

Smart and Sustainable Development of Peri-urban Villages (smart approach for) A case of Surat

A pro-active urban development approach

¹Aarti B. Desai, ²Bhasker Vijaykumar Bhatt,

¹P.G. Student, Town & Country Planning II, ²Former PG in-charge (ME-TCP) & Assistant Professor
Faculty of Civil Engineering, Sarvajanik College of Engineering and Technology, Surat, Gujarat, India

Abstract: This study is about proposing the development of cluster for the area at peri-urban areas. Two villages namely 'Karadva' and 'Saniya Kande' were identified as apt study locations in the South-east inner fringe of administrative boundary of Surat city in the Gujarat state of India. The threats of urban development such as poor land management and haphazard construction activities were identified in the study area. In addition, the study area location is not included for preparation of town planning scheme by the urban development authority. The current scenario is depicting a need for planning of land use and infrastructure for future. The same is attempted based on the prevailing norms of URDPFI 2015 guidelines. The inclusion of Smart components in the proposal is also studied and discussed in the context of the existing situation and proposed development. The component of smart water supply network proposal with a pro-rata cost estimation is discussed.

Index Terms - Gap analysis, Infrastructure, Land management, Peri-urban, Rural, Smart development, Urbanization.

I. INTRODUCTION

In developing countries like India, people are attracted to urban centres due to available economic and social opportunities in a wide range of variety of alternatives. During the year 2011, India reported on its urban population increase from 28.53% to 31.06% (India 2011) in a decade. In one report of UN world population, urban population in India will reach to 40.36% by 2030. One of the major components for an increase in urban population is migration. In 2011, migration was reported as 56% which was 42% in 2001 (India 2011). Increase in urbanization may create different problems like pressure on natural resources and its balance, environmental quality degradation with the rise of pollutants, lack of land for housing, poor infrastructure facilities and so on. As land values are costing very high in urban areas and a huge source of land is available at suburbs, or peri-urban areas, people tend to settle in the suburbs irrespective of the additional burden of commutation costs. Due to the sudden growth of population haphazard growth may be reported.

The study proposes for developing a context over an existing situation that is prevailing in the study area and identifies for a suitable smart alternative towards a cluster development based sustainable approach for Karadva and Saniya Kande. The primary objective of the work includes studying the existing scenario of the area; to analyze requirements of different type of infrastructure for future; and, to propose for development components aiding the control over haphazard growth.

II. STUDY AREA

The study area can be located in the South-East of the Surat city and within a spatial reach of about 5km distance from the administrative city limits. The area has excellent road connectivity options.

