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Smart Cities and the Challenges of Control of Water Resource for Sustainable Future

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ABSTRACT: The continuous rapid growth of Indian cities highlights a persistent issue i.e. The exceeding rate of negative impacts than the opportunities that it provides. As populations increase, the chaotic utilization and excess exploitation of natural resources as such land and water can have irreversible negative environmental effects. Water is one of the excessively misused assets of our society, which can be proficiently conserved utilizing the advantages of electronic control systems, and community oriented utility administration. Initiatives such as utilizing grey water to irrigate parks and gardens and sending it back to household units require 'smart' control systems and new abilities among city planners and architects, who are so far used to water administration being a centralized function. If these issues are neglected, our cities would just be a step away from complete breakdown. This paper will bring out the social, economic and environmental challenges with regard to water control in urban areas and accomplish a net advantageous outcome in each area, with minimal trade-offs. Consequently, it explores the case of Ahmedabad wherein the level of public acceptability of the above-mentioned initiatives is unsatisfactory and discusses the steps taken by state government in right direction.

Key words: cities, grey water, environmental challenges

I. INTRODUCTION

The world is urbanizing at the fastest rate ever, and we should be prepared to expect the result of such a development. It is assessed that the year 2050 will bear a world of roughly 9 billion individuals, 70% of which will live in urban agglomerations (Brown, 2006). As urban areas around the globe encounter this exploding development, the need to guarantee they can grow economically, work productively and keep up a high calibre of life for occupants, turns out to be much more difficult and important than ever. This is the where 'smart city' comes to our rescue. The expression 'smart city' is increasingly discussed among governments, city planners and even the private sector to address the anticipated needs of urban communities in the future. Making cities more efficient to bolster development is becoming the agenda of governments and the private parties alike. This decade, urban regions around the globe will put $108 billion in raising smart city setup, for example, energy- efficient buildings, smart grids etc., as indicated by Navigant Research (O'Mara, 2016).One of a city's most fundamental infrastructures is its water framework and if the state and locals do not understand water arrangement, financial prospects will definitely crash. With residents in urban areas growing, it is inescapable that water utilization will also increase proportionally. The fast developments in populace like urbanization, industrialization and farming have exerted lot of excess pressure on existing water assets. Shortage of water assets in the long run can prove to have a non-manageable negative effect on the improvement of a city and on the lives of its occupants (Hashim et al., 2013). A smart water framework is intended to assemble significant and noteworthy information about the flow, pressure and distribution of a city's water. Consequently, it is important that that the utilization and projections of water usage is precise. A city's water distribution and administration framework must be sound and suitable in the long run to keep up with its development and should be prepared with the ability to be monitored and well coordinated with other basic frameworks to acquire more modern and granular data on how they are performing and influencing each other. For conducting a survey, Ahmedabad city was selected for case study purpose. It is one of the diverse and fast growing cities of India with a population density of $12000/km^2$ (Ahmedabad - Wikipedia).

It has an average annual rainfall of 800 millimetres (Ahmedabad - Wikipedia). It is also included in the list of '100 Smart City' plan. The paper also tries to gather failures behind the low success of Rainwater Harvesting. It also focuses on the status of water services in the city and on the ways to further improve them with the help of latest technologies and 'Smart City' initiatives in the concerned field.

II. LITERATURE REVIEW

The advancement of distributed water frameworks plans to accomplish a move centralized systems to small-scale and neighbourhood based ones in urban areas. It can empower a city to decrease its ecological footprint, since water can be all the more effectively provided utilizing the advantages of electronic control frameworks and community-oriented utility administration. Most water frameworks for urban areas over the past 100 years have turned out to be greater and more incorporated. While more current types of frameworks are progressively of smaller scale, they are frequently still fitted into urban areas as if they were huge. The development that tries to perceive how these new advancements can be fitted into urban communities is called 'distributed water systems' (Droege, 2006).

The appropriated water framework approach is regularly called 'water sensitive urban design'. It incorporates utilizing the entire water cycle that is, utilizing precipitation and local water sources like groundwater to bolster into the framework and afterward to reuse 'grey' water locally and 'black' water territorially, consequently guaranteeing that there are critical reductions in water utilized. This framework can empower the green plan to become central to the infrastructure administration of a city; storm water reusing can include artificial wetlands that can get to be distinctly essential territories in the city.

