

IMPACT OF POPULATION GROWTH ON PER CAPITA WATER DEMAND IN SELECTED STUDY AREA

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ABSTRACT

The global water, surface water, groundwater levels in India are all examined in this research. Globalization significantly influences a country's cultural, social, financial, political, and communal life. In several places of the world, especially South Asia, threats of international water wars have made headlines. In South Asia, and the area's largest country, national water conflicts and challenges in water management continue to plague the region. Urban water authorities and water planners are straining to meet the rising urban water demand while also failing to develop sustainable urban water systems. Domestic and commercial water consumption is quickly expanding as a result of fast population expansion and economic changes such as LPG models, altering per capita water demand. Piped water supply is commonly one of the numerous sources from which families obtain water in developing countries, and it is frequently unmetered. Using questionnaire-based primary data, the nature of Coimbatore's drinking water supply was discovered. To get relevant information, a multi-stage, stratified, simple random sampling procedure was used in the selection of samples. Interviews were conducted with people from varied socioeconomic backgrounds. In this work, we employ primary domestic urban household survey data from five corporation zones in the Coimbatore district, which was planned and gathered expressly for this study. The sample size is determined by the income level, which is divided into three categories: low income, middle income, and high income. This report shows the water usage patterns of urban residential homes in the Coimbatore area. The district authority for developing better strategies to increase water supply and meet the per capita water demand of urban households.

KEYWORDS: Population Growth, Urbanization, Water Consumption, Liter Per Capita Demand

INTRODUCTION

Population expansion is a major driver of rising water demand, both directly (for drinking water, sanitation, and hygiene) and indirectly (e.g. through growing demands for water-intensive goods and services, including food and energy). Over the last few decades, water demand has outpaced population increase by a factor of two. The global population is increasing at a rate of 80 million people per. As of June 2017, the world's population had risen to 7.6 billion people. By 2030, it is predicted to be around 8.6 billion people, with further growth to 9.8 billion by 2050. Nearly all current population increase is accounted for by Africa and Asia.

Water availability per person is determined by a country's population, and in India, per capita, water availability is decreasing as the population grows. The average annual per capita water availability was estimated to be 1816 cubic meters and 1545 cubic meters in 2001 and 2011, respectively, and is expected to decrease to 1486 cubic meters and 1367 cubic meters in 2021 and 2031. According to the Ministry of Housing and Urban Affairs, the guideline for urban water supply is 135 liters per capita per day (lpcd) (PIB, Jal Shakthi, 2020)

Water is a valuable resource that is becoming increasingly scarce. Most of the world's countries are dealing with freshwater scarcity as a result of global population growth, urbanization, and climate change-driven rainfall variations. By 2025, around two-thirds of the world's countries, primarily developing countries, will be under moderate to severe water stress, with half of the global population facing serious water shortages. (Environmental Programme of the United Nations, 2012). Water is a necessity for fundamental existence and economic growth. Water availability per capita at the national level is expected to diminish by 40 to 50 percent by 2050 as a result of high population increase and business consumption. The quality of water available, both for other productive sectors and for public usage, would be affected by the key sectors that are strongly reliant on water, such as India's agriculture and power generation. India's water resource management and ties with neighboring nations are influenced by the demand for, availability of, and diverse usage of water. Domestic and commercial water consumption is quickly expanding as a result of fast population expansion and economic changes like altering per capita water demand. The current study concentrated on socioeconomic variables that influenced per capita water consumption at the home level.

STATEMENT OF THE PROBLEM

There is a rapid growth of population and urbanization in recent years which affect water resources at worse. These are important elements that are creating basic problems to the global water cycle, with an emphasis on urban water supply. Cities have increased their water use fivefold since 1950, not just due to population expansion but also due to rising per capita demand. Cities are increasingly struggling to find adequate water to feed their populations, and half of the world's cities with populations of more than 100,000 people are located in water-scarce locations. Meanwhile, there is a growing decoupling of urban and rural systems, as well as a shrinking holistic view of the global water cycle, with metropolitan regions seen as separate entities. Cities must acknowledge that they do not exist in isolation if they are to prosper in a world marked by resource difficulties and restrictions. Climate change, which includes rising temperatures, severe weather events, rising sea levels, and reductions in river flows and groundwater levels, is overlapping and exacerbating all of these stresses. Another major aspect is the growing worldwide demand for "water-intensive" items such as food and technology products, with agriculture currently accounting for over 70% of global freshwater withdrawals. If current water management practices continue. Water Resources Group anticipates a 40% worldwide imbalance between safe freshwater demand and availability by 2030, unable to support the projected population. With the risk of water depletion and increased competition due to shortage, new methods of thinking and managing water are essential (Arup,2015). The study's precise aims were set against this backdrop. To understand the water resources at the Global and Indian levels.

