

A Modernized and Innovative way of Developing Dhule as a Smart City an Analytical Approach

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ABSTRACT: Now a day there is advancement and innovations are made to make any city to be smart. As the population's increases, there is large need to provide best possible services in terms of Public amenities like shelter, Water supply, sewage, transportation, employment, etc. This research aims the problems in Dhule city and promising the solution to be made to make it smart city. A smart city is an outcome of these problems. Our society is facing socio-economical challenges & major problems are urbanization.

KEYWORDS: Infrastructures, Urbanizations, ICT, Smart city.

I. INTRODUCTION

The first question is what is meant by a 'Smart city'. The answer is, there is no universally accepted definition of a smart city. It means different things to different people. Some definitional boundaries are required to guide cities in the Mission. In the imagination of any city dweller in India, the picture of a smart city contains a wish list of infrastructure and services that describes his or her level of aspiration.

To provide for the aspirations and needs of the citizens, urban planners ideally aim at developing the entire urban ecosystem, which is represented by the four pillars of comprehensive development-institutional, physical, social and economic infrastructure. In the approach of the Smart Cities Mission, the objective is to promote cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and application of 'Smart' Solutions. The focus is on sustainable and inclusive development and the idea is to look at compact areas, create a replicable model which will act like a light house to other aspiring cities. Smart Cities as "an emerging conceptual view of a city that promotes the use of Information and Communication Technologies (ICTs) to engage with citizens to develop social capital and intellectual capital, to make better use of hard infrastructure (physical capital), reduce usage of environmental capital and support smart growth.

However, there is no strict definition of a 'smart city'. Our society is facing various socio-economical challenges and among them the major problems are related to urbanisation. The migration from rural areas to cities and the growth of urban population have carried a decrease of living spaces, many environmental issues.

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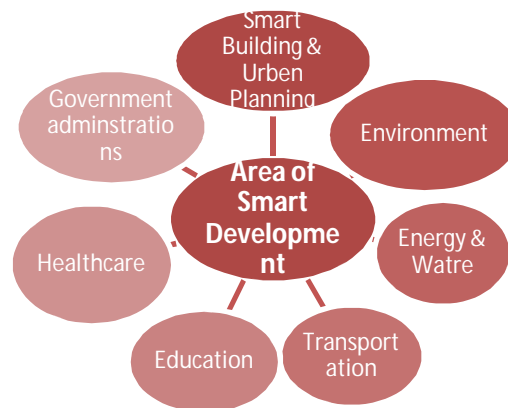


Fig.1 Areas of smart development

II. LITERATURE SURVEY

Dhule (Dhule is located at 20.9°N 74.78°E) district is the northwestern part of Maharashtra state, India. It is one of the very few well-planned cities of India. Dhule is widely known across the country for its architecture and urban design. The town planning of this city was done by Sir Mokshagundam Visvesvaraya. Dhule is largely emerging as one of the biggest upcoming hubs of Textile, Edible oil, and Power-loom across the state and has gained a strategic advantage for being on the junction of three National Highways viz. NH-3, NH-6, and NH-211.

Dhule is also a part of Delhi Mumbai Industrial Corridor Project, India's most ambitious infrastructure program, aiming to develop new industrial cities as 'Smart Cities' and converging next generation technologies across infrastructure sectors. As of 2011 India census, Dhule had a population of 376,093. At the 2001 census, males constitute 52% of the population and females 48%. M.I.D.C. has planned to develop an industrial area on 400.35 Hect. of land. About 278.08 Hect. of land has come in possession of MIDC. MIDC has provided the entire basic infrastructure such as roads, street lights, and water supply pipe lines in this area. MIDC has constructed an earthen dam on Motinala to fulfill the requirement of water of the industrial area. MIDC has provided water supply scheme of 4.50 MLD capacities. Presently the consumption of the water is about 2.20 MLD. The rate of allotment of industrial plot is Rs. 100.00 per sqm.