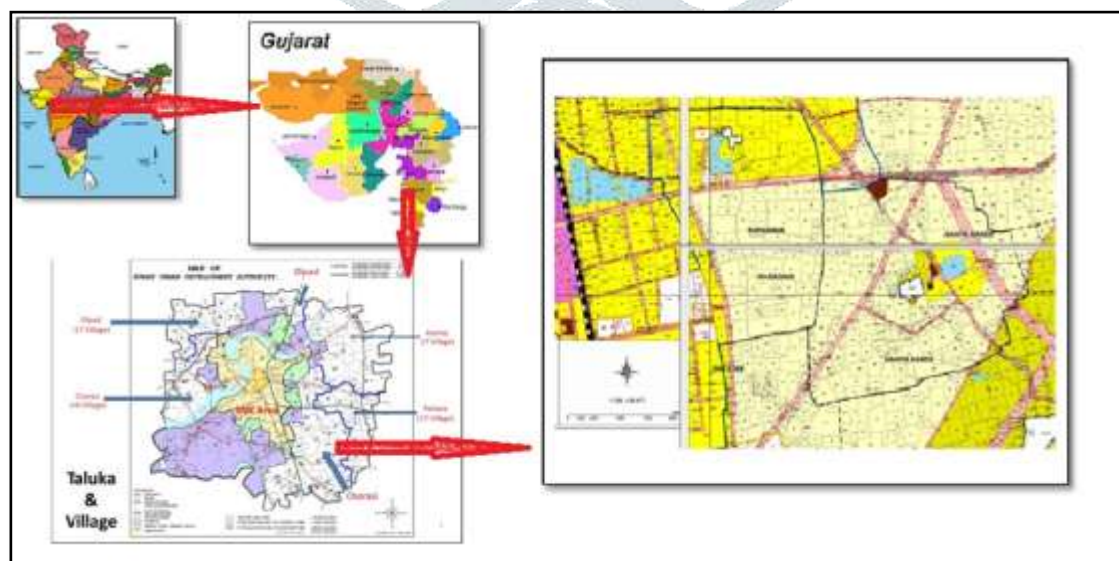


Figure 1 Selected study area

The map in above figure shows the location of the study area. On the West of the study region, the industrial establishments of Udhna, Pandesara and Sachin are located. It is expected that most of these industrial establishments will have their workers residing in the study area. From the chart below (figure 2), a steep rise in the study area population shows that there is an inclination of citizens for settling in

these areas. Such settlements demand proper land use planning and availing of service and social infrastructure facilities in place by the authorities. At present, the study area is beyond the Surat municipal corporation (SMC) regulatory limits; however, sooner it will be included with next expansion of the city limits as practised in the past.

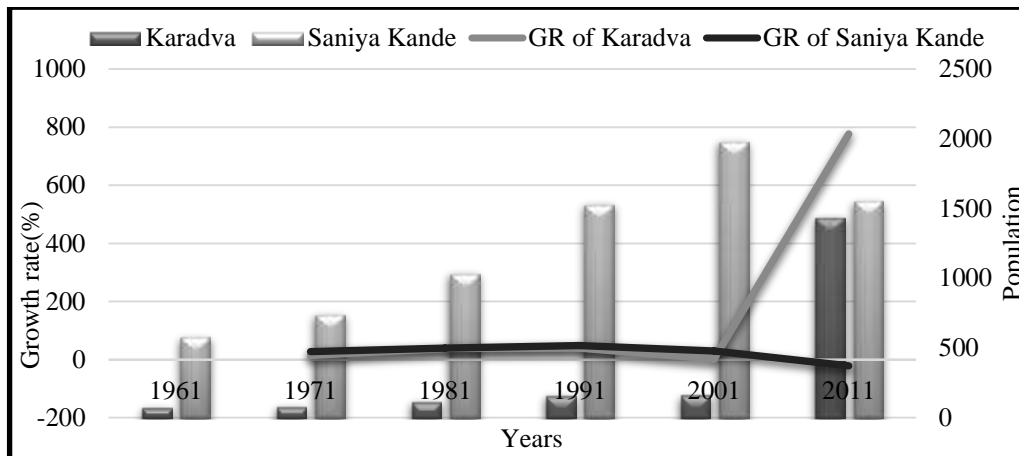


Figure 2 Growth rate of the study area

In the current work, the study area is situated within authority limits of the Surat Urban Development Authority (SUDA). Area of SUDA is 715.00 sq.km. and area of SMC is 326.50 sq.km (SUDA 2017). The study area is selected based on population growth, proposals in Revised Development Plan 2035 of SUDA, future scope of development and so on.

III. SMART DEVELOPMENT APPROACH

For the smart development of study area, different approaches should be explored. Here some smart development possibilities have been listed out for the exploration of the proposal.

