Impact of Residential Area on Water Supply and Services

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Abstract: The study made an attempt to find the impact of the residential area on water supply and services. A convenient sample of 500 respondents has been selected for the present study; out of 500 respondents, 330 is from semi-urban and 170 is from rural areas. The study has covered major areas of Theni district, Tamil Nadu, India. Correlation and regression analysis are used to work out the impact of the residential area on water supply and services. The foregoing analysis found significant variations in the water supply and services in semi-urban and rural areas. Many of the services have negative correlation and rest of them proved to have week relation.

Key words: Residential area, water supply, water services

1. INTRODUCTION

Water is essential for all living species on the Earth. It is essential to all basic human needs, including food, drinking water, sanitation, health, energy and shelter (Convention on Biological Diversity, 2002), yet, millions of people have no access to safe drinking water. World Summit on Sustainable Development in Johannesburg, South Africa in September 2002 has raised a question of the water scarcity many parts of the globe are facing (Anonymous, 2003). The rapid increase in the world population in the last century led to the growth of the population over 8 billion by 2025 (IPCC, 2000). Growing population and pollution affect more on existing water resources. The rate of freshwater loss has grown rapidly in tandem with human population growth (Andresen et al. 1997). All these lead to distribution problems and widening the gap between demand and supply of water in many parts of the world (Memon and Butler, 2006).

Water is the very basis of life and is the foundation for human survival and development. Sustainable and equitable use of water over millennia has been ensured by cultural adaptation to water availability through water conservation technologies, agricultural systems and cropping patterns adapted to different climatic zones, and conservation-based life styles. However, in the last few decades, the consequences of population growth, industrialization and urbanization, as well as associated consumerist culture have interfered with the natural hydrological cycle of rainfall, soil moisture, groundwater, surface water and storage of all sizes. This has led to overuse, abuse and pollution of our vital water resources and has disturbed the quality and the natural cleansing capacity of water (Kathpalia and Rakesh Kapoor, 2002). Humanity's key challenge over the coming decades is to meet the energy, land, water and material needs of up to 9 billion people, while keeping climate change, biodiversity loss and health threats within acceptable limits. Water management will continue to have a decisive influence on the generation and distribution of wealth and well-being (UNEP, 2012). Increasing imbalances in the world’s water and food security situation are unfolding. The differences between those who have access to plenty of food, for whom water is seldom an issue, and those who are less provided are obvious. Areas with high population growth face severe problems associated with poverty and low adaptive capacity. In addition, climate change is increasing the unpredictability of rainfall, the rate of evaporation and the occurrence of extreme events. In a situation where the competition for water is getting stiffer, these changes are
making food production, including fisheries and aquaculture riskier and more uncertain (Water and Food Security, 2012).

What government has to do to maintain and supply for safe drinking water? According to international reports, water quality is important aspects of water resource management. In order maintain water quality, Safe Drinking Water Act sets national standards for drinking water quality. Regulations on drinking water include setting and enforcing drinking water standards; administering water quality testing programs; and administering permits for public water system operations (CWP,2002). In order to manage water problems, to reduce national water demand and to augment the available water resources, several legislation and laws were adopted. Islamic Laws in Saudi Arabia, for example, can help to develop effective water management to meet the rapid growth in water demand, yet, seems development of legislation, assessment of available water resources in Saudi Arabia is not enough to overcome further water supply imbalances (Abderrahman, 2000). All governments must commit to provide sufficient investments in safe drinking water and sanitation services and hygiene education for its people. Enacting national legislation and guarantying access to water and sanitation for all and protecting freshwater ecosystems, and creating cost cutting frameworks that bridge ministries and sectors, leading the way to water, energy and food security in a green economy are all equally important (Stockholm Water Front 2011).

