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Research Paper

Effect of Income on Urban Water Consumption and Pattern: Findings from an Empirical Study.

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Abstract
Kerala's rapid urbanization trend has contributed towards increase in the demand for urban piped water .The demand for water has shown an increase not only in the quantity but also in the pattern of water consumption. The main factor that contributes towards this increase is changes in incomes of the consumers. The present study aims to examine the effects of changes in income of the consumers on the quantity of water consumed and pattern of water consumption. The study is based on the primary data collected at random from 600 urban water consumers from Kollam District in Kerala. The study makes use of descriptive statistics and various statistical tools for analysing the data.

Kerala has been considered as a model to show how it is possible to achieve both growth and improved income distribution through human development. Unfortunately Kerala has not done well in the drinking water segment. Safe drinking water remains out of reach for more than 65 per cent of the households in the State. Only 29.3 per cent of the houses in the State are serviced by the tap water supply network and just 34 per cent gets safe water supply which is 52 per cent less than the national average and 57 and 59 per cent less than our neighbouring states Andhra Pradesh and Tamil Nadu respectively. The rural-urban gap is also widening, total urban population getting safe water to the total population has been reduced from 42.85 in 2001 to 39.4 per cent in 2011. (Kerala Economic Review 2013)

The total demand for water (domestic use and non-domestic use) work out to 49700 million meters, where as the availability of surface water is only around 42000 million cubic meters. The actual utilization is much lesser than the potential. Kerala's 41 west flowing and 3 east flowing rivers convey 72000 million cubic meters of water to the Arabian Sea and neighboring states. Only 4 to 5 percent of runoff is stored in reservoir meant for hydel power generation and drinking water. Water resource conservation is very poor in the State of Kerala. Hence Kerala also faces water scarcity. Though the percentage of population covered under protected water supply has increased over the years there is wide spread availability problem and disparity in distribution.

Kerala Water Authority (KWA) is the primary drinking water supplier in the state. It covers 94 percent of total piped water supply in Kerala. Other agencies which provide water supply in rural area are Kerala Rural Water Supply and Sanitation Agency (KRWSA) and Local Self Government Institutions (LSGIs). KRWSA and LSGIs have been ensuring community participation in implementation of water supply schemes by sharing the financial costs and taking responsibility in management, operation and maintenance to some extent. Total water supply schemes operating under KWA is 2214, of which 72 are urban water supply schemes and 2142 are rural water supply schemes. In urban population, more than 85 per cent have been covered and in rural area more than 77 per cent reported as covered. District wise Ernakulam received the highest coverage of 97 percent and Kozhikode reported as the lowest coverage of little over 55 percent. For rural water supply coverage, again Ernakulam tops with 98 percent and Kozhikode is the lowest coverage district of nearly 42 percent. In urban area, Malappuram is the highest covered district of 99 percent and Wayanad is the lowest one with 50 percent. Additional coverage during the period 2012-13 is 7.33 lakh people. The whole additional coverage is reported from rural coverage supplemented by 14 additional Single Panchayat Schemes 11 Multi Panchayat Schemes and one urban water supply scheme.Kottayam has the highest additional rural coverage of 2.33 lakh people, followed by Kollam as 1.57 lakh people. Developed nations and other high income countries are projected to reduce their overall water consumption across sectors by 2050 through better water management measures and reduction in per capita water consumption. Yet no initiative has been undertaken in Kerala to reduce water

consumption. Nearly 30 per cent of water produced by Kerala Water Authority is to be considered as distributional loss due to the fact that the pipes are very old and tend to leak. We are lagging in integrated water resource management by means of coordinated use by location and use. Ensuring sufficient water in entire system to support various uses and distributed across districts is a pre requisite one. Kerala needs effective methods on demand side management through competitive price, training of recycling and reuse of water and cost benefit analysis by proper assessment of opportunity costs. Rain water harvesting is an effective process to utilize the natural gift. The households in Kerala depend on various sources for drinking water. The various sources include well water, tap water, hand pump/tube well/borehole water and other sources of water.With rapid urbanization the demand for water also increases. The changes in income of the people have also made changes in water consumption and pattern of water usage. The present study attempts to examine the changes in water consumption pattern and water use among urban water consumers of Kollam District in Kerala .

Objectives of the study

1. To examine the effects of changes in income on water consumption among urban consumers belonging to different income groups.
2. To examine the pattern of water consumption by different income groups.

I. Methodology

The present study is based on the primary data collected at random from 600 urban water consumers from Kollam District in Kerala. The details regarding the connected water consumers were collected from the Water Connection Register from the concerned water authority offices. Almost 1.5 percent of the total connections were taken from each of the Municipal/ Corporation area at random and the sample size is fixed at 600. Data is analysed using descriptive statistics and other statistical tools.

