International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 5, Issue 05, May-2019

Socio Economic Water Tariff Model for Unmetered connection for Gandhidham Nagar Palika, Kachchh, Gujarat – India.

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ABSTRACT:
The research work aims to review the existing water tariff of Gandhidham city and proposes a simple frame work for water tariff which is based on socio economics data collected through questionnaire survey conducted during January 2019 to March 2019 on 206 respondents. Response of the questionnaire survey suggest that in Gandhidham frequency of water supply by ULB is three or more days, the quality of water is poor and the quantity is inadequate . 14.1% of respondents felt that the existing water tariff is too low and 80.6% of the respondents are willing to pay higher for improved water supply services. The study proposes new water tariff models namely "Socio Economic Model" for unmetered water connections. The proposed socio economic model would have yielded 3.37 times higher revenue to the Gandhidham Nagarpalika for the year 2017-18. Adoption of the proposed model by all the ULBs in the state and the country has a potential to increase the revenue collection and thereby augment the infrastructure development activity and can make the city capable of generating its own revenue with reduction on dependence on grant from the Government.

1. Introduction

Water Tariff can be estimated to generate revenue, increase efficiency of the supply and supplier, manage demand, facilitate economic development and enhance public welfare and equity (Potter, 1994). However, fixing of water tariff is an intricate phenomenon. To ensure sustainable infrastructural development it is necessary that the cost incurred for the operation and maintenance and some portion of the capital cost that will be required to build future facilities, has to be recovered. At the same time, providing adequate incentive for promoting water conservation also cannot be neglected in the light of the fact that, the recovery of cost of supply of water on the premises of earning revenue cannot be sustained. The Gujarat State Water Policy – 2015 has very categorically expressed that the water has to be priced on economic principles. The present study proposes a simple framework for water tariff, which is constructed using primary data collection through Questionnaire regarding the socio-economic structure of dwellers of Gandhidham city. This study also assess the existing water tariff pattern and a new water tariff setting/model is developed, which will be helpful to improve financial position of ULB's by implementation of fair water prices on customers without any harmful socio economical effects. The proposed water tariff structure would serve as an important tool for the state government and other Urban Local Bodies (ULBs) to meet equity, efficiency and economic principles as articulated in the Gujarat State Water Policy – 2015. Improved financial position of ULB's will helpful to achieve Operation and Maintenance program and because of that quality of water supply and other infrastructural services in urban areas will also be improved.

2. Study Area

Twin city Gandhidham and Adipur are selected as a study area for the study. Gandhidham is a developing city and it has a municipality in the Kutch District of Gujarat state of India. The town was established in the early 1950s for the resettlement of the refugees from Sindh (now a city in Pakistan) after the partition of India. It was named as a tribute to Mahatma Gandhi, the father of Indian nation. Gandhidham is one of the economic capitals of Kutch and it is a fast developing city in Gujarat state. Gandhidham is situated at latitude 23.08° N longitude 70.13° E. Summers are normally hot and dry and frequently the temperature reaches 45 °C (113 °F). In winters, it goes down to 3 °C (37 °F) accompanied by cold waves. The average annual temperature is 26.8°C. The average rainfall is 375mm. There are total 12 wards, 6 wards in Adipur (1 to 6) and 6 wards in Gandhidham (7to12).Wards are zoned into residential, industrial and commercial zone in form of plots. The land ownership as well as its management is coming under the rights of SRC (The Sindhu Resettlement Corporation Ltd), which are known as 'Wards' while the land ownership as well as its management is coming under the rights of KPT (Kandla Port Trust), which is known as 'Sectors'. There are total 13 Sectors in Gandhidham. There is some of the land ownership as well as its management coming under the rights of GDA (Gandhidham Development Authority), which is known as "NU". Permission authority as well as license authority to all the construction activity between Gandhidham and Adipur and in between is coming under GDA.