Most population growth will occur in developing countries, mainly in regions that are already in water stress and in areas with limited access to safe drinking water and adequate sanitation facilities. More than 60% of the world's population growth between 2008 and 2100 will be in sub-Saharan Africa (32%) and South Asia (30%) (UNESCO, 2009). Currently, India is also facing serious water crises. Access to drinking water and pollution are two challenges India is facing now. Only 85 percent of the urban and 79 percent of the rural population has access to safe drinking water (SOE, 2009). In 1995, the Central Pollution Control Board identified severely polluted stretches on 18 major rivers in India (World Bank 1999). Water scarcity in India is predominantly a manmade problem. Therefore, people and government have to work together to manage pure drinking water facilities and it may pave way to get sufficient water resources for pure drinking water facilities and for irrigation purpose for the future generation (Shankar and Ramachandran, 2013). Realizing the importance and scarcity attached to the fresh water, water has to be treated as an essential environment for sustaining all life forms (National water policy-India, 2002). The population accounts for 7 % to that of India but the available water resources of the state account for only 3%. The total precipitation in Tamil Nadu is around 32909 MCM. The surface water availability is about 17,563 MCM and ground water availability is around 15,346 MCM. The demand for water is continuously on the rise with the growth of population, industry and agriculture while the availability of water remains almost constant (SOER-Tamil Nadu).

2. METHODOLOGY
The following methodology has been adopted to achieve the above objectives. Both primary and secondary data sources of information and data are used to carry out the present study. Primary data was collected by interacting with the user of water and their services. A questionnaire has been prepared and administered to the users of water on water supply and services to ascertain their perceptions. The secondary data was collected from the journals, world water reports, magazines, periodicals, newspapers and other relevant publications. In order to study socio-economic factors between semi-urban and rural areas, percentage method and chi-square analysis have been carried out. Correlation and regression analysis were used to work out the impact of residential area on water supply and services. SPSS-20 has used for statistical calculations.

A convenient sampling method has been applied. 500 users have been selected for the present study out of which 330 are from semi-urban and 170 are from rural areas. The study covered major areas like Bodinayakkunur, Tehni, Periyakulam, Adipatti and Uttamapalaiyam of Theni district, Tamil Nadu, India. The main objectives of the study are to study socio-economic factors of respondents in the study area, to study the impact of the residential area on water supply and services. The hypothesis to be proved on the basis of objectives of the study is to define whether there is a relationship between residential area and water supply and services or not. The result of the study helps in upgrading future facilities and service to be provided to users.
Selection of variables:
The variable of the study are:
Dependent variable:
• Residential Area (RA)
Independent variables:
• Source of water for your household (SWH)
• Source of water for drinking (SWD)
• Quantity of water needed in your house per day (QWNPD)
• Quantity drinking of water needed in your house per day (QDWNPD)
• Money spent on water (MSW)
• Money spent on drinking water (MSDW)
• Frequency of water supply (FWS)
• Quantity of water receive adequate (QWRA)
• Number of taps in the house (NTH)
• Taps leak (TS)
• Taps blown (TB)
• Timely maintenance (TM)
• Seasonal water problem (SWP)
• Complaint on water supply (CWS)
• Water-saving measures encouraged by municipality (WS)
• Overall satisfaction (OS)

3. EMPIRICAL RESULTS

The study has collected data from semi-urban and rural area of Theni district. The reason why Theni district has been chosen was that the district has both rural and semi-urban areas. From table 1, it is clear that out of 500 respondents, 330 respondents are from semi-urban area and rest of them is from rural. Out of 330 respondents from semi-urban area, about 56.10 percent are male and while rest of them are female. Out of 170 respondents of rural area, about 64.70 percent are male and remaining percent is female. Regarding educational qualifications of semi-urban area, majority of respondents are graduates (24.20 percent), followed by higher secondary (21.20 percent) and professional (1.50 percent) qualifications. Regarding rural area, about 29.40 percent out of 170 respondents is with diploma from universities, 20.60 percent is with diploma from colleagues.