- To examine socio-economic characteristics of selected urban households in Coimbatore district;
- To analyze per capita water consumption patterns in selected urban domestic households.

NEED FOR THE STUDY

Water is required for life to exist and survive on this planet. Water has been discovered in a broad and steadily rising number of uses as civilization has progressed. Many countries that have a good idea of their oil and mineral resources have little idea of their water resource potential. In a nation like India, where rainfall patterns are very unpredictable and the majority of people rely on agriculture and related industries, water resource evaluation and planning have become critical components of the country's growth.

RESEARCH GAP

The literature referring to previous research work connected to the current topic has been attempted to be presented. This necessitates a grasp of the many sources of water supply as well as the demand generated by diverse industries. Globalization has caused a decline in water quality, notably in groundwater, as well as a rising financial crisis, insufficient institutional changes, and enforcement issues in the country's water sector. Water resource management is the subject of very few studies. The following are some of the studies on water resource management that have been examined and presented.

Water usage trends in residential households in major cities were explained by Abdul Shaban and Sharma (2009). Urbanization leads to an increase in urban water demand and consumption; a water shortage or crisis, as well as deterioration of the water environment, will jeopardize the quality of urbanization. The report also suggests that to achieve urbanization, comprehensive efforts in the areas of urban planning, water resource preservation, water management, and ecological restoration are required.

Mushir Ali and Abraham (2012) analyze the situation of water supply and use in metropolitan areas at the home level: A case study of Ethiopia's east Wollega zone. Although the results reveal that there is no conflict in meeting existing stakeholder needs, they also suggest that the present proportion of surface water utilized is insufficient when compared to the amount of groundwater used. The findings also suggest that certain future requests of provinces with lower marginal water values would be unmet, perhaps resulting in a dispute amongst stakeholders.

Omvir Sing & Sushila Turkia (2013) in this study A survey of domestic water consumption patterns in rural semi-arid villages, India pointed out the water resources of the country constitute one of its vital assets. India receives annual precipitation of about 4000 km³. The rainfall in India shows very high spatial and temporal variability and the paradox of the situation is that mousinram near Cherrapunji. The concept of virtual water transfer requires to be introduced a policy level for food trade, water management, and agriculture. The capacity building and awareness programs may be organized for the users and public for encouraging their effective participation in water management practices and developing the ethical concepts for making efficient use of water resources. Capacity building is also needed for the water resources managers and developers for updating the knowledge and technology in the area of water resources management.

Hangaragi.S.S (2011) study revealed that rainwater harvesting systems offer many advantages for water collection. A system can often be adapted to fit locally available Skills, Materials, and Patterns of rainfall and water consumption. The

costs of catchment systems are often low relative to other alternatives of catchment systems that can be installed incrementally, reducing high initial costs. The water harvesting structures of various types are known by different names in the country such as farm ponds, small earthen dams, irrigation tanks, bunds percolation tanks, stop dams, etc. Rainwater harvesting is the only way to solve water scarcity.

METHODOLOGY

The current research is focused on the geographical distribution of drinking water in Coimbatore. Coimbatore is Tamil Nadu's third-largest city, with a population of more than 9.3 lakhs according to the 2001 census. There are around 30,000 textile mills and small, medium, and big businesses. Residents of the city are noted for their entrepreneurial spirit. The weather is pleasant throughout the year. Using questionnaire-based data, the nature of Coimbatore's drinking water supply was discovered. To get relevant information, a multi-stage, stratified, simple random sampling procedure was used in the selection of samples. People of various social standing were interviewed. The city of Coimbatore was split into five zones, each with 20 wards. Data were collected and processed, both cartographically and statistically, to explain various elements of water demand and supply in Coimbatore. Cartographically, the location and distributional elements of consumption, as well as the economic position and distribution of various sources, are discussed. The statistical methods used in the study are detailed in the appropriate chapters, however, the study is mostly qualitative, despite some attempts at quantification.