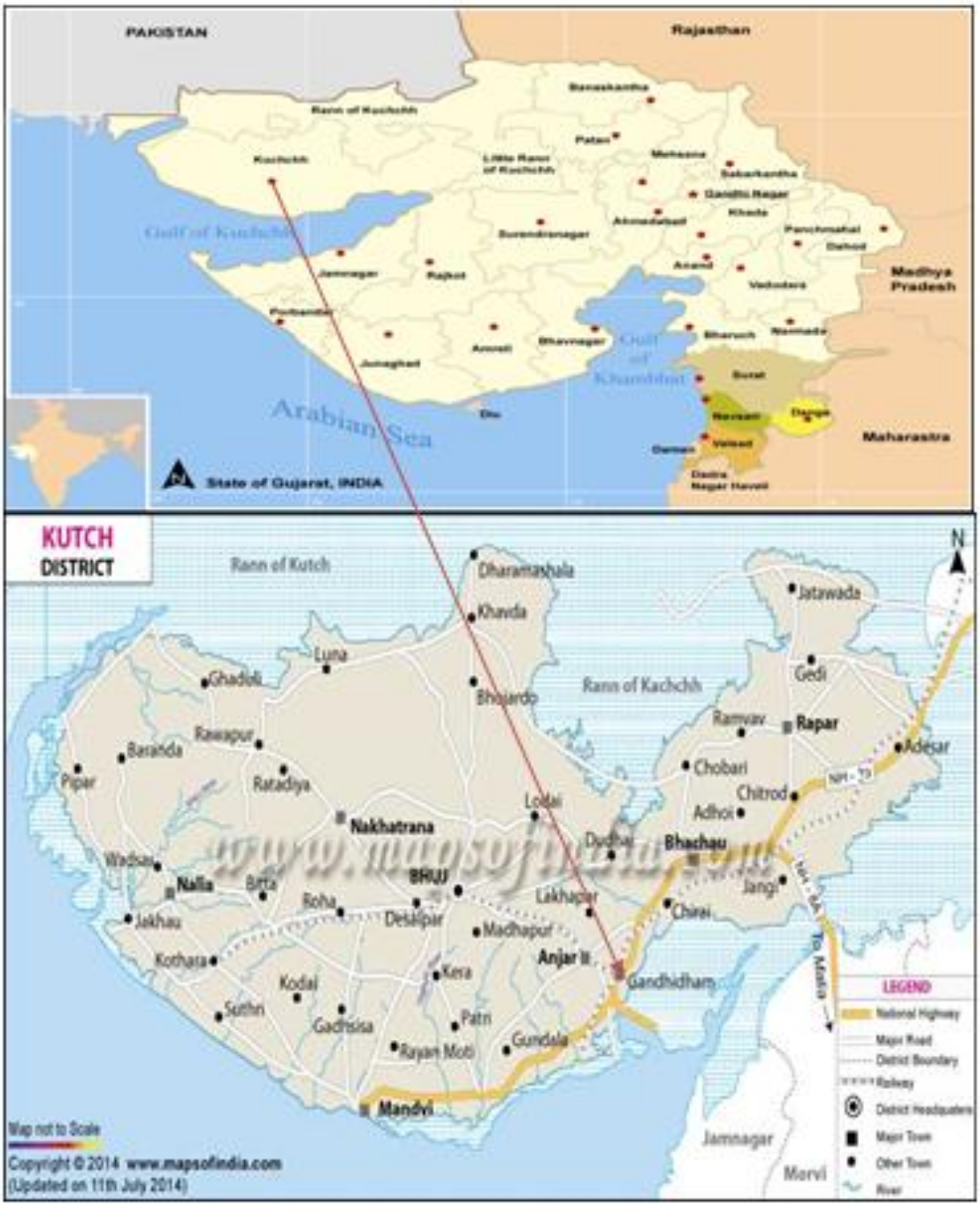


Figure 1: Study Area

3. Methodology

The entire task was divided into three category i.e..Data Collection, Data Analysis and Development of a Rational Unmetered Water Tariff Setting/Model for ULB. An online questionnaire survey was floated by Google Forms and the same was also electronically mailed/ shared to about 400 individuals for eliciting their preferences and willingness to pay for water supply services. The responses received from the survey were statistically analyzed to draw inferences. Required sample size is calculated by Yamane's formula as under.