Concerning occupation of respondents of semi-urban area, about 43.90 percent is business people. Some 27.30 percent are in government service and 1.50 percent is of retired people. In rural area, majority of respondents are business people (41.20 percent). 20.60 percent is from government service and none are in the group of retired. Marital status is almost similar in both semi-urban and rural areas, in semi-urban about 93.90 percent respondents are married while rest of them unmarried. About of 94.10 percent of respondents are married in rural area and the rest is unmarried. Regarding to type of family similarity is noted in both areas. Majority of families (60.60 percent) are nuclear in semi-urban and rest of percent joint families. In rural area, about 61.80 percent of the families are nuclear and the rest is joint families.
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**Table 1: Socio–economic profile of the respondents** (Source: Primary and computed data  
*N*= Number of Respondents)

| Variables              | Residential Area |  |  |  |  |  |  |  |  |  |
|------------------------|------------------|---|---|---|---|---|---|---|---|---|
|                        | Semi-Urban       | N=330 | Percent | Rural | N=170 | Percent |  |  |  |  |
|                        |                  |      |          |        |        |          |  |  |  |  |
| Gender                 | Male             | 185  | 56.10    | 110    | 64.70  |          |  |  |  |  |
|                        | Female           | 145  | 43.90    | 60     | 35.30  |          |  |  |  |  |
| Educational Qualification |                  |  |          |        |        |          |  |  |  |  |
|                        | Higher Secondary | 70   | 21.20    | 30     | 17.60  |          |  |  |  |  |
|                        | Diploma          | 60   | 18.20    | 50     | 29.40  |          |  |  |  |  |
|                        | Graduation       | 80   | 24.20    | 35     | 20.60  |          |  |  |  |  |
|                        | Post Graduation  | 65   | 19.70    | 25     | 14.70  |          |  |  |  |  |
|                        | Professionals    | 5    | 1.50     | 0      | 0.00   |          |  |  |  |  |
| Occupation             | Business         | 145  | 43.90    | 70     | 41.20  |          |  |  |  |  |
|                        | Government Service | 90  | 27.30    | 35     | 20.60  |          |  |  |  |  |
|                        | Private Sector   | 50   | 15.20    | 25     | 14.70  |          |  |  |  |  |
|                        | MNCs             | 25   | 7.60     | 25     | 14.70  |          |  |  |  |  |
|                        | Retired          | 5    | 1.50     | 0      | 0.00   |          |  |  |  |  |
|                        | Others           | 15   | 4.50     | 15     | 8.80   |          |  |  |  |  |
| Marital Status         | Married          | 310  | 93.90    | 160    | 94.10  |          |  |  |  |  |
|                        | Unmarried        | 20   | 6.10     | 10     | 5.90   |          |  |  |  |  |
| Type of Family         | Joint            | 130  | 39.40    | 65     | 38.20  |          |  |  |  |  |
|                        | Nuclear          | 200  | 60.60    | 105    | 61.80  |          |  |  |  |  |
| Size of Family         | 2 – 3 Members    | 85   | 25.80    | 30     | 17.60  |          |  |  |  |  |
|                        | 4 – 6 Members    | 225  | 68.20    | 125    | 73.50  |          |  |  |  |  |
|                        | > 6 Members      | 20   | 6.10     | 15     | 8.80   |          |  |  |  |  |
| Source of drinking water | Municipality tap water | 270 | 81.80 | 130 | 76.50 |          |  |  |  |  |
|                        | Packaged drinking water | 55 | 16.70 | 35 | 20.60 |          |  |  |  |  |
|                        | Others           | 5    | 1.50     | 5      | 2.90   |          |  |  |  |  |
| Source of water for household | Municipality tap water in my house | 285 | 86.40 | 140 | 82.40 |          |  |  |  |  |
|                        | Municipality tap water outside house | 40 | 12.10 | 30 | 17.60 |          |  |  |  |  |
|                        | Bore well in my house | 5 | 1.50 | 0 | 0.00 |          |  |  |  |  |