III. PROBLEMS OR OVERLOAD ON CITY INFRASTRUCTURES

One reason is that across the world, the stride of migration from rural to urban areas is accelerating numerically. By 2050, about 70 percent of the population will be living in cities, and India is no exception. It will need about 500 new cities to accommodate the influx. Smart Cities offer a conceptual and practical tool box to deal with unprecedented urbanization. The pace of urbanization is increasing exponentially. Every day, urban areas grow by almost 150000 people, either due to migration or births. Between 2011 and 2050, the world's urban population is projected to rise by 72 % (i.e. from 3.6 billion to 6.3 billion) and the population share in urban areas from 52 % in 2011 to 67 % in 2050.

In addition, due to climate change and other environmental pressures, cities are increasingly required to become "smart" and take substantial measures to meet stringent targets imposed by commitments and legal obligations. To promote a thriving culture, cities must achieve economic, social, and environmental sustainability. This will only be made possible by improving a city's efficiency, and this requires the integration of infrastructure and services. While the availability of smart solutions for cities has risen rapidly, the transformations will require radical changes in the way cities are run today.

IV. METHODOLOGY

In this study, to determine the ranking of criteria for the development of smart cities, the research problem was split into three hierarchal levels, beginning with the highest level, and followed by criteria and alternatives in the lower

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Vol. 6, Issue 2, February 2017

hierarchical levels. The selection of the essential information and criteria was based on the literature, and feedback from questionnaires. To obtain an understanding of the criteria and elements of smart cities, primary data were collected by the various departments through questionnaires and interviews in the field. The survey was based on the perception of road maps, water requirement lacking, and sewage treatment problems after all data collection sorting out various problems, analysis, design & suggestions of various parameters then we find out the most approximate cost or fund required for development of smart city. Hence, the majority of respondents felt that the criteria for the development of smart cities were ‘important’, while their perception of the same procedures were ‘high’.

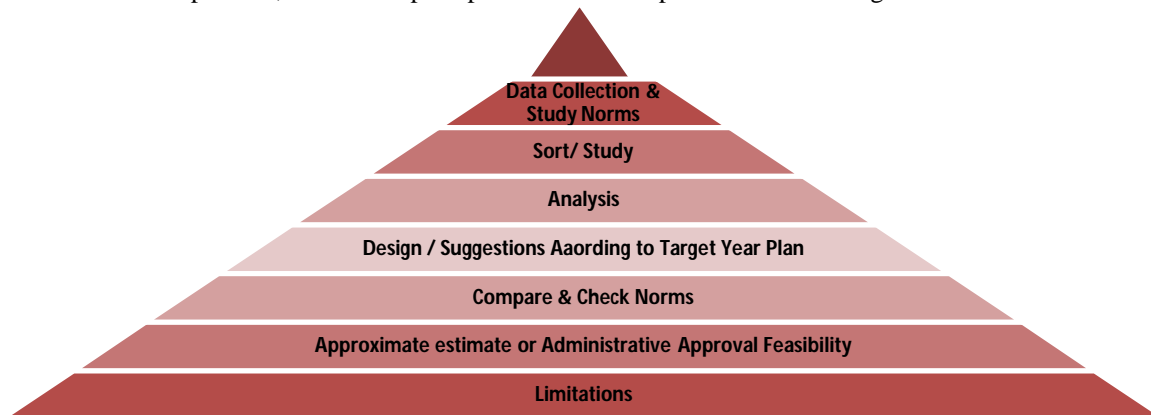


Fig.2 Methodology Diagram

V. DESIGN AND SUGGESTIONS FOR DIFFERENT AREAS OF DHULE CITY

Drawing on the conceptual literature on smart cities and the factors outlined above, we have developed an integrative framework to explain the relationships and influences between these factors and smart city initiatives. Each of these factors is important to be considered in assessing the extent of smart city and when examining smart city initiatives. The factors provide a basis for comparing how cities are envisioning their smart initiatives, implementing shared services, and the related challenges.

