Hypothesis

- There is no relationship between socio-economic variables and LPCD
- Factors of problems of water supply do not influence respondents to go for the secondary water source.
- The water consumption pattern of the consumers belonging to different income groups is the same.
- There is no relationship between waterborne disease and the cost of treatment of waterborne disease
- Factors do not influence the respondents on water-saving behavior.
- There is no relationship between Willingness to Pay and other variables like LPCD, Income, Family size, Source of water, Distance, and time of water collection.

The current study is an attempt to find out how income is playing significant role in urban domestic water consumption pattern and their intention to adopt water-saving technologies to minimize the hazards associated with an urban water supply and overcome the problems of demand for water for consumption.

CHAPTER - 2

REVIEW OF LITERATURE

The literature on the current study, on **"Socio-economic and Environmental Aspects of Urban Water Consumption in Selected Households"**, is evaluated under the following headings.

2.1. Impact of Urbanization on Water Availability in India

2.2. Issues and Challenges of Urban water Demand and Supply

2.3. Problems of Urban Domestic Water Consumption

2.4. Urban Domestic Water Conservation and Theory of Planned Behaviour

2.5. Private Sector Participation in Urban Water Supply

2.6. International Studies on Urban Water Resource

2.7. General Studies on Urban Water Resource Management

2.1. Impact of Urbanisation on Water Resources in India

Historically, urbanization has been associated with significant economic and social transformations. Living in a city, for example, is connected with higher levels of literacy and education, better health, lower fertility, and a longer life expectancy, as well as more access to social services and cultural and political engagement. Rapid and uncontrolled urban expansion, on the other hand, harms infrastructure, resulting in insufficient housing, water and sanitation, transportation, and health care services.

Arunpandiyan et al. (2015) made a study to make a comparison of the areas estimated for urban, water bodies and vegetation was done to identify the land increase and decrease over a period of 37 years. The results showed that the urban areas increased by 421.61 km2 and the water bodies had drastically decreased by 107.844 km2, and the land under vegetation had drastically decreased by 6075.78 km2. The pattern was accounted as a total sum for the entire three districts. It is revealed that the natural resource has greatly declined over the period of 37 years due to the urbanization activities. The value exceeds the naturally estimated decline for the same region. Hence conservation measures have to be adopted for the optimal utilization of these resources without compromising the economic benefits and sustainability of these resources.

Buhaug et al. (2013), have reported that population growth affected patterns of public unrest in urban centers within the context of crucial intervening factors like democracy, poverty, economic shocks. Also analyzed is that high urban population pressure leads higher risk of social disorder.

Fan et al. (2019) highlighted a multi-scale and multi-dimensional perspective, the independent and coupled relationships between economic development, urbanization, and environmental/social changes, and a hybrid approach of examining the influences of the institutional intervention and the market mechanism on urbanization in transitional economies.

Karthiyayini et al. (2016) attempted to assess the influence of urbanization especially changing land-use patterns on the water quality and quantity in Ooty town of Nilgiris district, Tamilnadu, India. The study area is a rapidly urbanizing region with land development progressing at a fast pace. Land use maps indicate that the forest area is reducing and is replaced by industries and houses. The Spearman's rank correlation analyses confirmed the change of water quality is impacted by land-use changes. Correlation analysis was carried out using SPSS software. Forest land shows negative correlation with all parameters except pH, which thereby shows that the concentration of other parameters decreases with increase in the forest area. Residential area has positive correlation with all parameters except pH the indicates that increase in residential area will increase the concentration of the water quality parameters beyond the permissible limit. Questionnaire survey was conducted to know about the socio-economic status of the people. Results from the study contribute to a better understanding of not only the impact of historical land use changes on water quality, but also provides appropriate information for effective management of urban growth in the future.