- Smart transportation: For smart transportation, it is necessary to decrease traffic congestion, decrease fuel combustion, intelligent system of transport and so on (Transport 2017) Some of the solutions for smart transportation system are:
 - Electric public transport: We can propose public transport to travel inside the study area with electric charging. As use electricity as a fuel, it can decrease combustion of fuel which can directly decrease air pollution also;
 - Charging stations: For charging of transportation services proposal of charging station with efficient electricity should be proposed;
 - Efficient road accessibility: Width of the road should be proposed considering future growth;
 - Parking with sensors: In street lights provision of sensors and connect it with GPS system so as the driver can find parking space from mobile GPS system.
- Smart energy: For smart energy, the proposal should be made from which electricity can be saved (Council 2016).
 - Solar energy: Proposal of solar parks can decrease use of electricity;
 - Wind power: Wind power can be used for working of motors and such things in agricultural use;
 - Biogas plant: It can decrease use of LPG gas;
 - Rainwater harvesting: It can save the loss of a lot of water in runoff as today's problem is drinking water, is insufficient quantity.
- Smart water: Water is one of the essential components on earth for the living of human being. For water supply following are the possibilities in a smarter way (Council 2016).
 - Water meter: At every household provision of water meter should be applied. Water meter should be connected with GSM system so that the reading of every water meter can directly get on the control centre.
 - Sensors: Sensors on every valve should be provided for getting any problem in line or to run different quantity of water.
 - Leakage and quality of water: From sensors problems in water supply system can be found out easily at the control centre. At every particular time loss of water and quantity of water can found out.
- Smart environment: Nowadays climate change is experienced at every place. This climate change is due to environmental degradation. For the solution of degradation of environment, some solutions are listed (Council 2016).
 - Smart sewerage system: Sewerage system should be proposed with sensors at particular distances for getting any blockage or any problem in the supply system.
 - Smart waste management: Provision of smart bins at different locations should be provided. The sensors in bins connected with GSM and on full filled bin that sensor will message to the control system for empty the bin. This can reduce time and fuel consumption and workforce also.
 - Green infrastructure: Green buildings should be proposed, and garden at every place should be compulsory.

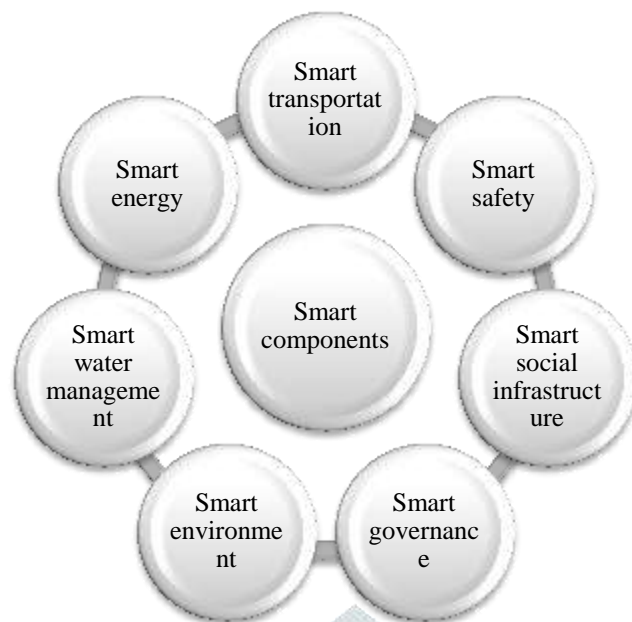


Figure 3 Smart development approaches

5. Smart social infrastructure: For development of any area social infrastructure should be proposed effectively as per standard norms (Farah Nasri 2017).
 - Smart education: For smart education provision of smart pre-schools, automatic attendance system, study with projector and so on can be suggested;
 - Smart healthcare: One mobile application can be designed in which different hospitals and nearby locations, emergency services, medical shops will show. As well as different information about patients, their diseases, reason of disease will show in application thus in next year government can take necessary steps to decrease rate of patients.
6. Smart governance (Poonam Malik 2014)
 - Online services: Every government service should be available online so public can get everything on mobile or laptop.
 - Transparent government: Every detailed report of any design or provision should be available on website so public can get every information about government’s steps.
 - Seamless internet connectivity: For internet connection without interruption.

IV. SPATIAL EXTENTS OF SUDA AND SMC

SUDA was constituted in the year 1978 and the area under jurisdiction was 722 sq.km. But in 1979, Kamrej and Delad was removed from the list of village under jurisdiction of SUDA (SUDA 2017). Thus, the area was decreased to 715 sq.km.

Table 1 Area under the jurisdiction of SUDA

Year	Area (sq.km.)		
	SMC	SUDA (excluding SMC)	SUDA (including SMC)
1978	55.7	666.3	722
1979	55.7	659.3	715
1981	55.7	659.3	715
1994	112.28	602.72	715
2001	112.28	602.72	715
2006	326.52	388.48	715
2011	326.52	388.48	715

(Source: (SUDA 2017))

V. POPULATION PROJECTION FOR THE STUDY AREA

Population projection was attempted for next of the 30 years considering an ultimate projection year of 2041. Here population is projected based on two approaches. These includes for natural projections which uses mathematical formulae and a density based projection that is based on ceiling of residential population density that may be allowed after adopting spatial planning in the area.

