

Water distribution Network optimization for zone 1 (dadri) Tarsadi area of Mangrol Taluka, Surat district.

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Abstract- India has the second-largest "urbanization," or urban system, in the world. The conversion of rural areas into cities is known as urbanization. More planning is required to fulfil the demands of the population because of the unplanned, uncontrolled expansion that follows from this fast urbanization. In wealthier countries, however, the amount of urbanization has essentially stabilized due to improved infrastructure and a high standard of living. The developing world is advancing in the same manner and at the same rate as the developed world. This article assesses the provision of the water delivery system based on a case study of the Zone 1 (Dadri) Tarsadi area of Mangrol Taluka, Surat District. A random city-wide survey of residential households made up the dataset. The database needed to use the WaterGEMS programme for analysis must be built after the problems in the study field have been recognized. The study's final report makes a strong recommendation for planning measures to ensure sustainability as well as a planning proposal for municipal services to meet future demand.

Keywords: Municipal service, Tarsadi, Urbanization, Water supply system, Water GEMS

I. INTRODUCTION

In the contemporary globalization climate that exists in India, metropolitan areas have a greater impact on the country's economic recovery. Urban centers have a significant impact on any areas, regions, or country's overall growth and development. The effectiveness of this function will depend on how effectively these urban regions can generate jobs, income, and maintain a degree of infrastructure and services. A population's concentration in metropolitan regions is well known. Urban regions have typically gotten less attention when it comes to planning, development, and management.

Urban areas are a source of wealth and a driving force behind the growth of the economy and of the physical environment. Rapid urbanization has many advantages, but throughout the years, it has drawn criticism since governments in developing countries like India have been unable to handle its detrimental impacts on the infrastructure, services, and basic needs of their growing populations. It's crucial to keep development on its current course and refrain from wasting resources in order to address the issues. The establishment of policies and plans that will rationalize expansion, stimulate development, assure effective administration of urban areas, and make optimal use of resources is therefore crucial if better living circumstances are to be achieved.

To encourage quick growth and development in every city, it is necessary to examine the growth pattern, infrastructure development and services, the efficiency of the transportation system, and other aspects. On the basis of these facts and problems, suitable strategies and the action plan's structure can be created.

Providing sanitary amenities and clean drinking water is a challenging task for a developing country like India. Over 20 million people in India did not have access to safe water, and 100 million did not have sanitary facilities, according to the 2011 Census of India. The general condition of the city's water supply is shown in this report.

Problem definition:

Water is important basic needs for improvement of the quality of life which is limited up to certain limits. To meet the future demand of study area and improvement of the quality of life it is necessary to study proper method of planning.

Objectives of study

- to study the existing water supply system scenario & address issues for same.
- to prepare optimize design proposal using WaterGEMS tool for water supply system of study area.

II. LITERATURE REVIEW

Today, Urban India facing serious problems of safe drinking water shortage, inadequate sanitation, and limited resources etc. due to rapid growth of population & unmanaged planning. Therefore, needs to pay attention towards water supply & sanitation as these affects quality of life & economy growth of nation. This section briefing background study based on literature, research papers & case study.

Urbanization: Urbanization is a type of metropolitan development that is a reaction to frequently less comprehended ramifications of mechanical, financial, social, and political powers and to the physical topography of a region. At present, the Indian economy is encountering an odd change from mostly agrarian (with around 70 percent of the populace in provincial ranges adding to around 28 percent of GDP) to administrations based economy (with around 30 percent of the populace in urban regions contributing a critical extent of the administrations part commitment to GDP). With critical monetary and business opportunities in the urban territories, an extension for pleasing the outsiders (or moving populaces) is bringing about more noteworthy urbanization. Urbanization, all things considered, is not seen as a risk to the earth and advancement yet it is the impromptu urbanization and

element urban development, or the sprawl that influences the area utilization of any locale that turns into a matter of worry through its artificiality in the loss of prime horticultural grounds.

Urban communities are growing in certain pockets with an adjustment in the area use along the roadways and in the quick region of the urban areas because of specially appointed methodologies in local arranging, administration and basic leadership. This outgrowth along expressways and streets associating a city and in the outskirts of the urban areas is brought on by the uncontrolled and clumsy urban development.