Kumar et al. (2020) analyzed the pattern of urbanization and its impact on the quality and quantity of flow in the Yamuna river basin, India. During the last two decades, the basin has undergone urbanization at an unprecedented rate. Urbanization has resulted in adverse impacts on the surface water drainage system that often gets clogged up due to siltation. Although the flow during the monsoon season has increased in the river Yamuna, the water availability during the dry season is still not adequate to meet various competing demands. An adverse impact of urbanization has been on the quality of river flow, which has deteriorated largely due to the disposal of untreated industrial and domestic sewage in the river. Due to urbanization, the flooding events in the basin, both in terms of magnitude and frequency, have exhibited an increasing pattern. Consequently, the vulnerability of thickly populated areas along the river has increased. Several implementable measures for sustainable development and flood risk management of the river Yamuna basin have been suggested in the paper. The result of the study presented herein could be effectively utilized by basin managers and planners to mitigate the adverse impacts of urbanization in river Yamuna basin.

Miao et al. (2016) stated that living in more urbanized areas raises the risk of developing chronic diseases. The health penalty of urbanization is more severe among higher-income earners. Rapid urbanization accelerates the spatial concentration of people adopting unhealthy lifestyles. An unhealthy diet and decreased physical activity contribute to the negative effects of urbanization on health.

Pan et al. (2016) indicated that the Zhoushan islands experienced remarkable urban expansion and economic prosperity over that period, with a clear acceleration since 2000. The increase in built initially occurred in urban cores and then spread to peri-ocean areas over the last decade. They further quantified the socioeconomic drivers of urban expansion using multivariable regression. The study have informed ecological management, and provide a scientific case for urban development and contributed to sustainability of islands and coastal regions.

Sharma et al. (2017) made an attempt to correlate and identify the periodical changes in Urban Hydrology, during urbanization of Bhopal City, India during last twenty years and above. The observations are based on GIS Mapping of the Study Area from 1991 to 2009 using rational method of Runoff and Recharge Calculations and statistical analysis of related built-up areas. Also Change in Natural course of Drainages with help of GIS imageries during twenty years have been detected that help to observe the adaptation of natural system to urban course. Observations show an interesting relation of geology, land use-land cover and water table, which can be used for further research and sustainable development.

Sitaram (2014), described the effect of urbanisation on water quality parameters and suggest for its improvement. The water spread area for Ashtamudi Lake in these three years are found to be shrinking (1999 – 6424 ha, 2003 – 6140 ha, 2006 – 5734 ha). The detailed physico-chemical and biological examinations are collected for three years (1999, 2003, and 2006) made during pre-monsoon season for various locations and their average values are reported. A comprehensive plan is prepared to restore the water quality of Ashtamudi Lake near the Kollam City.

Srinivasan et al. (2013), examined the relationship between urbanization and water vulnerability for a fast-growing city, Chennai, India, using a coupled human–environment systems (CHES) modeling approach. Although the link between urbanization and water vulnerability is highly site-specific, our results show some generalizable factors exist. First, the urban transformation of the water system is decentralized as irrigation wells are converted to domestic wells by private individuals, and not by the municipal authority. Second, urban vulnerability to water shortages depends on a combination of several factors: the formal water infrastructure, the rate and spatial pattern of land use change, adaptation by households and the characteristics of the ground and surface water system. Third, vulnerability is dynamic, spatially variable and scale dependent. Even as household investments in private wells make individual households less vulnerable, over time and cumulatively, they make the entire region more vulnerable. Taken together, the results suggest that in order to reduce vulnerability to water shortages, there is a need for new forms of urban governance and planning institutions that are capable of managing both centralized actions by utilities and decentralized actions by millions of households.

2.2. Issues and Challenges of Urban Water Resources

In India, 163 million people do not have access to safe drinking water, and 210 million people do not have access to improved basic sanitation. In metropolitan regions, 96 per cent have access to a better water supply, while 54 per cent have access to better sanitation. In rural areas, where 72 per cent of India's population lives, only 84 per cent have access to safe water, and only 21 per cent have access to sanitation. Furthermore, there is a scarcity of wastewater treatment facilities to treat the wastewater of an expanding population. To meet present and future water demands, purified wastewater must be reused.