1. Natural projection:

In this approach population is projected by two conventional methods Arithmetic Increase Method and Geometric Increase Method. Projected population is shown in below graph:

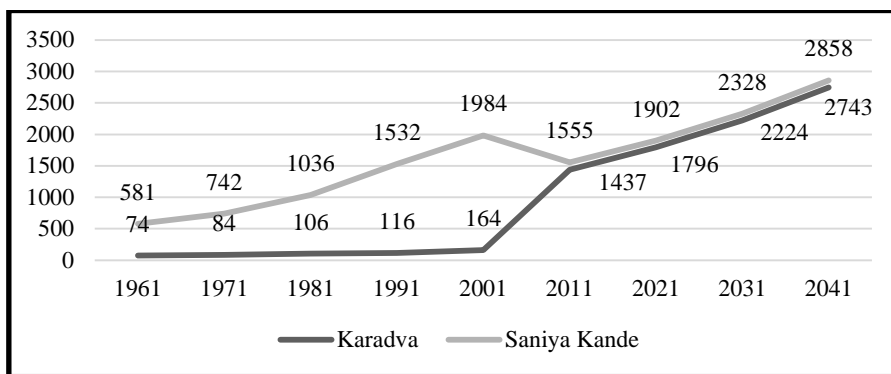


Figure 4 Natural growth of population

As the area going to be developed as urban area and all facilities will be given as urban area, population growth will not be natural. Population growth will increase rapidly. Thus, population calculation should be done by density which is taken for the proposal.

2. Population based on projected density:

The density of study area is very low as compared to average Surat district density. Average density of Surat district is 13.37 PPHA, while density of Karadva is 6.36 PPHA and density of Saniya Kande is 5.82 PPHA.

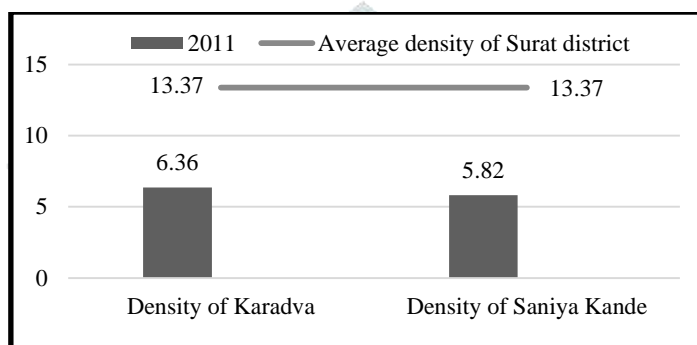


Figure 5 Comparative density (Source: (India 2011))

The existing population density of Surat city as per the population records of Census of India, 2011 suggests for an assumption over projected density ceiling to be 137 PPHA. Hence, the population = Density x Total cluster area to be developed. Table below shows the projected population over ultimate year of 2041 assuming the area to be developed through implementation of town planning scheme where the land use is defined and further norms are set for construction activities.

Table 2 Population based on density

	Area (ha)	Population
Karadva	225.92	30,951
Saniya Kande	267.15	26,600
Total	493.07	57,551

VI. SEX RATIO OF STUDY AREA

The average sex ratio of Surat district is low as compared to sex ratio of study area. Sex ratio of Karadva is worked out to be 883 and for Saniya Kande as 976. The sex ratio of Surat district is reported as 787 in the records of Census of India, 2011. Below chart shows a graphical representation of comparative sex ratio in the study villages as per the records of the year 2011.