This scattered advancement outside conservative urban and rustic focuses that is along interstates and in provincial field is alluded to as sprawl. Sprawl by and large alludes to some sort of advancement with effects, for example, misfortunes of rural terrains, open spaces, and biologically delicate territories in and around the urban ranges. These areas need essential courtesies because of the impromptu development and absence of earlier data and estimates of such development amid strategy, arranging and basic leadership.

It is especially evident that urban communities had developed more than a couple millenniums prior, while some developed and died, urban development was predominant and not urbanization. It is crucial to plainly recognize from the development of urban communities from the huge number of years to the later urbanization. On the refinement of urbanization and urban development, a few creators have advanced their perspectives. Alerted that crediting just the development of urban areas to urbanization, Davis (1965) noticed that urbanization alludes to the extent of the aggregate populace moved in urban settlements, or else the ascent in this extent. It is contended that since urbanization would represent the aggregate populace made out of both urban and provincial, the extent of urban is an element of them two.

As needs be, urban areas can develop without urbanization gave the rustic populace develops at an equivalent or more prominent rate. The change of human settlements from a spread-out to conservative urban focuses is a change that can be followed yet the development of urban areas has no innate farthest point as are the limits. Such development could proceed even after everybody was living in urban communities, as in urban areas of officially urbanized created nations, through sheer abundance of births over passings.

In 1800, just 3 percent of the world's populace lived in urban ranges. By 1900, just about 14 percent were living in urban focuses, and just 12 urban communities had 1 million or more tenants. In 1950, 30 percent of the world's populace lived in urban focuses and the quantity of urban communities with more than 1 million individuals had developed to 83. The world has encountered extraordinary urban development in the late decades. In 2000, around 47 percent of the world's populace lived in urban zones. Presently, there are 411 urban communities more than 1 million populace.

The commonly created countries are around 76 percent urban, while 40 percent of inhabitants of less created nations live in urban territories. Be that as it may, urbanization is happening quickly in numerous less creating nations. As indicated by Population Research Bureau (2005), it is normal that 60 percent of the world populace will be urban by 2030, and that most urban development will happen in less created nations. The procedure of urbanization is decently contributed by rustic urban movement prompting the higher corresponding populace development of urban-provincial and base activities, bringing about the development of towns into towns, towns into urban areas and urban areas into metros.

Impact of urbanization

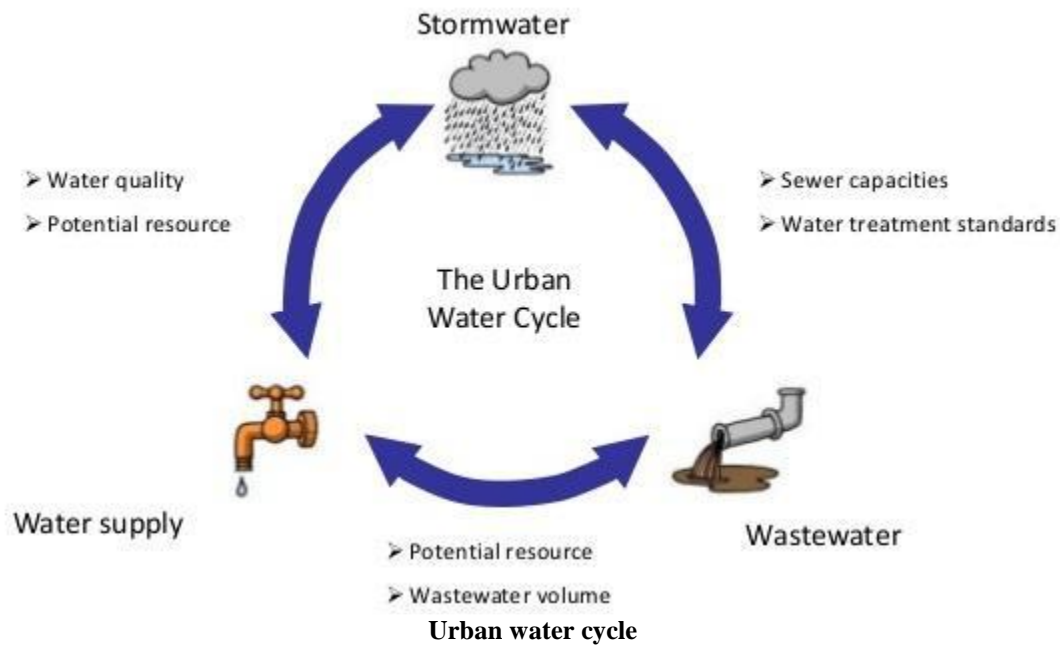
Urbanization is generally seen as a marker of advancement as it demonstrates that increasingly individuals are occupied with auxiliary or tertiary financial exercises. Lamentably, this has not been the situation in India. The legislature, while organizing industry has neglected to keep up its impartial land appropriation. This has made some industrialized pockets require increasingly **labourers** while whatever remains of the nation needs sensible livelihood opportunities. The urbanization in India has been disproportionate and hence has accompanied loads of issues.