Aijaz (2010) in their research work pointed that requirement of the fundamental infrastructure and services in India because of growth in population. This demand affects the quality of urban life style, the economic productivity and sustainable development. This paper mainly focuses on the critical problem of water access in big cities due to the shortage of water. The study undertakes a case study approach in which the status water access in large cities such Delhi, Mumbai and Kolkata are taken into consideration. It proposes that there is a dire need to reform and construct the water infrastructure and institutions. For this the stakeholders must work on the challenges of reform process and the implementation of efficient water governance practices.

Akoteyon (2019) examined factors affecting households' access to water supply in three residential areas in parts of Lagos metropolis, Nigeria. The study used, a random sampling technique was employed to administer questionnaires to 200 households. The study area was delineated into residential types using the grid method. The result shows the dominance of improved water sources in the high/medium-income residential areas. Households in the medium-income area recorded the highest access in terms of distance to, and safety of water supply.

Arunkumar et al. (2011) examined the water demand analysis of Public Water Supply in Municipalities used EPANET 2.0 software with the aim of providing effective planning, development and operation of water supply and distribution networks which is one of the most essential components of urban infrastructure. A number of factors ranging from population expansion to inadequate existing facilities are thought to be responsible for the frequent shortage in water supply to the metropolis. The study delineated the areas within the Municipality that are un-served or underserved by the Municipality. Used EPANET 2.0 water model software, the demand for the Underserved and Unserved area is calculated. A framework for taking management decisions such as an extension of the supply network and location of new facilities was given.

Bhandari and Khare (2006) made a study on observed that though water is not strictly a public good in most countries it has been a convention that water supply and provision is the government‘s realm. In India too this is the case. India has blessed with some of the best natural water resources in the world. It has perennial rivers that are spread fairly evenly across the country, a large coastline, and (generally) high rainfall levels. The study analyses the problems with urban water supply in Delhi and other regions of India. It examined the adverse human and environmental impacts of unpriced water which is supplied inefficiently by the public sector

Cobbinah et al. (2019) explored the agency perspectives and policy responses on the possibility and procedure for harnessing urban planning as a tool for managing climate change impacts in a Ghanaian city of Kumasi. Using a review of three relevant urban planning and climate change policies of Ghana, and interviews with six urban planning and climate-related agencies in Kumasi, findings indicate a demonstration of an unclear nature of policies, and a lack of focus on climate change issues in urban planning. Evidence of weak agency framework and coordination challenges (e.g., logistics, enforcement of laws) are reported, a situation that has contributed to the city's inability to manage ‘normal’ climate change impacts (e.g., flash floods). The study concluded with proposals for incorporating climate change concerns into urban planning in Ghana.

Hossain and Delowar (2014) carried out to understand the existing water supply and its demand. The study was conducted among 80 families, where total family members are 770.The survey and sampling was used based on questionnaire for data collection followed by data interpretation and data analysis. Primary information was collected through questionnaire survey conducted with person to person. The study resulted that Jessore pourashava water supply cannot fulfill consumer demand for water. Because, there are some limitations which are electricity problem, shortage of enough pumps houses and manpower shortage.

Jayaraj et al. (2016) analyzed the water quality by using sampling points which are selected on the basis of their importance. Six sampling locations namely at Perur Lake (L1), Selvachinthamani Lake (L2), Ukkadam Lake (L3), Kurichi Lake (L4), Valankulam Lake (L5), and Singanallur Lake (L6) are selected and water samples are collected mostly from open wells in and around Coimbatore district. The physico-chemical parameters like Dissolved oxygen, Faecal coliforms, pH, Electrical conductivity, Biochemical oxygen demand, Chemical oxygen demand, Turbidity, Total dissolved solids, Sulphate, Nitrate, Phosphate, Chlorides and Alkalinity are analyzed. The results suggested that, the lake water samples collected from various sites in and around Coimbatore city are above the limits of WHO standards.