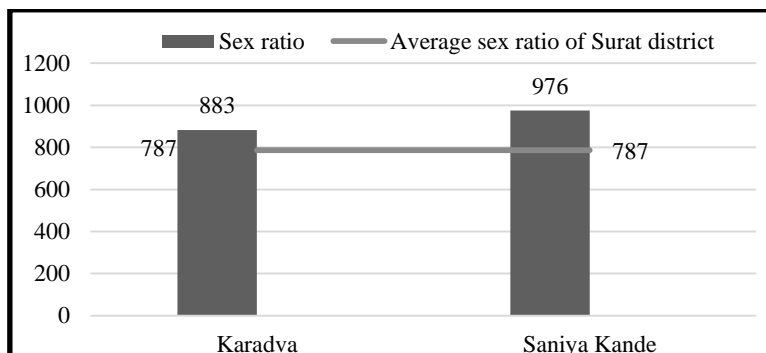


Figure 6 Comparative sex ratio (Source: (India 2011))

Population of total male and female citizens have almost equal gender distribution with a minor dominance by the males. In Karadva, male population is about 53% and balancing females have 47% of the total population composition. On the other hand, in Saniya Kande, the male

and females have a composition of 51% and 49% respectively. In direct interpretation over the statistics suggest for an understanding that the social configuration is well balanced. Table below shows the male-female populations in both study constituencies.

Table 3 Sex ratio of study area

Village	Karadva	Saniya Kande
Male	763	787
Female	674	768
Total	1,437	1,555

(Source: (India 2011))

VII. LITERACY RATE OF STUDY AREA

Literacy rate of Karadva is higher than average district literacy rate, while literacy rate of Saniya Kande is lower than average district literacy rate. (Census of India 2011). Literacy rate of Karadva is 90.32% and that of Saniya Kande is 81.02%. Average district literacy rate is 85.53%. Below table and graphical representations show a comparative status regarding literacy prevailing in the constituencies under study. As far as it is not 100%, there is a considerable scope for availing educational facilities as required and spread of awareness among the citizens.

Table 4 Literacy rate of study area

Village	Karadva	Saniya Kande
Literacy (%)	90.32	81.02
Male (%)	93.03	86.54
Female (%)	87.14	75.44

(Source: (India 2011))

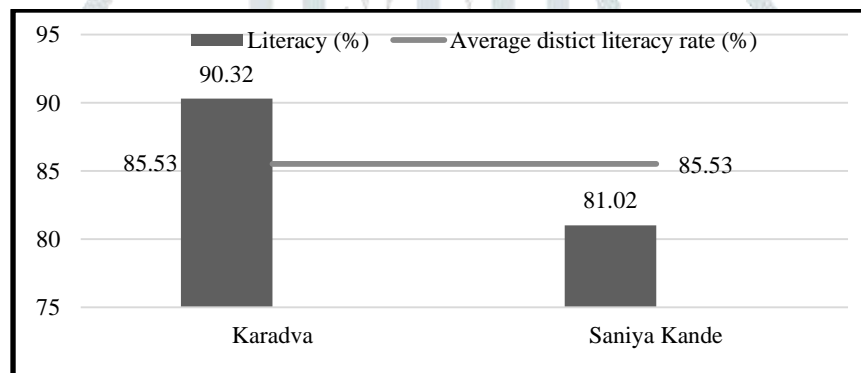


Figure 7 Comparative literacy rate

Source: (India 2011)

VIII. PHYSICAL INFRASTRUCTURE

The existing scenario of physical infrastructure facilities was assessed in the current work. There is availability of tap water, RO plant for treating palatable raw water, overhead tank, drainage network, electricity distribution in both the villages. Physical infrastructure is available in good condition in both the villages. Water supply is given by sub center at Dindoli by GWSSB (Gujarat Water Supply and Sanitation Board). RO water is provided to villagers on demand at 4 Rs. Per litre (Gram Panchayat Saniya Kande).

IX. SOCIAL INFRASTRUCTURE

Existing situation of social infrastructure is studied. Karadva is lacking behind in social infrastructure as there is no availability of schools, PHC, gardens, panchayat office and so on. All administrative work of Karadva is done in the panchayat office of Saniya Kande. Saniya Kande has very good social infrastructure. The recreational facilities are completely absent in Saniya Kande.

X. LAND USE

Land use is prepared based on District Land Records office documents available for both the villages. Total area of Karadva is 225.9 Ha and total area of Saniya Kande is 267.03 Ha.

