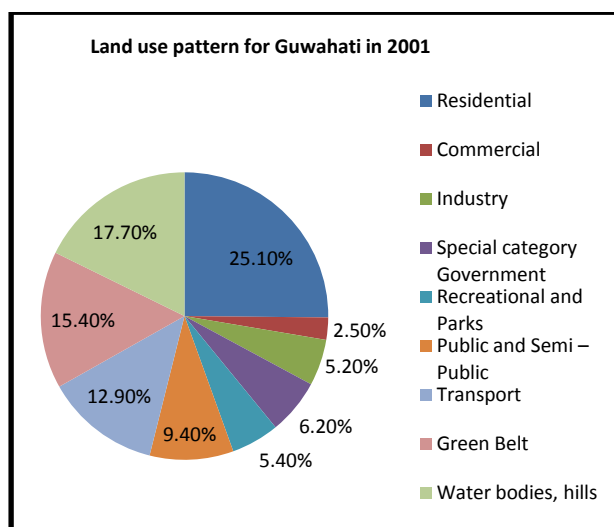


Figure 3a: Land use pattern for Guwahati in 2001

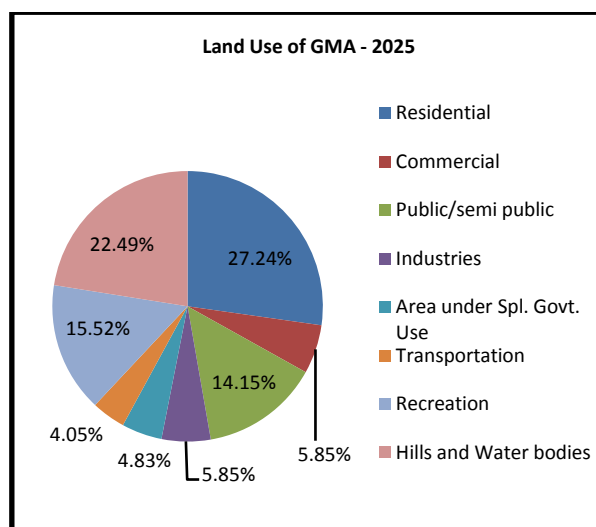


Figure 3b: Land use pattern for Guwahati Metropolitan Area in 2025

Source: Master Plan-Guwahati, 2009

3.3. Infrastructure Status

Water, sanitation and drainage are critical to urban life. They have direct implications on the health of our economy, society and environment. This section analyses current state of basic infrastructure in the city and compares it with service level benchmarks of Ministry of Urban Development (MoUD), Government of India. The gaps between service delivery capacity and requirement of GMC are assessed in **Table 1**.

3.3.1 Water Supply

Guwahati city gets its water supply from multiple organizations such as Assam Urban Water Supply and Sewerage Board (AUWSSB), Guwahati Municipal Corporation (GMC) and Public Health Engineering, Railway, Refinery and other government agencies. The main source of water supply is the Brahmaputra River and ground water sources. Presently, only 30% of Guwahati city area is covered by the piped water network, with total installed capacity of 110 MLD potable water generation, against which actual production stands at 73 MLD, i.e., only 66% of its total capacity. The transmission loss is also estimated to be very high, at around 40% (MoUD, 2013; Parikh et al., 2015). Substantial areas such as North Guwahati and eastern parts of the city are not covered by the distribution system. Further, ground water is not fit for drinking because it is inflicted by high fluoride and arsenic content.