The "push" variable has made a mass migration from the towns. As no efficient exertion was made to create commercial ventures in littler towns which could give vocation to these individuals, this gathering arrived in urban communities which were not adapted to give even essential offices to these individuals. The principal prerequisite of these vagrants was convenience and when the city couldn't meet their requests, ghettos came up in urban communities, in which individuals lived in greatly despicable conditions. According to draft mission archive of national urban employment mission under the service of lodging and urban destitution easing, populace dwelling in urban ghettos has been assessed at around 93 million. According to information gave by evaluation, 2011, that is 3% of the urban populace does not have a select space for living, while 32% live in a one room house. Around 29.4% of the urban populace don't have entry to faucet water and 18.6% don't have restroom offices inside the house. 7.3% of urban populace still does not have admittance to power this show shameful foundation offices till date. This part of urbanization can scarcely be acknowledged and carries with it a large group of financial, social and ecological issues. The relocation which happens because of "force" element for the most part includes individuals who however well off in towns, envision better foundation and offices in urban areas and move there looking for better personal satisfaction. This sort of movement does not have any unfavorable effect on urban communities but rather this depletes the town of the gifted and taught populace.

Urban water cycle management

The urban water cycle starts with water take out from reservoirs, and then proceed to portable water before delivery to consumers through pipe system. Some this water is then used to transport wastes through sewer network to water treatment plant. This Treated water discharge into rivers, lakes, and oceans.

The water cycle concept is useful tool for achieving goal, that of restoring and maintaining the balance between current demands and supply.



Source: International Council for Local Environmental Initiatives

Urban Water supply system challenges

Management of Urban water systems are major challenges to all town and cities. Other major problem is reaching consensus among various stakeholders on the environment, social, and economic goals and values of urban water systems.

Other major challenges suggested by Mays (1996) are as follows:

- Inadequate water flows
- Infection of surface waters & ground water from uncontrolled or deficiently directed storm water drainage and waste water.
- Lack of awareness & understanding of value of urban water system
- Poor recreational water quality
- Lack of investment

Factors Affecting Water Demand

Following are the different factors affecting the quantity of water supply:

- Pollution and their characteristics
- Climatic conditions
- Size and type of city
- Standard of living
- Quality of water
- Pressure in the supply
- System of supply
- Rates of water
- Type of sewerage system
- Metering
- Fire fighting requirement
- Number and type of industries
- Area under public gardens
- Policy regarding the metered supply
- Potential sources of water supply
- Age of community

Urban Governance & Planning

The key authoritative structure capable and speaking to the nationals in urban regions are the chosen neighbourhood bodies. Actually for all towns and urban areas in India, there exists a urban nearby body. For the metropolitan urban areas, there exists the City Corporation encompassed by neighbouring city chambers, which are for the most part a part of the bigger urban agglomeration. The 73rd and 74th Constitutional Amendment Acts went in 1993 commands the urban nearby bodies for controlling, overseeing and get ready expert/advancement arranges. Rather, arranging as area use zoning is embraced for the metropolitan district while their control is vested with a parastatal office.