Table 5 Land use of study area

	Karadva	Saniya Kande
Agriculture (Ha)	193.646	174.22
Residential (Ha)	21.51	83.08
Gaucher (Ha)	6.636	0.34
Water bodies (Ha)	4.718	3.437

(Source: www.anyRoR.com)

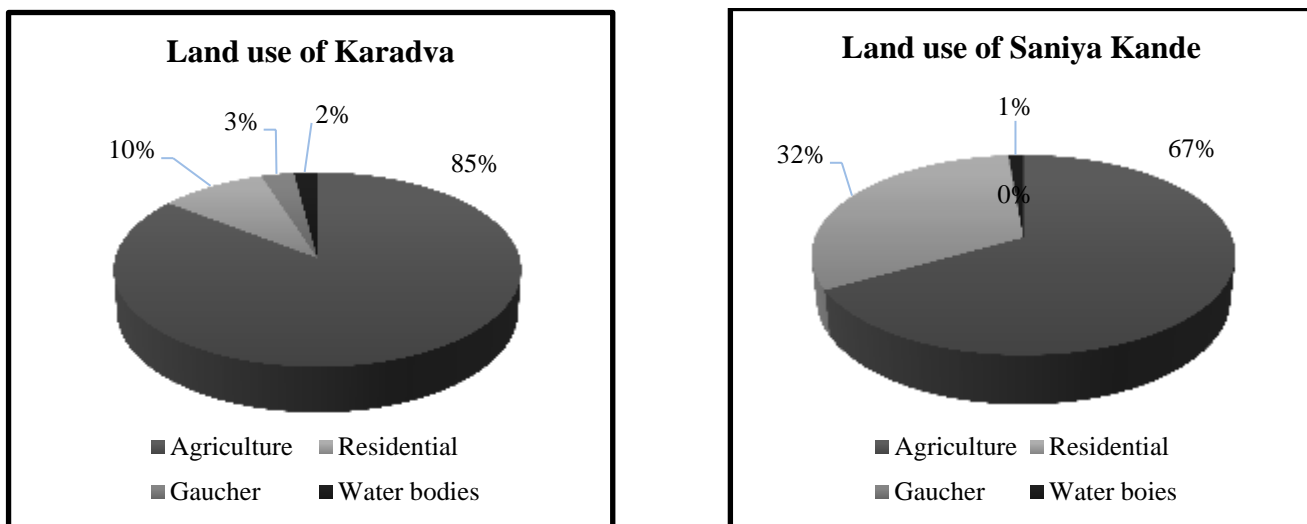


Figure 8 Land use of study area

XI. GAP ANALYSIS

Techno- economic survey is the study of current problems which affects the economy of the village and gives some technical solution of that problem and hence improves the economy of the village. It is the overall survey of the village which includes the appraisal of the economic condition of that area with respect to the technological exposure. Gap analysis is the process of finding out the lacking facilities in the village by comparing the needs of the village as per URDPFI guidelines with the present available amenities.

Table 6 Gap assessment for facilities in the study area

Facilities	Population 57551		
	Existing	Required	Gap
Education facility			
Aanganwadi (Pre-primary school)	3	23	20
Primary school	2	12	10
Senior secondary school	1	8	7
Integrated school	0	0	0
College	0	0	0
Technical training center	0	0	0
Health facility			
Govt/Panchayat Dispensary or Sub PHC or Health Centre	0	4	4
PHC & CHC	0	3	3
Polyclinic	0	0	0
Child Welfare and Maternity Home	0	1	1
Intermediate Hospital	0	0	0
Family Welfare Center	0	1	1
Service infrastructure			
Over Head Tank	N		
U/G Sump	N		
Pucca Village Approach Road	Y		Adequate
Bus/Auto Stand provision		Inadequate	Inadequate
Drainage network Open	N		
Drainage cover	Y		
Socio-cultural facility			
Community Room	1	12	11
Community Hall cum Public Library	1	4	3
Religious Facility	2	2	0
Safety and security			
Fire Post	0	1	1
Police post	0	1	1

XII. SCOPE FOR SMART DEVELOPMENT PROPOSALS

Proposals for the development of study area in smart manner is done. Proposals for water supply, smart bins, and health care services is given in brief.

Water supply: For water supply it is necessary to give pipe supply network to the study area. After that total length of pipeline is carried out. Requirement of total no. of water meters is found out. Water meter will be connected to every household. Requirement of valves is also carried out. In every valves sensor will be connected so any leakage or pressure can be find out at any point of network.