| S. No | Indicator | ULB's value | MoUD Benchmark |
|--------------------------------|--|---|----------------|
| Water Supply | | | |
| 1 | Coverage of water supply | 30% | 100% |
| 2 | Per capita water supply | 75 lpcd | 135 lpcd |
| 3 | Metering of water connections | No data available | 100% |
| 4 | Loss in water distribution | 40% | 20% |
| 5 | Water supply duration | 2-3 hrs/day | 24 hrs/day |
| 6 | Redressal of consumer complaints in 24 hrs | No data available | 80% |
| 7 | Quality of water supply | No data available | 100% |
| 8 | Recovery of revenue on water supply | 70% | 100% |
| 9 | Efficiency in water supply charges | No data available | 90% |
| Solid Waste Management | | | |
| 10 | Household coverage to collect MSW | Less than 50% | 100% |
| 11 | Efficiency of collection of MSW (500TPD/600TPD) approx is 623g/day/capita | 80% | 100% |
| 12 | Segregation of MSW at origin and at dumping ground | No data available | 100% |
| 13 | Recovery of MSW (both wet and dry MSW) | No data available | 80% |
| 14 | MSW disposal mechanism | Open dumping | 100% |
| 15 | Cost recovery in MSW services (recovery of INR 6.5 million per month against expenditure of INR 9.9 million per month) | 65% approx | 100% |
| 16 | Efficiency in MSW collection user charges | No data available | 80% |
| 17 | Redressal of consumer complaints in 24 hrs | No data available | 90% |
| Storm Water Drainage | | | |
| 18 | Coverage of storm water drainage network | No data available | 100% |
| 19 | Incident of water logging/flooding | Many places in the city | Zero |
| Sewerage and Sanitation | | | |
| 20 | Coverage of toilets | 92.3% | 100% |
| 21 | Coverage of waste water network services | Presently GMA does not have any | 100% |
| 22 | Collection efficiency of waste water network | integrated sewerage system and | 100% |
| 23 | Adequacy of waste water treatment capacity | treatment plants, except for railway colonies, IOC refinery and defence | 100% |
| 24 | Quality of waste water treatment | establishments (which have their | 100% |
| 25 | Extent of reuse and recycling of waste water | own systems). About 53% of houses | 20% |
| 26 | Extent of cost recovery | with toilets in their premises have | 100% |
| 27 | Redressal of consumer complaints in 24 hrs | septic tanks and 20% have sewer | 80% |
| 28 | Efficiency in collection sewerage user charges | systems linked directly to drains. | 90% |

Table1: Latest service level benchmark of Guwahati city

The major hurdles faced by the inhabitants of the city are:

- Lack of water recharging and billing mechanisms (presently less than 10% is collected against expenses), leading to losses and insufficient revenue generation
- Outdated infrastructure
- Huge distribution loss due to leakages
- Poor quality of electricity supply for water pumping
- Inadequate human resources
- Poor coordination between service provider and customer.

Only one water supply project, worth INR 2.80 Billion (90% funding from Centre), was sanctioned under JnNURM (MoUD, 2013; Parikh et al, 2015). This project covered the west Guwahati region.

3.3.2 Sewerage Network

Delivering safe and secure water and sewerage services largely relies on adequate treatment capacity. At present, Guwahati Metropolitan Area (GMA) does not have any integrated sewerage system except for certain pockets of railway colonies, IOC refinery and defence establishments. Railway colonies, IOC refinery and defence establishments have their own separate sewerage facilities. Most of the individual houses of the city have septic tanks and the effluents are being directly released into drains or low-lying areas. About 53% of houses with toilets in their premises have septic tanks and 20% have sewer systems linked directly to drains. The Master Plan of Guwahati city (2025) estimates the generation of 225 MLD of waste water from Guwahati city and 107.2 MLD from proposed new towns (MoUD, 2013; Parikh et al, 2015). The toilet coverage in the city is around 92%, which is on a par with other cities in India.

3.3.3 Solid Waste Management

Solid waste management is necessary, as lack of proper scientific waste management system can pollute the air, water and land. The management of solid waste is the responsibility of the five engineering divisions of GMC. There is no separate solid waste management department in the city. For operational purposes, the entire city is divided into 21 zones comprising of 3-5 wards in each zone. As per the city development plan (CDP), solid waste generation was 744MT/day in 2010. It is projected that by 2025 it will further rise to 1739 MT/day (MoUD, 2013; Parikh et al, 2015). Per capita waste generation presently stands at 0.6 kg/person/day and will rise to 0.8 kg/person/day by 2025, which will be much higher than the norms for a class I city. The Master Plan also reveals that 90% of waste generated is organic in nature, and that the landfill area requirement for the city has been estimated at 38 hectares for present capacity, and is projected to increase to about 91 hectares by 2025. This indicates about new projects required to be sanctioned for solid waste management. Less than 50% of households are covered under solid waste management services, with collection efficiency of 80%. Around 65% of the total cost is recovered for SWM services (MoUD, 2013; Parikh et al, 2015). The major drawbacks of the present solid waste management are:

- No arrangement for segregation and storage at source
- No organized system in place for primary collection
- Open and unscientific waste storage depots
- Open trucks with manual loading used in transportation
- Irregular frequency of removal of solid waste, and practically no processing
- Crude, unsafe and open disposal.