Huge organization and basic leadership in these territories concerning conveyance of different administrations rests with other parastatal associations. Aside from the urban neighbourhood bodies spoke to by the nearby chose delegates, every single other association in charge of crucial administrations are parastatal bodies controlled by the State governments. In this manner, there exist hitting diverges from appreciation to decaying forces to the particular urban nearby bodies by the State governments much against the arrangements of Central government.

A basic angle in the managed advancement of urban ranges is through legitimate usage of ground breaking strategies/improvement arrangements. Albeit 1200 end-all strategies improvement gets ready for towns and urban communities have been arranged so far in India, their execution has not been tasteful because of an assortment of reasons, which thusly have brought about mushrooming of ghettos and squatters, unapproved and aimless advancement or more all natural corruption and transportation issues inside and around the urban territories. Further, the advancement arranges all-inclusive strategies are for the most part archives arranged with constrained gauging capacities without catching the whole flow and are for the most part not receptive to element issues and receptive to strategy changes. Other than this, these arrangements generally limit to separate just land-use zones with next to zero successful direction for the same. Further, with arranging powers limiting to generally arrive utilizes, there is not really any organized push to include or incorporate transport, water and sanitation, and so forth in the arranging procedure. This outcomes in, associations included or taking into account diverse administrations (transport, wellbeing, water, vitality, and so on.), work in breaking down to address fundamental conveniences. Absence of coordination among numerous organizations has prompted unsustainable utilization of area and different assets furthermore ungraceful urban development.

From the perception and examination of the practices in urban administration, the operation arranges attracted are incapable tending to smooth coordination with different organizations worried with conveyance of administrations. Basically a significant part of the turmoil is contributed because of the separation with the arranging association and the association required with day by day operations. A stark standing out certainty from the arranging association is its absence of affirmation of any city capacities: versatility, employments, economy, vitality, and so on.

The arranging association from one perspective is focussed ashore utilize arrangements and its control alone, tolerating supplements of incorporating area use with transportation for upgrading portability. Then again, the neighbourhood organization needs to determine overnight about every day operations administration with little acknowledgment on the ramifications of the arranging association overlooking the city capacities.

With various associations in charge of tending to different city capacities, it is basic that these associations recognize their interdependencies formally through proper systems. Basically the interchange of these associations required with various city capacities must be recognized and crossed over from short-to-medium (5 to 10 years) time span arranging attempted by advancement powers to close to-fleeting operations embraced by City Corporations.

Hence, it is crucial to interface the day by day operations with the arranging of 10 year time period so that future confusion is captured. In this point of view, arranging and administration must be receptive to nearby and territorial issues while guaranteeing imperative base and conveyance of essential administrations.

Policies and Programs for Urban area

Customarily, the approaches of urban advancement have been focussed on tending to the absence of lodging and conveyance of essential administrations because of the ascent in urban populace. A reason while seeking after urban strategies was likewise that the nation was prevalently agrarian and to a great extent upheld by the provincial economy. These are further clear from the arrangement costs under lodging and urban advancement part in the Five Year Plans of the Planning Commission of India. As of not long ago, the positive parts of urban communities as motors of monetary development with regards to national financial strategies were very little refreshing and, accordingly, the issues of urban zones were dealt with additional as welfare issues and divisions of leftover speculation instead of as issues of national monetary significance (Ministry of Urban Development, 2005).

Tending to the urban zones in the underlying years, centre was ashore strategies, later on towards conveyance of fundamental administrations to urban poor, and right now on urban base and administration. Ravindra (1989) has endeavored to outline the urban area approach in the nation.

As needs be he has inspected the instruments of area approach utilized by the State for mediations extensively as: lawful measures, monetary measures and direct intercessions. There have been extreme level headed discussions and some expansive scale activities to efficiently handle urbanization.

The primary real endeavour to address the urban area issues was by the Committee on Urban Land Policy. Alternate activities were through: the Task Force on Housing and Urban Development in 1985, the National Housing Policy in 1985, the National Commission on Urbanization in 1988, the Mega City Scheme amid 1993-1998, and the Jawaharlal Nehru National Urban Renewal Mission (JnNURM) from 2005 to 2012 and the National Urban Transport Policy (Ministry of Urban Development, 2006).