1. Total number of projected households in the study area is 92,536. Hence, total number of water meters required will be 92,536 (assuming one family will have one metered connection of water supply) and, the unit cost of a water meter is INR 3,000/-. So, the total cost for water meter works out to be INR 2,776.08 Lakhs. Metered water supply will prevent the wastage of water utilization at the end-user level.
2. Identified need for valves suggests for installation of 33 valves over the main supply lines. The cost of one valve for main supply line is about INR 2,50,000/- making a gross estimate for the valves installation in main supply line as INR 82.5 Lakhs. Further, the requirement for valves in the sub-main lines were identified as 63 numbers. With a unit cost of such valve as INR 2,00,000/-, cost estimate for this component is worked out to be INR 126 Lakhs.
3. The unit cost of sensor for valves enabling it for SCADA based smarter operations is INR 4,000/- for installation over each valve. The total number of sensors required is 96. Considering a cost of sensor installation works out to be INR 3.84 Lakhs.
4. Total length of pipe of 2" diameter required is 9,890.51 m having a cost of installation as INR 1,000/- meter length. Hence, the total cost for pipeline is worked out as INR 98.90 Lakhs.
5. Total length of pipe of 1" diameter required is 9,948.43 m having the cost of INR 500/- per meter length. Considering the same, the total cost is derived at INR 49.73 Lakhs.

Total cost for water supply line is approximated as INR 3,136.55 Lakhs that has smart system of network operations. Likewise, other components shall further be explored for and smart approach can be added as in conventional system making the system sustainable over a longer run. The cost component for adding sensors and allied controlling facilities is worked out at 0.12% of the water supply network cost. However, the cost of installing water meters at household level needs to be a responsibility of the user. The cost of the project was found to be increased by 7.5 times if the meters are installed by the government availing 24x7 water supply against a conventional intermittent supply system.

XIII. RESULT AND CONCLUDING DISCUSSION

Primary data collection was done by visit to village, meeting with village secretary and secondary data was obtained through the records of Census of India, State government revenue department and other documented records. Projected population shows that there will be a rapid increase of citizens in the study area. And in nearer future, the area will have features of an urban sub-center. For different infrastructure amenities, it is necessary to identify the existing situation and to work out proposal and details to match the identified gaps for existing conditions as well as for future. Based on the projected population, there is a need identified for provision of 23 pre-primary schools against existing only 3 such level amenities. Also, additional 10 primary schools need to be in place making a total of 12 over a period. Health sector is seldom addressed so far, and a considerable need is identified for provisions for facilities with some minimum provisions for at least 3 PHCs, 4 Dispensaries and 1 Maternity home. For a project of water supply system installation, an addition of water meter will assist in conservative use of water making the resource utilization sustainable over a longer run. Further, a remarkable addition of sensor at a rate of 0.12% of project cost can make the entire system smart and responsive. Similar components shall be examined for exploring opportunities.

XIV. ACKNOWLEDGMENT

The authors are thankful to the secretary of village Mr. J. B. Kantharia for giving information about study area. The authors are also thankful to Dr. Vaishali Mungurwadi, Principal and Prof. (Dr.) Pratima A. Patel, Head, Faculty of Civil Engineering, Sarvajanic College of Engineering and Technology for morally supporting the academic expedition. Special thanks to all faculty members and friends at town and country planning program.

XV. REFERENCES

- [1] Arati Kochar, Dr. Hansa Jeswani. 2017. "Planning a Sustainable Development of Existing Village." (International Journal of Science, Engineering and Management (IJSEM)) 2 (2).
- [2] Authority, Surat Urban development. 2017. "Surat Development Plan 2035." Surat.
- [3] Goel, Neha. 2011. "Dynamic Planning and Development of Peri Urban Areas: A Case of Faridabad City." (Institute of Town Planners, India) 8 (3): 15-20.
- [4] India, Census of. 2011. "Rural-Urban Distribution."
- [5] Krunal Rameshchandra Savani, Bhasker Vijaykumar Bhatt. 2016. "Identification of Factors Responsible for Urban Expansion of Surat." (International Journal of Engineering Research) 1 (6): 508-10. Accessed 2016. doi: 10.17950/ijer/v5s6/618.