Grey water can also be reused to flood green parks and gardens, and local black water reusing can be tied into provincial ecosystems. Every one of these activities require 'smart' control frameworks to fit them into a city grid, furthermore require new aptitudes among town planners and engineers, who are so far used to water administration being a centralized activity as opposed to being a local planning issue (Benedict and McMahon, 2006). There are currently numerous urban areas that can show small scale local water frameworks that are extremely effective. Also distributed water arrangement in urban communities needs constant community support. The same should be possible with new advances in water and waste management, for example, rain water tanks and grey water reusing. Another model illustration is the redevelopment of the Western Harbour in Malmö, Sweden. Here the objective was to accomplish distributed water frameworks from local sources. This urban locale now has an innovative storm water administration framework that reuses water into green courtyards and green housetops. The venture includes local government in the administration and exhibits that an unmistakable arrangement drives developments in conveyed frameworks (City of Malmo, 2005 Distributed infrastructure had started to be exhibited in urban communities over the globe. Utilities must create models with city organizers of how they can operate local water planning through community-based approaches and local administration.

Recent Developments

The advancements listed below have already been introduced in India for a while now but due to inadequate 'support' infrastructure they have not been commercially successful yet.

A. Water pressure optimizer: Guarantees that the correct pump setup is running at the right time – constantly, at optimal efficiency. This minimizes the water lost in existing spillages and decreases the danger of new burst and breaks (Clean Water PSI, 2010).

B. Water supply analytics: Utilization of predictive analysis to comprehend how the residents utilize water, how this influences a city's water system and how might it be streamlined to guarantee sufficient supply of water (Clean Water PSI, 2010).

C. Automatic meter reading (AMR): Automatically gathers consumption, diagnostic, and status data from water meter or energy metering gadgets (gas, electric) and exchanges that information to a central database for billing, investigating, and analyzing. Moreover the billing can be based on near real-time continuous consumption instead of on estimates based on past or anticipated consumption (Prolos, 2012).

III. STUDY AREA

Ahmedabad city has been selected as a case for this study. The city is known for its arid and semi-arid climatic conditions, with few inland water sources. As per 2011 census, the city had 1,179,823 households, spread across the area of 464 km^2 (Source:Ahmedabad Municipal Corporation, 2016). Ahmedabad Municipal Corporation (AMC) is responsible for the civic infrastructure and administration of the city. The area within AMC comprises of six zones which are divided into 48 wards (Fig. 1). The area falling outside the periphery of AMC is administered through Ahmedabad Urban Development Authority (AUDA).

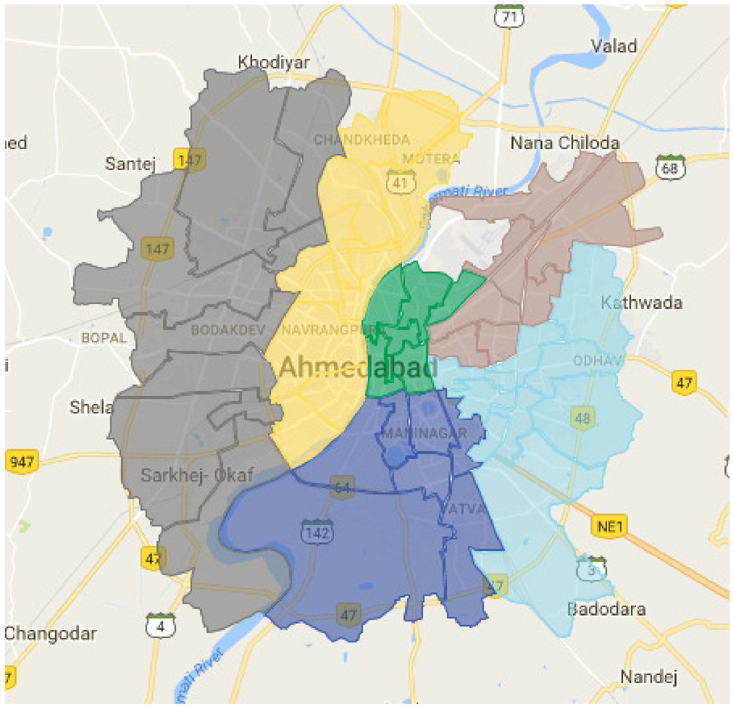

Fig. 1. Study area and Zone boundaries (Source:Ahmedabad Municipal Corporation, 2016).

Table 1

Zone Number	**Zone Name**	**Area (Sq. Kms.)**
1	Central	16.6
2	North	41.54
3	South	94.6
4	East	78.52
5	West	57.53
6	New West	178.76

Source: Ahmedabad Municipal Corporation, (2016).