Lyu et al. (2019) discussed about climate change has larger impacts on sand fixation and carbon sequestration, especially in mountain areas. In 2017–2045, RCP 8.5 would result in a larger increase in sand fixation (by 1.75 times to 2045) and a slight decrease in carbon sequestration (by 1.62 per cent) than RCP 2.6. Land use change has a more substantial impact on the other three ESs than climate change, especially in the central plain. Specifically, cropland reclamation during 1989–2017 and urban expansion in 2017–2045 caused the most intense alterations in ESs. Reclamation can increase food production and nutrient retention, but reduce recreational opportunity, while urban expansion has the opposite impacts. Encouraging compact urban growth, creating riparian vegetation buffers and environment protection policies can effectively reduce the trade-offs and simultaneous losses among ESs. Specific recommendations are proposed for different sub-regions indicated by the ES bundle classification. Results can provide references for urban planning to enhance ESs under future global warming.

Nallathiga (2006) examined the inadequate reforms and their slow progress in water supply in urban area of India. This is true with Mumbai also where there are not enough reformation schemes for the efficiency of water service. However, the increased demand for water enforced to develop water supply system.

Noiva et al. (2017) in their research analyzed a dataset of 142 cities that includes annual per capita water use (m3/yr./cap) and population. It added a 0.5◦grid annual water budget value (P-PET/yr.) as an index of hydro climatic water supply. With these indices of urban water supply and demand, they conducted a hierarchical cluster analysis to identify relative similarities among, and distances between, the 142cases. While some expected groupings of climatically similar cities are identified, unexpected clusters are also identified, e.g., cities that use water at greater rates than local climatic water budgets pro-vide. Those cities must seek water from greater distances and greater depths. They face greater water and wastewater treatment costs. To become more sustainable they must increase water use efficiency, demand management, reuse, and recycling. The significance of the population variable suggests that adding other explanatory socio-economic variables, as well as more precise water system indices, are logical next steps for comparative analysis of urban water sustainability.

Nyathikala et al. (2017) made a study by utilizing panel data on 21 municipalities observed over the financial years 2005 and 2010, to analyze the relative efficiencies and productivity growths of utilities. Data envelopment analysis is used to obtain efficiency scores and productivity measures such as the Malmquist index. This results indicated that the presence of large relative inefficiencies and decreasing productivity of water supply services over time, alluding to a failure to revise tariffs upwards despite increasing input costs over time, thereby driving the need for sector regulation and tariff revision in accordance with X-factors, which was found to have a mean value of 2.4 per cent for possible price cap regulation in the sector.

Omarova et al. (2019) made a paper to assess the current access to the perceived water quality in villages with various types of water supply .They used to selected randomly households are interviewed. The results revealed that even though villagers are provided with tap water, significant numbers used alternative sources. There are three reasons for this situation: residents' doubts regarding the tap water quality; use of other sources out of habit; and availability of cheaper or free sources.

Robert et al. (2010) analyzed issues of water supply and contemporary urban society in Greater Amman, Jordan. The study showed an effective ubiquity of access to mains water in the Greater Amman urban area, regardless of income level and geographical area of residence within the city between high- and low-income households. The study argued that the social and economic costs of water rationing and management are high, with much emphasis on water quality as a major concern to all consumers regardless of their socio-economic status.

Singh et al. (2017) they stated that the significant variables of domestic urban water demand required for the purpose of estimation of urban water supply in five planned colonies of the City of Ajmer, Rajasthan, India, are identified. The data for these 16 variables are entered in the multiple linear regression (MLR) (stepwise) models in SPSS software, and domestic water demand models are developed. Based on these models, the six most significant variables, namely temperature (T), rainfall

(RF), family size (FS), family income (FI), number of bathrooms (NB), and age of house (AH), are identified. The data of 16 variables are further utilized in principal component analysis (PCA), and five factors/variables are extracted, comprising combinations of these 16 variables. A regression coefficient of 0.76 is obtained in the PCA model. These six significant variables are further fed into a multilayer perceptron neural network (NN) model for water demand forecasting. The linear regression coefficient of NN is 0.90, very close to the MLR (stepwise) coefficient of 0.89, and verified the dependence of water demand on these six variables. The outcome of the study suggests that the six variables are significant for the estimation of water demand for Ajmer.