A solid waste management plan with an estimated cost of INR 660 Million was sanctioned under JnNURM (MoUD, 2013; Parikh et al, 2015).

Table 1 List of Smart Interventions required in Guwahati City

| Component of Smart City | Present State | Smart Interventions |
|--------------------------------|---|---|
| Social Infrastructure | 1. Ambiguous spatial management of schools, healthcare, open spaces, recreational places, etc. | <ul style="list-style-type: none"> • Mapping of individual houses or groups of houses with characteristics of households on GIS for easy and effective decision making, development of control enforcement and defining catchment for open spaces for schools, health care, open spaces, etc. |
| | 2. Increase in urban slums over a span of time | <ul style="list-style-type: none"> • An interactive GIS map which will be updated on a yearly basis will give the dynamics of slums |
| | 3. Natural ecosystems and characteristics of cities are generally not given due weightage | <ul style="list-style-type: none"> • Improvised land use planning and social infrastructure management; lands which represent contradicting criteria should be avoided for urban settlements |
| | 4. Location of essential critical support infrastructures such as hospitals, schools in disaster prone areas | <ul style="list-style-type: none"> • Buildings and land use which help in easy and quick relief and rescue operations should not be located in disaster prone areas but rather should be accessible and resilient in times of disasters |
| Economic Infrastructure | 1. Land use and circulation patterns are usually not integrated together | <ul style="list-style-type: none"> • Best mix of urban form, land use density and transportation network will help in reducing energy use and GHG emissions as well as improving efficiency of major economic activities in the city |
| | 2. Traditionally, GIS is only used for land use management, i.e., to keep track of zoning and related data on building, taxes and occupancy | <ul style="list-style-type: none"> • It is essential to use GIS as a planning support tool whereby multiple criteria evaluation (MCE) is applied to enhance community economic viability in terms of land use and density • Density of development in relation to the existing and planned infrastructure |
| | 3. Economic zones such as financial institutions, industrial and processing units treated as segregated units | <ul style="list-style-type: none"> • Mixed land use and transit-oriented development should be utilised to its maximum potential to build on economies of scale and aggregated economies concept |
| | 4. No information on migrant population to and from the city | <ul style="list-style-type: none"> • Online user portal for households to register themselves and update their information regularly at ward level so that employment opportunities can be generated for its migrant population |
| Physical Infrastructure | 1. No relationship between population to be served with basic services by city and capacity of these services | <ul style="list-style-type: none"> • Managing records of incoming and outgoing population to the city on an efficient database management system (DBMS) to inform city officials about population to be served and capacity of service delivery based on its threshold value |
| | 2. Water Supply: The major issues in terms of water supply are low per capita supply, leakage and distribution losses, unmetered water connection, obsolete network, pollution at local level making water un-potable, etc. | <ul style="list-style-type: none"> • Spatial mapping of urban utilities can help with real time monitoring of domestic and other water consumption in the city • Water consumption metering and collection • Smart grids for water supply network • Standards for water efficient devices, storage and transport, non-revenue water and distribution, and preventive action on unintended pollution sources |
| | 3. Sewerage and Sanitation: The major issues are insufficient as well as inefficient sewerage collection, limited coverage of toilets, no treatment of waste, no waste water reuse etc. | <ul style="list-style-type: none"> • Access to toilets on the basis of total population requirements • Waste water collection and treatment services which are feasible to be provided • Reuse of waste water after proper treatment for landscaping and toilets • Separate waste collection and distribution of soil water and waste water • Smart grids for integrated sewerage network |