IV. METHODOLOGY

The information for study is consolidated with figures acquired from household survey undertaken in six zones of AMC. Within these identified clusters, a random sampling of households was undertaken. For the collection of primary data, a sample size of total 240 respondents; all above 18 years of age, 40 respondents per zone were selected through random sampling. A structured questionnaire was administered comprising both open and close ended questions relating to water and sanitation services were prepared in both English and Gujarati (local language).Quantitative and qualitative approaches were applied, based on the questionnaire, to understand the perception of people about grey water and rainwater harvesting. Also an average was taken of residents across the all six zones to find out the number of houses getting water every day. Paired t test was applied to test the hypothesis that there is a significant difference in the standards of water services of zone 1 and zone 6. Households were classified in various economic classes with the help of income slabs. The annual income data of households were also collected.

For the collection of primary data, fifteen experts and officials including Deputy Mayor, Assistant Municipal Commissioner, City Planner and professor of Centre for Environmental Planning and Technology University (CEPT) were interviewed and their honest opinion of the state of water services and concerns regarding the same were duly noted.

V. RESULTS AND DISCUSSIONS

The Narmada Canal provides most of the water in Ahmedabad due to which majority of the people hardly face any water crisis. Even though water is available to them on daily basis (Fig 1) no house gets water supply 24*7. The picture may look glossy from far, but this model of water services is not sustainable. 17.5% residents of 1st and 5th zones do not get water on daily basis, due to which they have to spend a lot of money in acquiring huge storage capacities. Similarly 7.5 % residents of zone 4 get water only thrice a week. This clearly shows the uneven distribution water resources and inefficient administration of municipal bodies.

Due to the absence of water metering, the residents use water very carelessly. Thus, the city is heavily dependent on the canal, which is not going to exist forever. In the survey it was also realized that that out of 40 residents from each zone, on an average only 19.3 people felt that water administration is one of the key elements of 'Smart City Plan' but 60% of the 240 respondents rated the existing water systems less than 7 in the context of a smart city. This clearly shows that the current services are not able to satisfy people but also they do not give much importance to water administration.

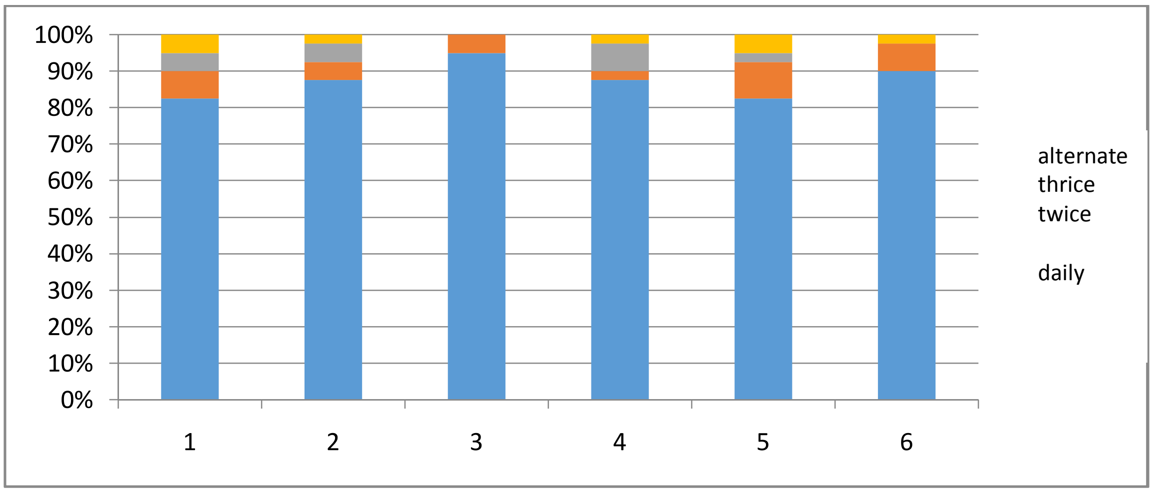

Fig. 2. Percentage of People Getting Water at different times throughout the week in the City across Six Zones (Source:Data obtained from the survey).

During the survey we also came to know that residents do not have a strong understanding of the concept of 'smart city'. Even though the felt that the operations of it are going to be people- centric, they did not think high of the role of stakeholders. Out of 240 respondents, only 25.41% of them thought that the involvement of all stakeholders can really change the scenario. Mostly due to the absence of various platforms to connect and discuss government decisions, they did not have much confidence in their collective efforts which may occur in near future.