Descriptive Statistics Related to the Quantity of Water consumed on Previous Day

The descriptive statistics related to the quantity of water consumed in the previous day is presented in table 6.35.

TABLE 6.35

Descriptive Statistics Related to the Quantity of Water Consumed on Previous Day

Group	N	Minimum	Maximum	Mean	Std. Deviation
Corporation	431	10	1500	343.55	194.646
Municipality	169	70	1200	318.85	174.762
All	600	10	1500	336.59	189.440

Source: Analysis of Primary data

Analysis of descriptive statistics in table 6.35 reveals that out of the total consumption of all the respondents the minimum consumption is 10 litres and maximum consumption is 1500 litres with an average consumption of 336.59 litres and a standard deviation of 189.440 litres with mean consumption ranging between 10 and 1500.

6.3.2 Average Quantity of Water Used for Washing in Day

The data about water used for washing clothes is shown in table 6.36.

TABLE 6.36

Average quantity of water used for washing in a day

Group	N	Minimum	Maximum	Mean	Std. Deviation
Corporation	431	5	400	61.84	42.474
Municipality	169	5	200	61.43	27.727
All	600	5	400	61.72	38.867

Source: Analysis of Primary Data

Analysis of data in table 6.36 reveals that mean consumption of water for washing clothes in both Corporation and Municipality areas are more or less same. However the mean consumption of households in Corporation area for washing clothes is slightly higher than the Municipality areas.

6.3.3Average Quantity of Water Used for Watering Plants

Data regarding water used for watering plants is collected to know the extent of water consumption. The descriptive statistics regarding the water usage for watering plants is explained in table 6.37

Table 6. 37
Average Quantity of Water Used for Watering Plants

Group	N	Minimum	Maximum	Mean	Std. Deviation
Corporation	431	0	300	6.25	21.575
Municipality	169	0	300	10.27	25.244
All	600	0	300	7.38	22.719

Source: Analysis of Primary Data

It is inferred from table 6.37 that there are respondents who do not use tap water for watering plants. Therefore the minimum quantity of water used is zero and the maximum quantity of water used is 300litres in the urban areas. However data on using of tap water for watering plants reveals the dismaying truth that tap water is used for watering plants both in Corporation and Municipality areas which should be restricted so as to utilise the water used for watering plants for drinking and other domestic purposes.

6.3.6 Comparison of Mean Consumption among the Respondents Having Different Incomes

The consumption of respondents belonging to different income categories is compared and presented in table 6.40.

TABLE 6.40
Comparison of Mean Consumption among the Respondents Having Different Incomes

Group	N	Mean	χ^2-value
< 5000	323	297.60 ± 6.87^b	42.089**
5000-10000	154	323.97 ± 16.51^b	
10000-15000	42	407.38 ± 31.97^a	
Above 15000	80	482.88 ± 32.35^a	

*** - significant at 0.01 level*
Means having same letter as superscript are homogeneous
Source :Analysis of Primary Data

H_0: There exists no significant difference in the water consumption among the respondents having different income level

Whether the water consumption is influenced by changes in income level is tested by using Kruskal Walli's ANOVA. Since p value is less than the level of significance reject the null hypothesis that there exists no significant difference in the water consumption among the respondents having different income level (level of significance-0.01). As there is significant difference in the water consumption among different income group, between group comparisons was done pair wisely using Mann Whitney U test. Results are given in the table 6.40. Even though an increase was noted in the water consumption as increase in the income level, no significant difference was noted between < 5000 and 5000-10000 income groups. Similarly no significant difference was noted between 10000-15000 income group and above 15000 income group. However 10000-15000 income group and above 15000 income group consume more water compared to other two low income group category.

Water Consumption Pattern

Water is consumed by the households for domestic and non domestic purposes. To know the water consumption pattern of consumers of different income categories water consumption data is analysed using the parameters like descriptive statistics related to the quantity of water consumed on previous day, proportion of

utilization for various purposes by different income groups and comparison of consumption among different income group. The proportion of utilization for different purposes is analysed using the parameters like water consumed for household purposes and non household purposes. One way ANOVA is used to compare the water consumption for domestic and nondomestic uses by different income groups. The relation between water consumption and the factors affecting water consumption is analysed using Multiple Regression .The comparison of water consumption of households having different income levels is checked by using Kruskal Wallis ANOVA and the comparison of consumption among households having latrines with flush facility and without flush facility is analysed using Mann Whitney U Test.