Regarding the size of the family, the majority of families are sized with 4-6 members in both areas. In semi-urban area, about 68.20 percent families are sized with 4-6 members followed by 2-3 members (25.80 percent) and the rest (6.10 percent) is greater than 6 members. Municipality tap water is a source of drinking water for more than 75.00 percent of respondents in both semi-urban and rural area. About 81.80 percent of respondents in semi-urban area is using municipal tap water for drinking followed by packed drinking water (16.70 percent) and other sources. Rural area also posted the same kind of results as semi-urban for majority of respondents; municipality tap water is source of drinking water for 76.50 percent population. Packed drinking water is being consumed by 20.60 percent of population. The rest is using other sources. Water for household purposes both for rural and semi-urban areas depends on municipality tap water. In semi-urban water for household purpose, about 86.40 percent using municipal tap water inside house followed by municipal tap water tap water outside house (12.10 percent) and rest of percent using bore well inside house. Rural area, about 82.40 percent are responded to municipal tap water inside house while rest of percent (17.60) using municipal tap water outside house. Respondents percent zero regards to bore well water inside the house.
Table 2: Correlation between Residential area and water supply and services

|                | RA   | SWH  | SWD  | QDW  | MSW  | MSDW | FWS  | QWRA | NTH  | TL   | TB   | SWP  | CWS  | WS  | OS  |
|----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|-----|-----|
| RA 0.001       |      |      |      |      |      |      |      |      |      |      |      |      |      |     |     |
| SWH 1         |      |      |      |      |      |      |      |      |      |      |      |      |      |     |     |
| SWD 0.03      |      |      |      |      |      |      |      |      |      |      |      |      |      |     |     |
| QDW 0.007     |      |      |      |      |      |      |      |      |      |      |      |      |      |     |     |
| MSW 0.62      |      |      |      |      |      |      |      |      |      |      |      |      |      |     |     |
| MSDW 0.06     |      |      |      |      |      |      |      |      |      |      |      |      |      |     |     |
| FWS 0.01      |      |      |      |      |      |      |      |      |      |      |      |      |      |     |     |
| QWRA 0.01     |      |      |      |      |      |      |      |      |      |      |      |      |      |     |     |
| NTH 0.005     |      |      |      |      |      |      |      |      |      |      |      |      |      |     |     |
| TL 0.02       |      |      |      |      |      |      |      |      |      |      |      |      |      |     |     |
| TB 0.01       |      |      |      |      |      |      |      |      |      |      |      |      |      |     |     |
| SWP 0.03      |      |      |      |      |      |      |      |      |      |      |      |      |      |     |     |
| CWS 0.01      |      |      |      |      |      |      |      |      |      |      |      |      |      |     |     |
| WS 0.008      |      |      |      |      |      |      |      |      |      |      |      |      |      |     |     |
| OS 0.006      |      |      |      |      |      |      |      |      |      |      |      |      |      |     |     |

**Correlation is significant at the 0.01 level (2-tailed).** PC= Pearson Correlation

*Correlation is significant at the 0.05 level (2-tailed). S= Significance

Pearson's Correlation analysis is used to examine the relationship between residential area and water supply and services. Table 2 shows multiple correlations of selected variables on water supply and services. Pearson's correlation analysis is used for data to find the relationship between residential area and water supply and services. The results state that residential area and quantity of water needed are negatively correlated. Correlation between residential area and money spent on drinking water is negative but shows significance at 5 percent. The RA and NTH, RA and TL, RA and TB, RA and TM, RA and WS, and RA and OS are negatively correlated. This indicates that many facilities regarding water supply and services in rural and semi-urban are not correlated.

Correlation between residential area and source of water for household, residential area and source of water for drinking are week. The RA and QDWNPD, RA and MSW, RA and FWS, RA and QWRA, RA and SWP, RA and CWS are weekly correlated. Hence, it is clear from statistics that residential area has great impact on water supply and services. Water supply and services are strongly varied between rural and semi-urban areas.
Table 3: Model of multiple regressions

| Model | R   | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|-----|----------|-------------------|----------------------------|
| 1     | .279 | .078     | .047              | .463                       |

a. Predictors: (Constant), SWH, SWD, QWNPD, QDWNPD, MSW, MSDW, FWS, QWRA, NTH, TL, TB, TM, SWP, CWS, WS, OS.