Vennila et al. (2014) the study by way of capturing the options of people for the sources of drinking and its impact on health attempted to explore the status of service delivery of drinking water also Results of water quality tests and service delivery of public water supply system brought out the fact that the samples of all sources of water and the service provided are not matching the standards of safety prescribed which resulted in fatal consequences

2.3. Problems of Urban Domestic Water Consumption

Apoorva et al. (2018) in their study utilized high-resolution pressure-sensor data as a reference to evaluate the effectiveness of conventional household survey methods through a sample of 82 households in Coimbatore city in South India. The pressure sensors produced detailed, continuous and accurate information on all sources of water accessed through the household storage infrastructure, but they are expensive and intrusive. Compared with pressure-sensor derived estimates of tap water use, household surveys alone fared very poorly. However, household surveys and well-designed water diaries of supply and pumping, coupled with simple one-time field measurements, emerged as a valid approach to quantifying household water use from taps under multiple source dependence.

Dhanalakhmi et al. (2015) analyzed, the physico chemical parameters of municipal drinking water of Pollachi was analyzed from different consumer points. The analytical survey showed that the electrical conductivity (EC) (180 to 192 mMhos/cm), pH (7.3 to 7.9), calcium (12 to 17 mg/l), magnesium (5 to 7 mg/l), sodium (10 to 12 mg/l), potassium (3 to 6 mg/l), sulphate (Nil), chloride (10 to 14 mg/l), nitrate (0 to 2 mg/l), total dissolved solids (102 to 110 mg/l) and alkalinity (80 to 87 mg/l).The results revealed that the municipal drinking water contained very low quantity of calcium, magnesium, sodium, chloride, nitrate, total dissolved solids, alkalinity and are falling within the drinking water quality standards laid by WHO and ICMR. The electrical conductivity (180 to 192 mMhos/cm) of drinking water exceeded quality standards laid down by ICMR.

Ditipriya et al (2019) measured the proportion of households used to improve drinking water and sanitation facility and determined the association between diarrhea in under five children with water. The study used cross- sectional was conducted among 796 slum householder and they presented questionnaire based on drinking water for households. They result that majority 733(92.1 per cent) of slum households used on improved drinking water. Source 567(71 per cent) was public tap. About two third (65.7) household used improved facilities.

Fan et al. (2013) examined factors affecting domestic water consumption in rural households in the Wei River Basin, China. The study revealed that per capita domestic water consumption per day correlates significantly with water supply pattern and vegetable garden area. A significant negative correlation was also obtained with family size and the age of the head of the household. Hygiene habits, use of water appliances, and preference for vegetable gardening are identified as the dominant behaviours in the villages with access to improved water supply. The study recommended future studies on rural domestic water consumption with an emphasis on user lifestyles and cultural backgrounds in formulating water management schemes for rural areas.

Guimaraes et al. (2016) study deals with the water access focusing on the impact it has on a vulnerable population. The proposed approach aims at capturing the exclusion conditions of people, and is implemented through stakeholder dialogues to raise social control. The innovation approach was built supported on case studies and participatory processes tested for communities in Brazil. Water and Sanitation access durability is given by the institutionalization of services for the poor, which is achieved through adequate capacity building and transparency. Two essential dimensions are designed to monitor the right to access to water and sanitation services: inclusive governance and inclusive access.

Mayurakshi et al. (2013) discussed the ‘Shortage of Domestic Water in Jorhat Town of Assam’. The main objectives of the study are to highlight present sources of supply of domestic water and to investigate gap between demand and supply of domestic water in the town. The data base of the study consists of both primary and secondary sources. It resulted pertains that all the municipal wards are not covered by the piped water connections and thus people still collecting water from other sources which are not safe for domestic consumption, fully contaminated.