The Ministry of Urban Development, Government of India, propelled the JnNURM in 2005. This countrywide project addresses reestablishment of urban territories for 63 urban areas including almost 70% of aggregate urban populace, its essential point being to connect the revitalisation of urban base with a particular motivation of institutional changes. The aggregate speculation conceived under JnNURM over the mission time frame (2005-2012) is pegged at Rs. 12, 05,360 million. The key mission of this system is to bolster changes driven, quick track, arranged improvement with spotlight on enhancing productivity in urban framework and administration conveyance components, through group cooperation and guaranteeing responsibility of urban nearby bodies and parastatals towards subjects. JnNURM is made operational with two sub-missions:

- Urban Infrastructure and Governance (UIG)
- Basic Services to Urban Poor (BSUP)

The sub-mission on UIG concentrates on significant base ventures for water supply, sanitation, sewerage, strong waste administration, street system, urban transport and redevelopment of inward (old) city ranges with a perspective to redesigning foundation in that, moving modern and business foundations to accommodating territories, and so on. The sub-mission on BSUP concentrates on incorporated redevelopment of ghettos consolidating lodging, water supply, seepage, storm water channels, strong waste administration, road lighting, and community halls.

Gujarat water supply & sewerage board

GWSSB is a statutory body set up by the State Government for Development, Regulation and Control of the Drinking water area in the State. The ward of the GWSSB (Board) stretches out to the entire of the condition of Gujarat barring the territories involved in urban communities and cantonments. The Board works for setting up rustic water supply framework and in addition operational administration of Rural Regional water supply plans covering bunch of towns. Here the principle capacity of the Board is to get ready, official, advance and fund the plans for supply of water for drinking purposes. The Rural water supply frameworks incorporate Installation of hand pumps, Mini water supply framework, and so on in little homes and funneled water supply framework for individual towns including extensive water supply framework covering a few villages.

Complete 306 activities are arranged under State Wide Water Supply Grid. Out of which, 171 ventures covering 3250 Kms. Mass pipelines and 9633 towns/131 towns of Narmada Master Plan are being actualized under Sardar Sarovar Canal Based Water Supply Project program and Sujalam Suphalam Yojana Program, separately. While, 135 ventures covering 3758 towns and 12 towns in view of surface/sub-surface sources are being actualized under rustic water supply Program at State/National level and so on.

Out of 13391 arranged towns and 143 towns, till now 10675 towns and 127 towns have as of now been secured through the Water Grid. State has contributed intensely for foundation creation for this reason, which incorporates 2178 km of mass water pipelines, 116697 km circulation pipelines, stockpiling and pressure driven structures and system of 155 water treatment plants with an aggregate introduced limit of 279 crore liters of water every day. GWSSB gives designing, administration and budgetary inputs to guarantee that all the rustic water supply plans work proficiently, adequately and financially and can keep up customary and solid drinking water to the recipient group. Since the day of its commencement in 1979, GWSSB has been to a great extent required being developed of capital foundation as pipelines and water stockpiling structures. Productive and financially savvy operational administration of these real water supply establishments is the prime errand of the Board.

Water and Sanitation Management Organization

WASMO was made for bringing recognizable systemic changes through an outlook change in the part of administration from supplier to facilitator and citizen's engagement in drinking water administration conveyance at user's level in provincial territories of Gujarat State. In 1993, the 73rd alteration to the Constitution made an outlook change in the drinking water part. There was a movement from the supply-driven government-possessed frameworks to decentralized interest driven, group claimed water supply and sanitation frameworks, with accentuation on strengthening and limit working of the neighbourhood groups. The Panchayati Raj Institutions (PRIs) were given a protected status and had more prominent force in overseeing nearby assets and group issues. WASMO was subsequently settled as an institutional development in the administration to encourage the usage of the changes.

Town Characteristics

The town is the spot where distinctive capacities are assembled. Those capacities can be monetary, social, political, managerial or even budgetary, and the town is by all accounts formed by the mix of those capacities, which makes it of significance for whatever is left of the region survey.

Big medium-sized towns: Central submits of higher-request or focal puts in of medium request,

□ from 50,000 to 100,000 occupants,

□ Small medium-sized towns: Central submits of higher-request or focal puts in of medium request, underneath 50,000 occupants,

□ Small town: Possession of town mandates and benefits, frequently focus of low level, in this positioning, Gatzweiler utilizes the centrality of the town as a fundamental measure for definition which towns can be considered as medium-sized or little.