Table 3 indicates the model of multiple regressions which shows that independent variables like SWH, SWD, QWNPD, QDWNPD, MSW, MSDW, FWS, QWRA, NTH, TL, TB, TM, SWP, CWS, WS and OS.0.279 effect on the dependent variable (RA). Moreover, this explains 7.8% of the variation in the dependent variable as indicated by the adjusted R² value.

Table 4: Model Coefficients

|                  | Un-standardized Coefficients | Standardized Coefficients | T-Value | Sig. |
|------------------|-----------------------------|---------------------------|---------|-----|
|                  | B   | Std. Error | Beta   |       |     |
| 1 (Constant)     | 2.171 | 0.385 |         | 5.636 | 0   |
| SWH              | 0.006 | 0.054 | 0.005  | 0.11  | 0.913 |
| SWD              | 0.046 | 0.039 | 0.054  | 1.198 | 0.232 |
| QWNPD            | -0.046 | 0.04 | -0.054 | -1.149 | 0.251 |
| QDWNPD           | -0.006 | 0.035 | -0.008 | -0.172 | 0.863 |
| MSW              | 0.102 | 0.041 | 0.115  | 2.469 | 0.014 |
| MSDW             | -0.036 | 0.023 | -0.069 | -1.53 | 0.127 |
| FWS              | 0.114 | 0.034 | 0.162  | 3.363 | 0.001 |
| QWRA             | -0.009 | 0.052 | -0.009 | -0.165 | 0.869 |
| NTH              | -0.164 | 0.236 | -0.031 | -0.696 | 0.487 |
| TL               | -0.068 | 0.048 | -0.074 | -1.408 | 0.16 |
| TB               | 0.045 | 0.092 | 0.023  | 0.492 | 0.623 |
| TM               | -0.024 | 0.058 | -0.019 | -0.409 | 0.682 |
| SWP              | 0.035 | 0.027 | 0.061  | 1.289 | 0.198 |
| CWS              | 0.126 | 0.063 | 0.097  | 1.986 | 0.048 |
| WS               | -0.063 | 0.038 | -0.082 | -1.665 | 0.097 |
| OS               | -0.045 | 0.022 | -0.097 | -2.086 | 0.037 |

The regression analysis used to investigate the impact of residential area on water supply and services and results are given in Table 3. The coefficient of SWH and RA is 0.006 and result of t-test is significant. SWD and RA show positive coefficients with positive beta value and t-test result is significant. Coefficient between QWNPD and RA is negative with significant difference of t-test. Whereas QDWNPD, MSDW, QWRA, NTH, TL, TM, WS and OS explains negative coefficient with negative beta value. T-test here is significant with 50% level of significance. MSW, FWS, TB SWP and CWS show positive coefficients with positive beta value and t-test result is significant.

5. CONCLUSION AND RECOMMENDATIONS

Socio-economic conditions of respondents are similar in few variables; marital status is almost similar, majority of families are sized with 4-6 members in both areas, and municipality tap water is source of drinking water for more than 75 percent of respondents. Water for household purposes both for rural and semi-urban areas depends on municipality tap water. It is clear from statistics that residential area has a
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great impact on water supply and services. Water supply and services are strongly varied between rural and semi-urban areas. Many services have been shown negatively and there is a poor correlation between semi-urban and rural area. 7.8 % of the variation in the dependent variable can be explained by all the included factors as indicated by the adjusted $R^2$ value.

There are some limitations of the study: the study area is confined to Theni district, Tamil Nadu, India and the data has been collected from selected areas of the district during the year of 2015, so the study results may not be applicable to all the regions;

Further comparative study could be made between rural and urban areas on water facilities and user perception on it.

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