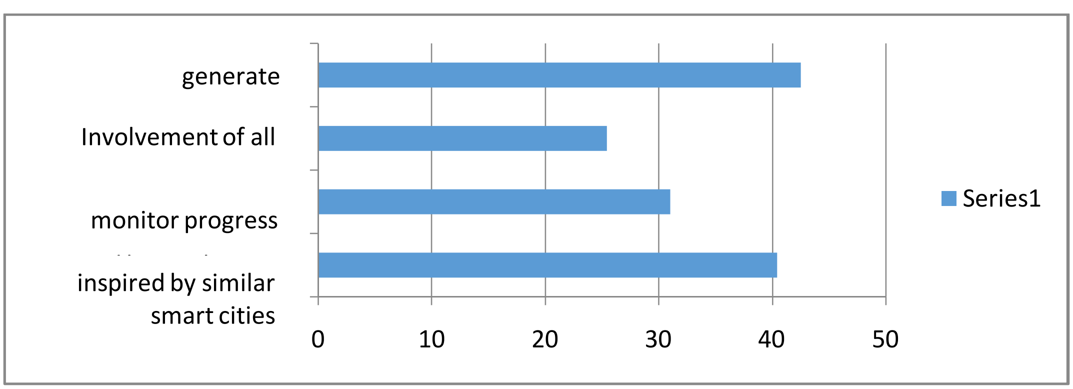

Fig. 3. Ways to speed up the process of making a smart city (Source:Data obtained from the survey).

Table 2: Result of paired t- test.

t-Test: Paired Two Sample for Means	
df	3
t Stat	0
P(T<=t) one-tail	0.5
t Critical one-tail	2.35336
P(T<=t) two-tail	1
t Critical two-tail	3.18245

Source: Data obtained from the survey

Each and every zone of the city is quite different from each other, but in terms of facilities and infrastructure zone 6 tops the list and zone 1 is at the bottom. Zone 6 has maximum number of malls, flyovers, multiplexes and multispecialty hospitals etc., therefore paired t test (Table 1) was applied to test the hypothesis that there is a significant difference in the standards of water services of zone 1 and zone 6. As t stat is '0', it's proved that there is no statistically noteworthy change in the levels of water services. Therefore the local officials have done a commendable job in maintain an evenness in the implementation of same service across the city with a huge population density of 12000/ km^2 (Ahmedabad - Wikipedia).

During interviews with the experts and local government officials, we realize that simple correction at the ground level and a solid push from politicians can make a big difference. During an interview for the survey, the Additional Chief Engineer of one of the zones said that even though everyone is in favour of installing 'smart water meters', it has only remained on paper as it is not backed by strong political will. This is happening inspite of everyone knowing the benefits of installing water meters and realizing its potential to combat the looming water crisis in the most practical way. Similarly the Deputy Town Development Officer, stated that Rainwater Harvesting has not been a success in the city till now, inspite of it being one of the most cost effective and nature friendly ways of gathering water, as government and policies only target the builders and not individual houses. Once builders receive permission to build houses, many do not abide by the rules and some provide infrastructure for Rainwater Harvesting for the namesake, which is not maintained by residents later. And lack of a mechanism of regular checks further degrades the scenario.

VI. CONCLUSION

It will be a tough job for a megacity like Ahmedabad to be water efficient along with its diversity and high population density. Even though the local officials still need time to come in terms with the 'Smart City' concept and change their work patterns accordingly, they do realize that it's their only wise option.

Our general public's goal for the ways of life of future eras ought not really be reducing utilization, but rather a decrease in the utilization of non-renewable assets. In any case, this objective calls for a rework on ways of producing merchandise, products and also the way we build places, to make them more nature friendly and ethical. A balance of the five domains and genuine sustainability can only be brought by the unavoidable Smart City system striving for Sustainable Design, Smart Planning, and vigilant Urban Administration.

Green urbanism for the city of the future is becoming an agenda that cannot be neglected as the global concerns accelerate over climate change, peak oil, water, waste, biodiversity and urban quality of life. Green urbanism offers ways of solving all these problems together. There will need to be infrastructure to support the seven city types outlined if any city is to respond to these concerns. Examples have been provided of how each agenda is underway; however, no city has begun to work equally on all seven areas. Eventually this will be required. This is a challenge but it is also a great opportunity.

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