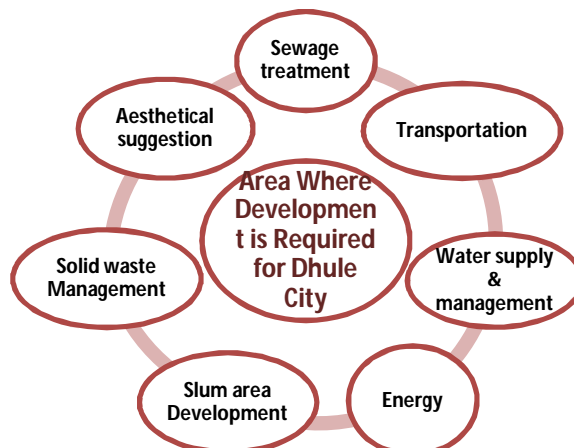


Fig.3 Area where Development is required for Dhule City

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Vol. 6, Issue 2, February 2017

A. DESIGN OF SEWAGE TREATMENT PLANT:-

Table No. 01 population forecasting

YEAR	POPULATION	INCREASE IN POPULATION	% INCREASE IN POPULATION	DECREASE IN % INCREASE
1951	76,880	-	-	-
1961	98,893	22013	28.63	-
1971	1,37,129	38236	38.66	-10.03
1981	2,10,759	73630	53.69	-15.03
1991	2,78,317	67558	32.05	21.64
2001	3,41,473	63156	22.69	9.36
2011	4,18,446	171241	50.15	-27.46
2021	6,59,867	241421	57.69	-7.54
			Average	-4.84

Population Forecasting

Forecasted population for year 2041, (30 Years)

$$52.85 - 4.84 = 48.01 \quad = 1008607 + \frac{48.01}{100} \times 1008607 = \mathbf{14,92,839 \text{ Nos.}}$$

Design of Treatment Units

Population as calculated by decrease rate method: 1492839 Nos.

Sewage: 85lit/day/capita

Quantity of effluent in lit/day: $\frac{85 \times 1492839}{3} = \mathbf{42297105 \frac{m^3}{day}}$

Volume of sewage: $\frac{42297105}{1000} = \mathbf{42294.105 \frac{m^3}{day}}$

Design of Screen Chamber

Total flow of sewage = 42297.105 m³ / day.

Volume of screen chamber = 293.73 m³ \cong 294 m³ (Standing period screen chamber is 10 minutes)

If we consider screen chamber of 2m height, then size will be 17.5 m x 8.5 m x 2m

Design of Grit Chamber:

Total flow of sewage = 42297.105 m³ / day

Volume of one grit chamber = 294 m³ (Standing period screen chamber is 10 minutes)

If we considered grit chamber of 2m height, then size will be 17.5 m x 8.5 m x 2m

Design of Storage Tank:

Total flow of sewage = 42297.105 m³ / day

Volume of storage = 3525 m³ (Standing period of storage tank is 2 hours.)

If we consider the height of storage tank is 10 m then diameter of storage tank is 22 m

Design of Settling Tank and Aeration and Skimming Facility

Total flow of sewage = 42297.105 m³

Volume of settling tank = 10574 m³ (Standing period of settling tank is 6 hours)

We assume three settling tanks then volume of one settling tank will be 3525 m³

If we consider height of settling tank is 10 m then diameter of tank is 22 m.

Design of Dosing Tank and Trickling Filter..... (Assume free board of 100 cm)

Total flow of sewage = 42297.105 m³ / day

There is no standing period for dosing tank therefore dosing of 1m x 1m x 1m.

Volume of dosing tank and trickling filter will be 587.45 m³ (Standing period is 20 min.)

Assuming height of dosing tank and trickling filter is 4 m

Then diameter will be 14 m. assuming free board 100 cm.

Design of Secondary Settling Tank

Total flow of sewage = 42297.105 m³ / day..... (Standing period is 20 Hrs.)

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Vol. 6, Issue 2, February 2017

Total volume of secondary settling tank will be 10574 m³
Provide total three units for secondary settling tank then volume will be = 3524.76 m³
Assuming height of a tank is 10 m
Diameter of tank will be 22 m

Design of Sludge Digester Tank

- i. Total suspended solids in the raw sewage = 350 mg / liter
- ii. Volatile suspended solids = 250 mg / liter
- iii. Moisture content of the digester sludge = 87 %
- iv. 65 % of sludge removal is done in the primary settling tank and the fresh sludge has water contents of 95 %.