$$n = \frac{N}{1 + N (e)\ 2} \quad \text{..... (i)}$$

Where,
n = Sample size
N = Size of population (3,50,000)
e = Acceptable sample error (10%)

As per calculation of sample size, 100 number of samples were required for 3,50,000 population (Year 2019) of study area. The 206 responses were received from the survey and same were statistically analyzed. All the respondents were categorized in different categories. Social score calculated on the basis of house hold assets. For various household assets different score is allocated. On the basis of total of social score, all respondents are divided in four social categories as under.

Table 1 Household Asset and Social Score

Household Assets	Social Score
Four Wheeler	4
Two Wheeler	2
Refrigerator	1
Washing Machine	3
Microwave/Oven	3
T.V	1
A.C	4
Computer/Laptop	2

Table 1 Social Score and Social Category

Category	Social score	No. of Respondents	%
1	0-10	48	23.30
2	11-25	115	55.83
3	26-35	33	16.02
4	> 35	10	4.85
		206	**100**

Economical Category was decided on the basis of Annual Income of respondents. As per Annual Income Range, all Respondents categorized in four categories and On the basis of Social and Economical category, Socio Economical score and Socio Economical category has been assigned and calculated as under.

Table3 Economical Category

Category	Income Range	No. of Respondents	%
1	Rs.0 to Rs. 500000	134	65.05
2	Rs.500001 to Rs.1000000	57	27.67
3	Rs. 1000001 to Rs.1500000	11	5.34
4	More than Rs.1500000	4	1.94
		206	**100.00**

Table 4 Socio Economical Score and Category

SE Category	SE SCORE	No. of Respondents	%
1	0-50	38	18.45
2	51-100	132	64.08
3	101-150	32	15.53
4	more than 150	4	1.94
		206	**100**

On the basis of Socio Economic Category and Rate of Inflation of Current Financial Year, Socio Economic Coefficient (ai) was decided.

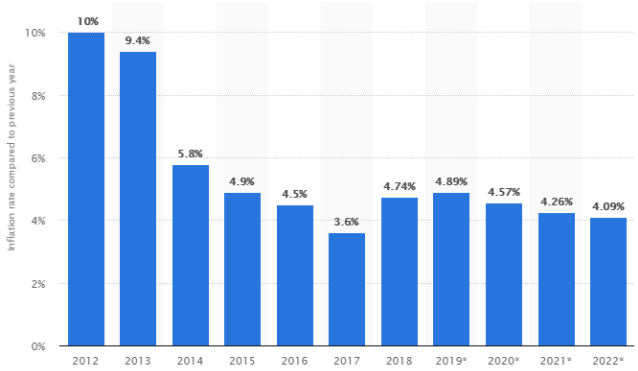


Figure 1 Rate of Inflation with respect to previous year in India

As Shown in Fig. 1 Rate of Inflation with respect to previous year for the Year 2019 is 4.89% (0.0489), on this basis Socio Economic Coefficient for Category 2 is kept 0.05. To give benefit of Cross Subsidy to people of Category 1, coefficient (ai) kept 0 for Category 1 and gradually increases for Category 3 and Category 4 as shown in table 5.

Table 5 Socio Economic Coefficient (ai)

Socio-Economic Category	I	X = Monthly Average Electricity Bill (in Rupees) Range	a_i
I	i=1	BPL Category users and 0 to 1000	0
II	i=2	1001 to 2000	0.05
III	i=3	2001 to 3000	0.0525
IV	i=4	More than 3000	0.0550

Convenience Charge Coefficient has been calculated by finding Ratio of Category wise Monthly Average Water Expenses to Category wise Monthly Average Electrical Bill of last financial year as given in Table 6.