Rao (2005) in their paper noted a systematic approach has been adopted to calculate drinking water needs at present and in the near future in a spatial environment using multi-criteria decision analysis techniques. Drinking water problems in the city of Dehradun have been studied and causes of drinking water shortage have been analyzed. Different thematic layers required for the study such as, land use and land cover, road network map, have been arranged in a Geographic Information System environment using very high-resolution digital data of IKONOS satellite coupled with the field data. Future drinking water require areas have been recognized considering many variables such as: topographic slopes, land use/land cover, distance from the main city, road distance, present population density, floodplains, soils and the existing water supply method.

Sau et al. (2017) made a study to know the present scenario of accesses to safe drinking water and availability of adequate sanitation at a slum in Kolkata. Objectives are to estimate the accessibility of safe drinking water to the households at that slum and to estimate the availability of sanitary latrine to the households. Materials and Methods: An observational descriptive study with cross-sectional design was conducted at Bagbazar Slum, Kolkata, and West Bengal there are total 450 households living at that area. 200 households are selected by simple random sampling. Each household was selected using Random Number table. One adult member from each household was interviewed at their home using predesigned and pretested. Results: About 94 per cent of the selected households are using piped water supplied by Kolkata Municipal Corporation and 6 per cent are using bottled water for drinking purpose. 78 per cent households had to use shared sanitary latrine into their household premises, but (84 per cent) households did not have any latrine facility. Conclusions: All the household had access to safe drinking water. There is a need for improvement in sanitation facility at that slum.

Shaban (2008) in their study noted that the quantity of water used in domestic households and suggested quantity of water consumption in seven major Indian cities that is, Ahmadabad, Delhi, Hyderabad, Kanpur, Kolkata, Madurai and Mumbai. The paper also observed that to find out equity in utilization of water across different socio-economic groups, sources of water supply, awareness of households about quality of municipal water and period of municipal water supply.

Shah et al. (2015) examined the urban water status in India and also it advances the series of hypothesis which was served as an initial analytical framework and outlines a way forward for an urban water systems, which could provide a rich terrain for the future research.

Singh (2013) examined the households daily and activity wise water consumption, sources, quality, duration, frequency of water supply, distance of different sources and the level of awareness about rainwater harvesting. They based on questionnaires and interview survey of 763 households. Results of the study revealed that the daily average water consumption for the village was found to be 117.0 l per person per capita per day (SD = 35.8). Washing of clothes consumes the highest amount of water, whereas 85 per cent of the households are using government water supplies with very safe water quality.

Troy et al. (2004) examined that the water consumption patterns for different types of residential dwellings and areas in Adelaide, Australia. The method uses datasets regularly collected and maintained by a number of organizations to allow water consumption patterns to be analyzed and examined over time. The results suggest that water consumption varies between different types of residential dwellings, and areas, and that using metropolitan averages to measure national consumption patterns can be misleading. Importantly, the results suggest that per capita consumption is not significantly different between different types of dwellings. The ability to analyze water consumption patterns at the local level would enable planners and managers to better target initiatives aimed at reducing water consumption, and would also give planners a new tool to assess planning and environmental policies.

Victore et al. (2019) investigated the relationship between the quantity of domestic water use and some selected factors in Bauchi metropolis. The study used exploratory research of mixed design; a structured questionnaire was administered using a stratified random sampling technique to collect data. Descriptive statistical tools are used in analyzing the data and the instrument of analysis was Microsoft Excel software. The study resulted that there was a positive correlation between the quantity of domestic water use and education level, income, household size and marital status. The study recommended that socio- cultural factors should be an integral part of any water planning scheme in Bauchi metropolis.