| | | |
|-------------------|---|--|
| | <p>4. Solid Waste Management: The major issues are limited coverage of collection, inefficient collection mechanism, no segregation of dry and wet waste at household level, no provision for converting organic waste to manure/organic fertilizers, no scientific landfills, insufficient transportation infrastructure for transferring waste to main landfill</p> | <ul style="list-style-type: none"> • Threshold value of population density for an area should be kept in mind while designing these services • Refuse chutes for dry and wet waste separately for mid-rise to high-rise buildings • Reduction and segregation of waste at local level to be carried out through regulatory measures and behaviour support tools • Efficient, aggregated and sustainable solid waste streams for processing • Solid waste tracking, auditing and recovery channels at spatial level to support planning decisions • Scientific landfills should be proposed according to waste generation |
| | <p>5. Storm Water Drainage: The major issues are insufficient capacity of drains especially during heavy rains, siltation of drains, inefficient collection potential of natural drains, no rain water harvesting provisions at neighbourhood or city level</p> | <ul style="list-style-type: none"> • The city should be planned with best natural drainage layout as per its topography and hydrology • Drainage lines should be monitored and cleared of siltation by authorities regularly, for which real time monitoring of rainfall should be carried out at spatial level • Rain water harvesting and its treatment standard should be an essential component of planning considering reuse, natural drainage and run-off patterns |
| Governance | <p>1. Involvement of multiple agencies for management and planning of infrastructure and services, leading to lack of coordination, lack of clarity in local functions, inter-institutional conflicts, jurisdictional issues</p> | <p>In order to ensure accountability and transparency in the functioning of the agencies, it is necessary to streamline their functions by adopting the best practices and E-governance measures:</p> <ul style="list-style-type: none"> • An assessment of the existing institutional structure for gaps, overlaps and duplication of function between various organizations • An assessment of the manpower/skill requirement of GMC |
| | <p>2. The multi-location offices of GMC affect its management efficiency</p> | <p>Need for single official premises for Consolidation and streamlining of database management system; professionals should have the required expertise</p> |
| | <p>3. Staff shortage and lack of trained/technically qualified staff</p> <p>4. Hazy strategy and roadmap for fortifying the accounts department</p> <p>5. E-governance not fully implemented</p> | <p>Hiring of technically skilled staff on priority basis having computer literacy and handling Double Entry Accounting System (DEAS); E-governance implementation and imparting training to the staff for DEAS; booking, audit and budget preparation and monitoring on budgets; project implementation and maintenance in the area of water supply, SWM and storm water etc.; efficient collection of maintenance charges; and financial management and revenue enhancement measures</p> |
| | <p>6. Higher growth rate exhibited by expenditures than revenues</p> <p>7. Dependency on grants as own sources of revenue only 39% of revenue income</p> <p>8. Low property tax collection efficiency (40%), needs to be scaled up</p> | <ul style="list-style-type: none"> • Adoption of Unit Area Method and Cost recovery mechanisms need to be emphasized • Apart from building infrastructure in the city it is necessary to build willingness of people to pay for maintenance of services; hence, GMC should devise a strong mechanism to get maintenance charges from the public • Trainings should be imparted on asset management and valuation • Scientific methods for preparation of budget should be followed |
| | <p>Citizen charter (GMDA, 2012) does not define many important points</p> | <p>Citizen Charter needs to be strengthened, and should be more detailed in explaining how citizens can involve themselves in ULB functioning and ensure social accountability</p> |

3.3.4 Storm Water Drainage

Due to its particular topographical features, the whole GMA area is divided into 6 (six) drainage basins, which are ultimately drained into the Brahmaputra River, either directly or through various drainage channels and reservoirs. These six basins are: Bharalu Basin, Dipar Basin, Silsako Basin, Foreshore Basin, North Guwahati Basin and Kalmoni Basin. The Master Plan for Drainage was revised in the year 1991 to hold good for a period up to 2021. The Town and Country Planning Department constructed drains, including box drains, with a total length of 17 km from 1973-74 to 1996-97 (CDP-Guwahati, 2006; MoUD, 2013; Parikh et al, 2015). Small roadside drains are not efficient enough to provide relief to the locality. The drainage in many areas of the city remains waterlogged during the rainy months. Bharalu basin is the most flood prone area in the region because of siltation and encroachments on the natural drainage catchments areas of Bharalu River. A separate proposal has been made under the JnNURM scheme which gives separate plans for each basin. Each plan includes rehabilitation of the existing drainage system along with new drains, culverts, pumping stations and sluice gates. According to the Detailed Project Report (DPR) on storm water drainage (2008), the total capital cost of all items proposed under the project was INR 7.5 billion (CDP-Guwahati, 2006; MoUD, 2013; Parikh et al, 2015).