- Volume of sludge collected in the primary settling tank
- $V = \frac{65}{100} \times \frac{350}{1000} \times 42.29 \times 10^6 \times \frac{100}{5} \times \frac{1}{10^3} \times \frac{250}{1000}$
- = 48104.875 liters = 48.10 m³ / day
- Volume of digested sludge at 87 % by using formula
- $V = \frac{V_1(100 - P_1)}{100 - P}$
- V = volume of the sludge (wet)
- V₁ = volume of the sludge (dry or semi dry)
- P = Percentage of water in the sludge (wet)
- P₁ = Percentage of water in the sludge (dry or semi dry)
- $48.10 = \frac{V_1(100 - 87)}{100 - 95}$ V₁ = 14.8 m³ / day
- Assuming the Digestion period as 30 days
- Capacity required = $t \left[v - \frac{2}{3} (v - v_1) \right]$
- = $30 \left[48.10 - \frac{2}{3} (48.10 - 14.10) \right] = 777 \text{ m}^3$
- Providing 6.0 m depth, the diameter of the sludge digestion tank
- $\frac{\pi}{4} d^2 = \frac{777}{8}$
- $d = \sqrt{123}$ d = 8.93 m. \cong 10 m

∴ Provide 8 m deep and 12 m diameter sludge digestion tank.

Design of Sludge Drying Beds:

Volume of sludge will be reduced to 5/8 times the quantity of sludge.

Quantity of sludge in drying beds will be 485.625 m³

Providing 8 units of drying beds volume will be 60.70 m³

Provide height of 0.5 m area will be 121.26 m²

Dimension of the drying bed will be 16 m x 8 m

Table No. 02 Sewage Treatment Plant Details

Component	Nos.	Dimension In Meter
Screen chamber	1	17.5 X 8.5 X 2
Grit chamber	1	17.5 X 8.5 X 2
Storage tank	1	Ht = 10 ϕ = 22
Primary settling tank	3	Ht = 10 ϕ = 22
Dosing tank with trickling chamber	1	Ht = 4 ϕ = 14
Secondary settling tank	3	Ht = 10 ϕ = 22
Sludge digestion tank	1	Ht = 08 ϕ = 12
Drying beds	8	16 X 8 X 0.5

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Vol. 6, Issue 2, February 2017

Suggestion for sewage treatment plant for Dhule city

In addition to that to make the system smart we can use the SBR technique i.e. sequencing batch reactor techniques. Therefore, from this per capita cost of the plant is 600 Rs. And from this the cost required for the SBR plant in Dhule city is near about 45 crores.

B. TRANSPORTATION

Table No. 03 Main Roads in City and Their Length

Name of Road	Start to destination	Length
Sakri Road	Pritam Palace To Hanuman Tekadi Water Tank	3.98 km
Malegaon road	Aashta Hospital To Gurudwara Dhule	2.20 km
Parola road	Agriculture College To Municipal Corporation Dhule	2.55 km
Chalisgaon road	Chalisgaon Chaufuli To Big Cinemas	1.94 km
80 feet road	Dudhedia High School To Canossa Convent High School	2.36 km
Shivaji roads	Ganpati Flyover To Old Agra Road	1.06 km
Nakane road	Pramod Nagar To Nakane Road	3.88 km
Old agra road	Big Cinemas To M. Gandhi Statue	1.82 km
Wadibhokar road	Nehru Chawk To Wadibhokar	2.89 km
Gondoor road	Datta madir chawk to intersection at Wadibhokar road	2.03 km
Verkhedi road	Subhash Nagar To Verkhede	2.07 km
Total		26.78 km

The present condition of the roads in city is not as good as compared to roads in other metro cities. But some roads like Sakri road , Malegaon road , Gondoor and wadibhokar road are in good condition as they comes in the NH & including this main roads other roads in cities are also need to be repaired and maintenance or reconstruct.