SELECTION OF THE SAMPLE HOUSEHOLDS

Coimbatore District was selected for the study. As the study was mainly based on primary data, a **Multi-stage Stratified Systematic Random sampling** technique was adopted for the sample selection. It was clearly explained through the flow chart (Figure-). In the first stage, Coimbatore District was selected for the study. The study is based on Urban water consumption so, the researcher selects only urban areas Coimbatore corporation was selected. Coimbatore Corporation was divided into five zones in the second stage, namely North, South, East, West, and Central Zones. There were 20 wards in each zone. In the third step, each zone's highest household population ward was picked.

TABLE (1)
DETAILS OF SELECTION OF WARD IN EACH ZONE

S.No	Zone	Ward	No.of.Households	No.of. Water Connections	Selected No.of.Households
1	North	41	13066	10977	101
2	South	86	9999	2803	181
3	Central	45	7799	3874	160
4	East	59	6999	4571	116
5	West	24	5881	2796	93
	Total		43744	25021	651

Source: compiled from field survey, (2019).

Selection of the Sample Households

In the selection of the sample households, the researcher first approached the CCMC Officers, to get details on the ward population and area covered in a particular ward. It was found that in north zone ward no.41 there are 4 areas, in south zone ward no 86 there are 5 areas, in central zone ward no.45 have 7 areas, in east zone ward no. 59 have 5 areas and in west zone ward no.24 have 5 areas were selected. In the final stage, the total number of households from the selected wards in 43744 households. Using the Rao sample size calculator software, the researcher calculates a sample size of 651 households with a 95% confidence level, and a random sampling technique was used to select the households for data collection.

TABLE (2)
DISTRIBUTION OF THE SELECTED SAMPLE HOUSEHOLDS

S.No	Area Covered	Income Group			ALL
		LI	MI	HI	
North Zone					
1	Ganapathy	12	9	3	24
2	Police Quatres	3	25	1	29
3	Gandhi Managar	8	13	8	29
4	Sivanandhapuram	9	8	2	19
		32	55	14	101

South Zone					
1	KarumbuKadai	31	14	5	50
2	Kuniyamuthur	24	7	3	34
3	Veerapandipirivu	34	8	5	47
4	Selvapuram	12	23	2	37
5	Ukkadam	7	5	1	13
	Total	108	57	16	181
Central Zone					
1	Tatabad	4	3	2	9
2	Koundampalayam	17	11	3	31
3	Sanganoor	2	5	2	9
4	Gandhipuram	7	5	2	14
5	Nallampalayam	14	6	4	24
6	Metupalayam	17	15	0	32
7	Ganapathy Pudhur	24	15	2	41
	Total	85	60	15	160
East Zone					
1	Neelikonampayam	24	12	1	37
2	Peelamedu	9	4	4	17
3	Singanallur	17	10	5	32
4	Press Colony	7	9	4	20
5	Ondipudhur	3	4	3	10
	Total	60	39	17	116
West Zone					
1	Selvapuram (N)	10	8	4	22
2	P.N.Palayam	5	6	5	16
3	R.S.Puram	2	8	8	18
4	Ramanathapuram	5	9	3	17
5	Gandhi Park	10	3	7	20
	Total	32	34	27	93
	Grand Total	317	245	89	651

SOURCES OF WATER IN SELECTED AREA

Generally, there are five sources of water supply services in Coimbatore Corporation. Namely Siruvani, Pillur, Pillur added, Aliyar Added, and K.V. Scheme. Table (4) explains the amount of water supplied by each reservoir was given.

TABLE-3

DETAILS OF WATER SUPPLY RESERVOIRS IN COIMBATORE CITY (2019-2020)

S.no	Name of Reservoirs	Amount of Water in MLD Per Day
1	Siruvani	97.1 (36.49)
2	Pillur I	25 (9.39)

3	Pillur II	125 (46.97)
4	Aliyar	8 (3.01)
5	K V Scheme	11 (4.13)
	Total	266.1

Source:

Coimbatore Corporation, (2019).

Siruvani was Coimbatore Corporation's main source of water supply reservoir. The city received 97.1 MLD of water from Pillur II, while the second greatest amount of water came from Pillur II, which provides 125 MLD per day. And Aliyar has the smallest water supply in Coimbatore, sharing 8 MLD of water with the rest of the city.

SOCIO-ECONOMIC AND DEMOGRAPHIC PROFILE

The age group of population covered in the study varies from 0-20, 21-40, 41-60, and above 60 years, which means that surveyed households represent all age groups in various localities. The sample size of the study is 100 households is shown (Table 5).