3.4. Governance and Finances

Guwahati Municipal Corporation (GMC) and the Guwahati Metropolitan Development Authority (GMDA) are the two key agencies involved in the development of Guwahati city. For areas which are not under jurisdiction of GMC in the Guwahati Metropolitan Area, the Guwahati Metropolitan Development Authority (GMDA) is the nodal agency for Master Planning and provision of basic services such as water supply, sewerage and drainage, as well as infrastructure (roads and street lighting) and housing (CDP-Guwahati, 2006; MoUD, 2013; Parikh et al, 2015). Guwahati Development Department (GDD) has been established to coordinate between GMC and GMDA, and also looks after the execution of various State and Central development schemes such as BSUP and RAY through JnNURM (CDP-Guwahati, 2006; MoUD, 2013; Parikh et al, 2015). After analysing the institutional responsibilities of the various agencies, it was observed that the presence of multiple agencies for discharging the similar duties has compounded the confusion in ensuring delivery of services, further affecting the efficiency and accountability of the agencies towards service delivery. In order to bring transparency and efficiency into the city governance system, the property tax module of the E-governance system was implemented in 2013 and GMC launched an E-payment facility for property taxes. Also, Assam's Computerisation of Registration (Panjeeyan) Project, eliminating the need to manually create/store physical registers and other records, won the prestigious "**Gold Icon National Award**" from the Union department of administrative reforms and public grievances for the year 2012-13 (Business Standard, 2014). As far as the financial health of Guwahati Municipal Corporation is concerned, the revenue accounts of the ULBs have been in surplus (as per the ULBs' financial profile analysis up to 2012-13) except for FY 2012-13 (CDP-Guwahati, 2006; MoUD, 2013; Parikh et al, 2015). The ULBs have taken some smart initiatives in its finance management system, such as shifting to the Double Entry Accounting System (DEAS), and are planning to proceed towards the Accrual Based Accounting System. However, the budget planning by ULBs is still done on the basis of past years' data, and the budget is prepared in the absence of councillors. In addition to this the property tax is levied using the Annual Rate Valuation (ARV) method. Moreover, the ULBs are short of trained staff (CDP-Guwahati, 2006; MoUD, 2013; Parikh et al, 2015).

4. SMART INTERVENTIONS

Cities are termed as economic centres and make a high contribution to the country's as well as the state's GDP. With rise of economic prosperity, citizens of the city are increasingly demanding better quality of life. Meeting ever-increasing expectations of citizens in the city will be the key to achieving

the Smart City targets. So it is highly recommended that cities take advantage of evolving technologies with innovative thinking. From the analysis we were also able to list the smart interventions (**Table 2**) that need to be taken by Guwahati city ULBs to transform Guwahati into a Smart City.

5. CONCLUSION

The Government of India has launched an ambitious initiative to develop 100 Smart Cities, and 500 small and medium towns under Atal Mission for Rejuvenation and Urban Transformation (AMRUT). As per the guidelines, at least one city from each state will be selected. Guwahati city is the nerve centre of entire North-East and will soon be declared as one of the cities to be developed as a Smart City. In this context, this study serves the need of the hour where updated data collected from the city is analysed in detail against each component of Smart City framework. On analysis of the data, we found that the Guwahati city population is increasing, rapidly putting huge pressure on urban basic infrastructure such as water supply, solid waste management, sewerage and drainage. These services are also on the lower side compared to the MoUD benchmark. This is also reflected in land use patterns, where we find considerable change in residential, commercial, public and semi-public spaces. On the governance front, functioning of the agencies needs to be streamlined and made accountable to improve service delivery. Also, for a smart financial management system of the city there is an urgent need for trained accounts staff, adequate infrastructure and efficient measures for revenue collection/enhancement. The implementation of all the modules of e-Governance should be prioritised. The implementation of the ICT system will reduce the gap between public and governing bodies. While acknowledging that Guwahati city ULBs have taken some initiatives in the direction of smartness by implementing DEAS, investment in improving infrastructure of water supply and solid waste management etc., a detailed list of smart initiatives needed for Guwahati city, listed in Table 2, mentions specific interventions in each component of the Smart City. The authors thus hope that the findings of this study will be helpful to decision makers and government agencies in taking efficient and effective decisions.

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