According to URDPFI Guidelines Classification of town for the purpose of this study the town centres have been classified as:

Classification of town	Population range	
	Plain area	Hilly area
Small town	Less than 50000	Less than 20000
Medium town	50000 - 500000	20000 - less than 80000
Large city	more than 500000	80000 and more

Source: URDPFI guideline

UDPFI Guidelines

The basic objective of suggesting various norms and standards for urban development plans formulation is to provide a basis for taking decision. The suggested norms and standards as shown in Table No. 3 are indicative and can be suitably modified depending upon the local conditions.

Aspects	Small	Medium	Large and Metro
Domestic Absolute	70 lpcd	70- 100 lpcd	135 lpcd
Min. desirable	100 lpcd	135-150 lpcd	135- 150 lpcd
Non- Domestic Fire fighting Public Purpose	1 % of total demand 10-15 lpcd	20-25 lpcd	30-35 lpcd

Review paper:

1. *Analysis and Redesign of 24/7 Water Distribution Network using Water gem Software (Adhav et al., 2022).*

In this study, the author demonstrates the redesign of an existing network as well as the planning of a water distribution system using a programming tool that runs a long-term simulation of hydraulic and water quality behaviour inside a pressurised network of pipes known as a WaterGEMS. This paper explains how to examine the hydraulics of the distribution network using WaterGEMS. For the hamlet of Nighoj in the Indian state of Maharashtra, the studies offer the hydraulic design and analysis of the rural water

distribution system (WDS). A water distribution system was created for this study's population projections for the next 30 years using the WaterGEMS software, and the results were compared to find the most cost-effective pipe size. The water display system's pipes are sized economically by taking into account the following factors: peak factor, available commercial pipe diameter, elevated service reservoir level, residual pressure at each node, flow velocity, head loss, and pipe material.

2. *Division of district metered areas (DMAs) in a part of water supply network using Water GEMS (Bentley) software: a case study.* (Kowalska, Suchorab and Kowalski, 2022)

The partitioning of a chosen water supply network zone into DMA areas is shown in this study. The main transmission trunks were separated and excluded from the division into metering areas based on the spatial distribution of the flow rate and the geometrical structure of the network (routes, pipe diameters, and existing gate valves) in the analyzed water supply zone. Using the district metered areas module, which is a feature of Bentley's WaterGEMS software and supports the segmentation of water supply networks into metering zones, DMA regions were separated from the rest of the network. The primary criterion for distinguishing DMAs was the presence of 200 nodes in the region. The divided territories were merged into three primary DMA zones, with pipe lengths totaling between 2500 and 3800 m in each zone. The water supply route for each DMA was chosen separately with the goal of creating a one-sided inflow to the remote location. The majority of the time, this objective has been accomplished. In the third instance, it was discovered that two-sided water inflow was required. The hydraulic modelling of WDS served as the foundation for the examination of the proper operation of DMAs.

Water supply system of Tarsadi:

- Currently the town is having most of the water supply from ground water through bore wells.
- At present, the ground water is stored in the Existing GSRs in two zones viz.
 - Dadri Zone
 - Town Zone
- Each water zone has individual ESR and water distribution network.
- Some part of the above said zones received water directly from the bore wells as well.

Main Issues to Address in Existing Water Supply System

- In Dadri Water supply zone,
 - Due to insufficient pipe diameter of main lines, pressure at end node is not achieved.
 - Main line is not sufficient to cope the water demand of future development.
- In Town Water supply zone,
 - ESR (6 LL) is having leakages

Result

WaterGEMS is a multi-stage hydraulic modelling software developed by Bentley. WaterGEMS working across AutoCAD, GIS & stand-alone platforms. WaterGEMS is most widely application for analysis & designing of water distribution system. With available data of water distribution system of Tarsadi, a network was generated in WaterGEMS software. Elevation of each junction, reservoir, & Pump are filled into the system to calculate pressure of junction in pipe. WaterGEMS is a software for an establishment optimal route for Tarsadi.

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