TABLE-4

DETAILS OF SOCIO-ECONOMIC CHARACTERISTICS OF SELECTED HOUSEHOLDS

Characteristics	Particulars	Total	Percentage
Age Group	0-20	94	14.4
	21-40	213	32.7
	41-60	254	39.0
	Above 60	90	13.8
	Total	651	100.0
Education Level	Up to Primary	122	18.7
	High School	116	17.8
	UG	218	33.5
	PG and above	195	30.0
	Total	651	100.0
Type of House	Nuclear	398	61.1
	Joint	253	38.9
	Total	651	100.0
Level of Income	Up to 50,000	253	38.9
	50,000 - 1,00,000	251	38.6
	1,00,000 - 2,00,000	125	19.2
	Above 2,00,000	22	3.4
	Total	651	100.0

Source: Field Survey, (2019)

About 39 percent of the homes examined are between the ages of 21 and 60, and 14.4 per cent are between the ages of 1 and 20. Table (5) shows that the majority of the population in the sampled homes is between the ages of 21 and 40,

which is the working-age (workforce) population. There was a widespread belief that the younger population is more sensitive to water scarcity, which might alter Per Capita Water Demand. Nuclear families accounted for 65 of the 100 homes, while joint families accounted for just 35. In all zones, nuclear families made up around a quarter of the homes. As the number of people per residence grows, so does the amount of water required per family. In all of the areas, the education level of the households was reported. It is clear from the data that the majority of the households have a High School or UG education level. Others made up less than 20% of the total. Poor education equates to a low standard of life, and hence to a lack of knowledge of groundwater depletion and conservation efforts. In all zones, roughly 12 per cent of families were illiterate, and the highest degree of education was Undergraduate, which accounted for 33 per cent of responses. Education levels influence both the increase in water use and the awareness of water conservation technology, programs, and legislation. However, it was shown throughout the study that people from all groups showed minimal concern for water conservation. The usage of water was contingent on its availability. Household income is a major factor in their standard of living. High-income families have huge plots, extensive lawns, upscale neighborhoods, reliable water supply, and a significant number of water-consuming appliances. Household income was collected to determine the different income groups' level of life, and their water use habits were examined. It is obvious that roughly 5% of the population earns more than 2,00,000 pm, while around 16% earns between 1,00,000 and 2,00,000 pm; hence, Coimbatore Corporation is home to a diverse population, with some earning less each year and others enjoying a high level of life. A little more than 26% of respondents had incomes ranging from 50,000 to 1,00,000, with the remaining 53% falling into the low-income category. As a result, our research revealed a broad range of income levels across the various families. Households' ability to pay is influenced by their income levels. Lower-income levels limit water requirements and so they cannot avail themselves better water services. Lower-income levels also incapacitate the households to pay for improved water services and also they may not be able to install various water purifying systems to have quality water at their source.

WATER CONSUMPTION PATTERNS

Residential water use includes water used for indoor and outdoor activities. At the household level, various activities like bathing, toilets, clothes washing, utensils cleaning, drinking, and cooking, watering the garden, washing the car, and house cleaning are dependent on water availability. Residential water use is influenced by several factors, including climate, household income, price, fashion, and conservation awareness programs (Kennedy, 1984).

TABLE-5
WARD WISE DETAILS OF WATER CONSUMPTION IN SELECTED HOUSEHOLDS

Zone	Drinking	Cooking	Bathing	Washing	Cleaning House	Gardening	Vehicle cleaning
East	325	980	1017	593	139	48	200
Mean	16.25	49	50.55	29.65	6.95	2.45	10.05
SD	7.46	8.26	7.05	7.58	2.29	4.48	4.23
West	349	890	1688	535	150.5	35	185
Mean	17.45	44.5	67.05	26.75	7.52	1.75	9.25
SD	6.98	7.09	11.06	6.24	3.5	3.04	3.73
North	294.5	784	1353	497.5	189	41	158
Mean	14.72	39.2	67.65	24.87	9.45	2.05	7.9
SD	5.24	9.3	11.16	5.56	3.86	3.15	4.01
South	316.5	982	1456	458	178	31	134
Mean	15.82	49.1	72.8	22.9	8.9	1.55	6.7
SD	2.98	6.73	11.03	3.66	3.13	3.1	2.2
Central	351.5	827	1301	435	168	21	114
Mean	17.57	41.35	65.05	21.75	8.4	1.05	5.7
SD	2.3	5.06	8.81	4.43	2.27	1.76	1.45

Source: Field Survey, (2019). Liter Per Capita per Day (LPCD).