Table 6 Convenience Charge Coefficient

Co-efficient for Convenience Charges				
Elec. Category	Avg. Elec. Bill	Avg. Water Expenditure	Ratio – c / b	Avg. Ratio
(a)	(b)	(c)	(d)	(e)
1	785.71	235.18	0.30	**0.19**
2	1770.89	345.89	0.20	
3	2755.75	440.75	0.16	
4	4612.90	544.84	0.12	

PRILIMINARY SOCIO ECONOMIC MODEL FOR ULB

Water Charges = Socio Economic Charges + Convenience Charges

$WC = a_i x + 0.19x$ ..... (ii)

Where, ai = Socio-Economic Coefficient Based on Socio-Economic Category
X = Monthly average Electricity Bill (in Rupees)

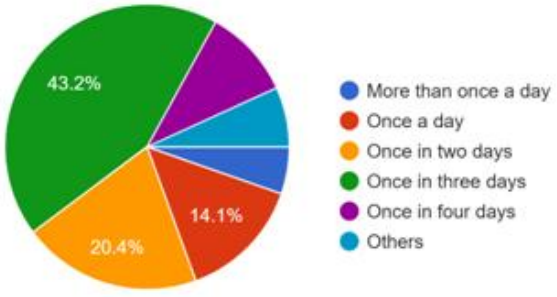
Calculation for Socio Economic Charges ($a_i x$):

Socio-Economic Category	i	X = Monthly Average Electricity Bill (in Rupees) Range	a_i
I	i=1	BPL Category users and 0 to 1000	0
II	i=2	1001 to 2000	0.05
III	i=3	2001 to 3000	0.0525
IV	i=4	More than 3000	0.0550

Note: Average Monthly Electricity Bill is to be considered for last financial year.

4. Data Analysis and Results

Online questionnaire survey was conducted to collect Water Supply and Socio Economic information of study area. Collected Data related to Water supply are analyzed as under.



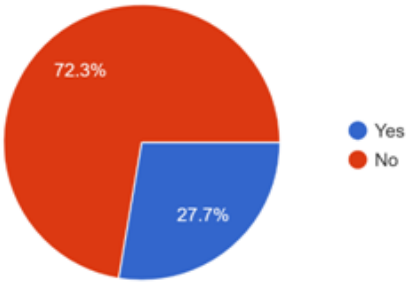


Figure 2 Frequency of Water Supply Consumption **Figure 3 Cleanliness of water for Human**

Figure 2 shows the responses on Frequency of water supply given by Gandhidham Municipality. It can be observed that 43.2% of respondents getting water once in three days. Whereas 20.4% of respondents getting water once in a two days. Because of these, majority of respondents requires big storage tank in their houses. Results regarding frequency of water

supply indicate that either region has scarcity of water or may ULB has faulty distribution network or may be both.
Figure3 shows results regarding quality of water supplied by Gandhidham Municipality. When question asked to respondents regarding Cleanliness of water for human consumption, 72.3% respondents said that they are not satisfied with cleanliness/quality of water for human consumption.