C. WATER SUPPLY AND MANAGEMENT

Table No. 04 Source of water for Dhule city and their capacity

Sr. No.	Source of water	Distance from the city (Km)	Total capacity (MCFT)
01	Nakane Lake	4	360
02	Dedargaon Lake	12	120
03	Taapi river (sulwade Barrage)	40	2200
04	Haranmal Lake	4.5	410
Total			3090

As we know that according to the standards the amount of water required is 135 lpcd for domestic purpose. So amount of water required for the population of Dhule city is,

Amount of water required = Population × rate of water per lpcd

$$Q = 659867 \times 135$$

$$Q_{\text{required}} = 89082045 \times 10^6 \text{ lit/day} \dots \dots \dots \text{(For domestic purpose)}$$

Amount of water required for the year = $89.082 \times 365 = 3251.49 \text{ MLD}$

= Available water for Dhule city = 3090 MCFT

$$\therefore 3090 \text{ MCFT} = 28.319 \times 3090 \dots \dots \dots \left(1 \text{ MCFT} = \frac{28316846.6 \text{ lit}}{10^6}\right)$$

$$= 87496.44 \text{ MLD} \dots \dots \dots \text{(Available water for a year)}$$

Therefore after fulfilling the domestic and drinking water demand the remaining water may be supplied to other sectors or it will stored as for further use.

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Vol. 6, Issue 2, February 2017

D. SLUM AREA DEVELOPMENT

Table No. 05 Declared slum areas of Dhule city

Sr. No.	Name of the slum area	Area in hectare
01	Ramabai Ambedkar Chowk, Deopur	3.6
02	Saibaba Nagar Deopur	4.9
03	Area behind moglai masjid	5.85
04	Area near Deopur lane No.10	1.0
05	Municipal Sweepers colony	1.5
06	Mang Garudi Vasti near Phansi pool	1.0
07	Deopur Bhagi Quarter	1.5
08	Subhash nagar Bhangiwada	1.2
09	Bhilati Behind the Government Polytechnic Dhule	32
10	Dadasaheb Gaikwad nagar, Dhule	2.4
Total		54.95

The slum area in the city makes bad impact on the development of the city. There is lack of education, cleanliness, awareness about social issues and some other things, the peoples living in this area are mentally, economically and socially undeveloped and the facilities allotted to the peoples from the government do not reach them. The slum area also reduces the aesthetical beauty of the city. So it is essential when the city is on the way to become a smart city the slum area in it must be developed.

Key feature of the developed area

- Number of apartments = 6
- Number of houses in each apartment = 50
- Main road width = 8m
- Secondary road width = 4m
- Type of house = 2BHK
- All other required facilities like water pipeline connection and electricity connection.
- The electricity charges can be minimized by providing the solar panel system on the roof areas
- Water metering system is provided for careful utilization of the water and minimizing the losses
- For the better appearance, the gardens are provided in those areas
- for the health issues the primary health centers may be provided

Similarly, the other slum areas in the city can also be developed and the standard of living of the people in those areas can be improved. For the construction, use the low costing materials so that the cost of the construction will get reduced and the affordable housing will be provided.

For the construction we may refer the specifications of the project Demonstration Housing Project at Laggerre, Bangalore, and Karnataka.

In this project the cost per sq.foot = Rs.218 /- Therefore the approximate cost of the slum area development project in Dhule is as follows Approximate cost for one unit = area of one unit × cost per sq.foot

$$= 750.19 \text{ sq.foot} \times 218 = \text{Rs. } 163541.42/- \cong \text{Rs. } 163550 /-$$

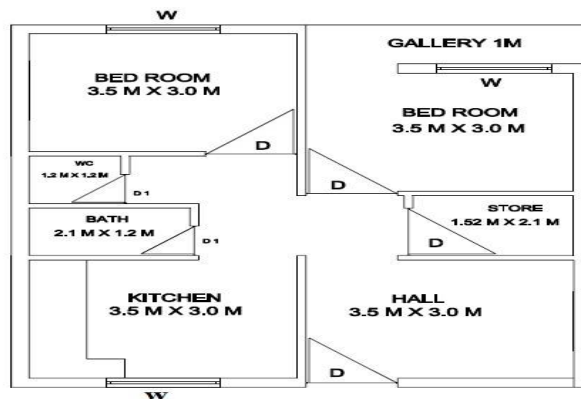
$$\text{Approximate cost of the whole project} = 300 \times 163550 = \text{Rs. } 49065000/-$$