There were considerable differences in the water usage in the various zone in the city. Table (6) and explains the total consumption pattern of water among various activities in all zones of the city to calculating the Liter Per Capita per Day (LPCD). Among the five-zone the maximum water was used by the west zone of the corporation and its LPCD was 192 liters. The low level of water consumption was central zone and its LPCD was 161 liters. The water consumption in the

summer season was higher in comparison to the winter season and it may be due to the higher quantum of clothes to be washed, utensils to be cleaned and bathing intensity was also higher during summers in comparison with the winter season.

Regression

Regression is the determination of a statistical relationship between two or more variables. It is concerned with the prediction of the most likely value of one variable when the value of the other variable is known in simple regression, there are only two variables, on a variable defined as independent is the cause of the behavior of another one defines as dependent variables.

The study tried to examine the relationship between the Liter Per Capita Demand and determinants of water consumptions in this secession for which they have used regression analysis.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \mu$$

Where Y= LPCD

X₁ = Family Type

X₂ = Family Monthly Income

X₃ = Education

X₄ = Monthly Expenditure for Water

X₅ = Sources for Drinking Water

X₆=Duration of Water

The paper tried to examine the relationship between the Liter Per Capita Demand and determinants of water consumptions in this section for which they have used regression analysis.

TABLE -6

REGRESSION ANALYSIS FOR FACTORS AFFECTING LPCD IN SELECED URBAN HOUSEHOLDS

R	R Square	Adjusted R Square	Std. Error of the Estimate
.648	.418	.405	.23352

Source: Estimation based on Field Survey, (2019).

Table (7) shows that, the R-value is 0.648 and R square Value is 0.417. The degree of determination shows the extent to which determinants of water influence the Liter Per Capita Demand.

TABLE – 9

ANOVAANALYSIS FOR FACTORS AFFECTING LPCD IN SELECTED URBAN HOUSEHOLDS

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	11.618	6	1.935	35.42	.000
Residual	16.151	292	.054		
Total	27.759	313			

Source: Estimation based on Field Survey,(2019)

ANOVA table shows that the significant value is less than 0.05, which means the dependent variable is significantly predicted by independent variables namely family type, Family monthly income, monthly expenditure for water, sources for drinking water, duration of water, and sources for another purpose of water at 95 % of confidence level. This indicates that the regression model for LPCD is significant.

TABLE -10

COEFFICIENTSANALYSIS FOR FACTORS AFFECTING LPCD IN SELECTED URBAN HOUSEHOLDS

Sl.No	Variables	Standardized Coefficients	T	Sig.
1	Family Type	.246	4.431	.000*
2	Family Monthly Income	.301	5.446	.000*
3	Monthly Expenditure for Water	.094	1.881	.061
4	Sources for Drinking Water	.176	3.440	.001*
5	Duration of Water	.345	5.675	.000*
6	Sources for other Purpose	.158	3.132	.002*

Source: Estimation based on Field Survey,(2019).

* *Dependent Variable: LPCD*

From the above table (9) it can be identified that variables such as family type, Family monthly income, sources for drinking water, duration of water, and sources for another purpose of water are statistically significant in determining LPCD at 1% level of significant the variable monthly expenditure for water is not statistically significant in determining LPCD.

CONCLUSION

India is not a water deficit country, but due to severe neglect and lack of monitoring of water resources development projects, and economic reforms like globalization liberalization privatization several regions in the country experienced water stress from time to time. The annual rainfall received by India is unevenly distributed across its different parts, across different times of the year. As a result, despite good annual rainfall, some river basins fall in the category of water-scarce and water-stressed regions, India faces a critical water shortage due to government mismanagement, pollution, and groundwater depletion, a major challenge for India is its rising water demand coupled with economic development. India's increasing population and economic growth have put tremendous pressure on India's water resources. Water demand is steadily increasing across all markets and will continue to do so. Balancing water demand with available supply will be crucial for future economic growth and development. For India to meet its growing water demands, it needs to clean its existing water supply and create new water supplies without increasing energy requirements. Globalization is, directly and indirectly, impacting water resources in the world. The government and common people have to manage water resources, and also local governments focus their management practices from the domestic level. Local authorities should improve their systems and practices so that they can cope with the global environment. To improve water supply people should keep the focus on their water conservation practices because it is an investment, not an expenditure. To reduce water demand in the future humans should manage and reduce their consumption and also avoid wasting and polluting the water with industrial and domestic dumps.

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