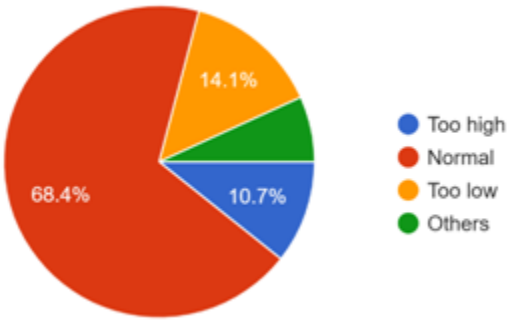


Figure 4 Current ULB Charges

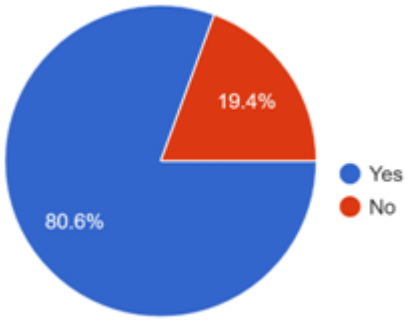


Figure 1 Willingness to Pay More

As shown in Figure 4, 68.4% of respondents think that current water tariff is normal and 14.1% of respondents think that current water charges are too low. This result indicates that there is a scope of increase in current water tariff. As shown in Figure 5, 80.6% of respondents are willing to pay more if Gandhidham Municipality will supply sufficient quantity and required quality of water to the consumers.
With help of Socio Economic Model, results (Proposed Water Tariff) are calculated for all four Socio Economic Categories by taking different values of Electrical Coefficient 0.02, 0.04, 0.06, 0.08, 0.1, 0.12, 0.14, 0.16, 0.18, 0.19, 0.20 and 0.22.Sensitivity analysis is carried out for all results calculated by Socio Economic Model to get most suitable results. Results of sensitivity analysis are summarized in below given Table 7.

Table 7 Results of Sensitivity Analysis

Value of Co-efficient (b)	SOCIO-ECONOMIC MODEL	
	Ratio of Proposed ULB Bill/ Current ULB Bill	Ratio of Proposed ULB Bill/ Current Water Expenditure
0-02	1.1846	0.3578
0.04	1.5495	0.4681
0.06	1.9144	0.5783
0.08	2.2793	0.6885
0.1	2.6442	0.7988
0.12	3.0091	0.9090
0.14	3.3740	1.0192
0.16	3.7389	1.1295
0.18	4.1038	1.2397
0.19	4.2863	1.2948
0.2	4.4687	1.3499
0.22	4.8336	1.4602

Proposed ULB bill calculated for coefficient 0.19 and then proposed ULB bill also find out for various socio economic coefficient having range from 0.02 to 0.22 to carry out sensitivity analysis. From results of above given Table 7, it is find out that value of co-efficient "0.14" is most suitable and acceptable because of at this coefficient Proposed ULB Bill and Current Water Expenditures are almost equal. Hence at this ratio consumers will not require to pay more money. And also at this value of coefficient ratio of Proposed ULB Bill to Current ULB Bill is 3.37, which leads to revenue generation of Gandhidham Municipality more than three times and it will become self sustainable in case of water supply.

PROPOSED SOCIO ECONOMIC MODEL FOR ULB

Water Charges = Socio Economic Charges + Convenience Charges

$WC = a_i x + 0.14x$ ..... (iii)

Where, ai = Socio-Economic Coefficient Based on Socio-Economic Category
X = Monthly average Electricity Bill (in Rupees)

Calculation for Socio Economic Charges ($a_i x$):

Socio-Economic Category	i	X = Monthly Average Electricity Bill (in Rupees) Range	a_i
I	i=1	BPL Category users and 0 to 1000	0
II	i=2	1001 to 2000	0.05
III	i=3	2001 to 3000	0.0525
IV	i=4	More than 3000	0.0550

Note: Average Monthly Electricity Bill is to be considered for last financial year.

5. Conclusion

The current water tariff structure of Gandhidham Municipality is inadequate. During last few years, Annual Construction and Maintenance cost on water supply work was approximately two times than revenue collection through water charges. Questionnaire survey indicates that People of study area are not satisfied with quality, quantity and maintenance etc of water supply work. People of study area are bringing water from outside through water tanker etc as well majority of people are dependent on mineral water bottles and R.O for potable use, these things leads to increase actual expenses on water. The Study proposes an Unmetered Water Tariff Model for ULB, Which is based on Socio Economic Category of respondents. The Proposed model is based on Willingness to Pay of Water user and Self Sustainability (Elimination of Revenue Loss) and thus the model turns up to be a Win-Win situation for both the Water User and the ULB.

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