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Website: www.ijirset.com

Vol. 6, Issue 2, February 2017



E. SOLID WASTE COLLECTION AND DISPOSAL SYSTEM

Present condition of solid waste collection system in Dhule city

- Quantity of waste collected per day = 150 MT
- No. of waste collecting trucks = 33
- No. of waste collecting tractors = 43

F. AESTHETICAL SUGGESTION FOR THE DHULE CITY

After making all the development in the city if the appearance or view of the city is not so good so there is no meaning for the development. So for the better appearance of the Dhule city some suggestions are as follows:

1. Developing the garden in the city for children's and residence of the city so that they can spend their weekends and holidays there and fill peaceful,
2. Developing the jogging tracks e.g. the jogging track along with the *Panzara* river,
3. Plantation of the trees in the city and in on the sides of the main roads in the city and proper maintenance and care should be taken of them,
4. By making some provision and store the water in the river so it will give the better look and it is also used for boating purpose&
5. Developing the decorative intersections in the city.

VI. CONCLUSION

Working on the mission of vision 2020, Indian government proposed to plan 100 smart cities. According to this plan, 10 cities in Maharashtra are allocated for this scheme. Dhule city is one of the 3 well planned cities in our country. Dhule city is the only city through which 3 national highways i.e. NH-3, NH-14, NH-211 do pass. It has great importance in DIMC programmed. These are various important factors in this city because of which Dhule Municipal Corporation submitted a proposal to include it in the list of upcoming smart cities. But Dhule got rejected from the list of smart cities. We did try to find out the reasons behind the rejection of Dhule city from the list of smart cities. We have suggested some solutions to overcome the problems and to take some steps to include the city in the smart cities. These are the following areas on which we have worked.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

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Vol. 6, Issue 2, February 2017

Table No. 06 Suggestion and design details for Dhule city

Sr. No.	Particular	Existing condition	Suggestions/Design	Approximate cost
01	Smart Sewage treatment	There is not any sewage treatment plant existing in the city	Sewage treatment plant for the city with the additional population of 16 new villages in municipal corporation with Advanced SBR technique	45 Cr.
02	Road construction	Present roads are in very poor condition with small width	Road construction should be done by using the plastic road technique and increasing the width of the roads and provision of the path ways for pedestrian traffic	3.0 Cr.
03	Water management and supply	Bad control on supply and loss of water	Water management is done by providing the water meter for every connection	180 Cr.
04	Slum area development	There is not a single proposal for the development of the declared slum area in the city	Slum area development is done by the provision of affordable low cost housing system	5.0 Cr.
05	Solid waste management	150 MT solid waste is generated every day and there is only provision of land filling method for sewage disposal	Solid waste management is efficiently done by using the 3R (Refuse, Reuse, Recycle)	1.0 Cr.
06	Aesthetical	In the city there are no gardens or places which will add aesthetics to the city.	Aesthetical development is done by developing the gardens and other historical or new places which are going to add the beauty to the city	1.0 Cr.
Total				235 Cr.

So, after considering all these suggestions and their approximate costing, the overall cost is going to be 235 Cr. and the period of completion for the innovations suggested is assumed up to 2025. So these are the various suggestions with their approximate cost and period of completion, from our side to step up in the path of making the DHULE A SMART CITY!!!

VII. LIMITATIONS

Considering the historical, existing, and geographical features of the city we have suggested some solutions for some areas in the city to make it smart.

For the above project work there are certain limitations,

- This work is only limited to Dhule city because this work is done after analysis of the various areas of the Dhule city, their existing and previous data. Work should get completed before 2025.
- The work is done after considering importance of Dhule city in the DMIC project.

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