Proportion of Utilization for Various Purposes by Different Income Groups

To understand the proportion of water used by different income groups for domestic and non domestic purposes the data on this is collected and compiled in table 6.38. With increase in the incomes of consumers the proportion of water used for non domestic purposes goes on increasing. With increase in income vehicles will be purchased by the people and other non domestic use of water will increase.

TABLE 6.38

Proportion of Utilization for Various Purposes by Different Income Groups

Purpose	Income Group				Overall sample
	< 5000	5000-10000	10000-15000	Above 15000	
Drinking	6.28	7.44	5.54	4.89	6.27
Cooking	17.42	17.17	13.36	14.43	16.47
Washing	31.78	26.82	26.36	26.72	29.14
Bathing	34.87	33.91	35.03	36.48	34.92
Household Purpose	90.35	85.34	80.29	82.52	86.80
Vehicle	2.61	7.66	10.94	10.49	6.03
Others	7.04	7.00	8.76	6.98	7.18
Non household	9.65	14.66	19.71	17.48	13.20
Total	100.00	100.00	100.00	100.00	100.00

Source : Compiled from Field Survey

It is evident from the analysis of data in table 6.38 that in less than 5000 income group 90.35 percent of use is for domestic purposes and only 9.65 percent of uses is for non- domestic purposes. But with increase in income of the households the proportion of water used for non –domestic purposes increase and the proportion of water used for domestic purposes decrease. This is because of the use of water for non domestic purposes like washing of vehicles, gardening etc

6.3.5 Comparison of Consumption for Domestic and Non Domestic Purposes among Different Income Groups

The water consumption of different income groups for household purposes and non household purposes is compared using ANOVA and the results are depicted in table 6.39.

TABLE 6.39

Comparison of Consumption for Domestic and Non Domestic Purposes among Different Income Groups

Income Group	Domestic Purpose	Non Domestic	Total consumption
< 5000	172.52 ± 6.6^{b}	18.43 ± 1.9^{b}	190.95 ± 7.62^{b}
5000-10000	184.63 ± 11.38^{b}	31.71 ± 3.99^{b}	216.34 ± 13.79^{b}
10000-15000	224.67 ± 18.45^{a}	55.14 ± 8.36^{a}	279.81 ± 22.86^{a}
Above 15000	228.93 ± 14.48^{a}	48.49 ± 7.56^{a}	277.41 ± 20.49^{a}
F-value	5.611**	15.476**	9.516**
P-value	0.001	< 0.001	< 0.001

Source:Analysis of Primary Data

H_0:There is no significant difference in the water consumption for domestic and non-domestic uses of different income groups

To compare the water consumption for domestic and nondomestic uses by different income groups a null hypothesis that there is no significant difference in the water consumption for domestic and non-domestic uses by different income groups is tested using One Way ANOVA. F-value was found to be significant at 0.001 levels and hence the null hypothesis is rejected. Duncan Multiple range test was done for finding out homogenous groups. There is homogeneity in water consumption for domestic uses among the first two income groups that is less than 5000 income group and 5000-10000 income group. There is homogeneity in water consumption for domestic uses among the last two income groups that is 10000-15000 income groups and above 15000 income group. Likewise there is homogeneity in water consumption for non domestic uses among the first two income groups that is less than 5000 income group and 5000-10000 income group. There is homogeneity in water consumption for non -domestic uses among the last two income groups that is less than 10000-15000 income groups and above 15000 income group. There is homogeneity in total water consumption for domestic and non domestic uses among the first two income groups that is less than 5000 income group and 5000-10000 income group. There is homogeneity in total water consumption for domestic and non domestic uses among the last two income groups that is less than 10000-15000 income groups and above 15000 income group.

6.4 Comparison of Consumption among the Respondents in Corporation and Municipality

For testing objective of comparison of water consumption among the respondents in Corporation and Municipality Kolmogorov -Smirnov test was done to find out the normality of the quantity of water consumed in Corporation and Municipality areas. Kolmogorov Smirnov Z worked out was 4.815 which was found to be significant ($P<0.001$). Hence reject the null hypothesis and conclude that quantity of water consumed is not normal hence go for non parametric test. The hypothesis tested is

H_0 : There exists no significant difference in the water consumption among the respondents in corporation and municipality

TABLE 6.42
Comparison of Consumption among the Respondents in Corporation and Municipality

Group	N	Mean	z-value
Corporation	431	343.55 ± 9.376	1.458^{ns}
Municipality	169	318.85 ± 13.443	

ns - Non significant

Source : Analysis of Primary Data

The hypothesis is tested using Mann Whitney U test. The calculated Z-value is less than the table value and hence we accept the null hypothesis. There is no significant difference in water consumption of people in the Corporation and Municipality areas.