2.4. Urban Domestic Water Conservation and Theory of Planned Behaviour

Only three per cent of the total water available is freshwater. But more than sixty per cent of this potable water is locked up in ice caps and glaciers. Therefore, we humans must consume water judiciously. But so far, we have done the reverse. We exploit water extensively for agriculture and industrial purposes. Moreover, we haven't kept our water bodies clean. Industrial effluents and sewage discharges are directly let into rivers. In cities, buildings come up on dried ponds and lakes. So, when it rains, we don't have the facility to store the rainwater. in concrete jungles, and a green cover is almost missing in our cities. It is the roots of trees that help in the retention of groundwater

Aprile (2016) investigated the link between water conservation behavior and general environmental concerns using a large. They used Multipurpose Household Survey conducted annually by the Italian Central Statistics Office. Univariate probit models show that pollution and resource exhaustion are positively related to individual water conservation behaviour while alteration of environmental heritage exhibits a negative relationship with water saving behavior. These resulted to the inclusion of environment knowledge and social capital variables. Robustness analysis also indicates that television and radio, participation in environmental initiatives, money for environmental protection and churchgoing are significant of determinants

Chaudhary et al. (2017) the study used survey research to examine the relationship between several variables, including attitudes, subjective norms, perceived behavioral control, personal norms, demographic factors, and past behaviors, on intention to use good irrigation practices among Florida home landscape irrigation users (N=1,063). Following subsequent hierarchical linear regression models, the final model explained 39 per cent of the variance in intentions to engage in good landscape irrigation practices. Subjective norms had a strong influence on intention to engage in landscape water conservation, and past behaviors and personal norms improved the prediction. Extension professionals should incorporate subjective norms into water conservation programs by emphasizing somewhat invisible conservation behaviors to improve perceptions of peers' practices. When personal norms are strong, the subjective norms are slightly less important. Residents who feel a personal obligation to conserve water may be more open to information related to water conservation, and they may be more likely to act, even in the absence of social support. Finally, Extension professionals should consider the audience's past behaviors to design programs that are compatible with actions that Extension clients are likely to take.

Fielding et al. (2012) examined that he key determinants of household water use, with a view to identifying those factors that could be targeted in water demand management campaigns. Water use data and surveys were collected from 1008 household's in four local government areas of southeast Queensland, Australia. Results showed that demographic, psychosocial, behavioral, and infrastructure variables all have a role to play in determining household water use. Consistent with past research, household occupancy was the most important predictor of water use. Households in regions recently exposed to drought conditions and higher-level restrictions also used less water than those who had less experience with drought. The effect of water efficient technology was mixed: some water efficient appliances were associated with less water use, while others were associated with more water use. Results also demonstrated the importance of considering water use as a collective behavior that is influenced by household dynamics. Households who reported a stronger culture of water conservation used less water. These findings, along with evidence that good water-saving habits are linked to water conservation, highlight the value of policies that support long-term cultural shifts in the way people think about and use water.

Koop et al. (2019) estimated that enhancing domestic water conservation provides a promising alternative or necessary addition to reduce costs and to stimulate pro-environmental behaviour. Although the number of field experiments on how people's behavior can be changed with respect to their daily water consumption was growing, to date, most studies in this field have focused either on explanatory socio-economic factors (e.g. water pricing, income, or family composition) or behavioral intentions and personal characteristics related to behavioral change. Used a review of the empirically oriented literature in this field and aims to provide an up-to-date assessment that identifies eight different Behavioral Influencing Tactics (BITs) that target long-term water conservation behavior within households. The analysis was structured around three information processing routes: the reflective route, the semi-reflective route, and the automatic route. They conclude that the current body of literature was promising and provides a useful body of evidence on the range and effectiveness of individual water conservation mechanisms, but that needs further development to deepen our understanding of how to effectively prolong and reinforce newly formed water conservation routines.

Lam (1999) in the study tested the explanatory power of Ajzen's (1991) theory of planned behavior (TPB), and a modified TPB model including perceived moral obligation (PMO) and perceived water right (PWR), to predict people's intentions to conserve water. The study had 244 government employees who participated. The TPB variables improved the prediction of intention to use less water, but were less successful in predicting intention to install water-efficient appliances. A significant interaction was found between attitude and subjective norm, suggesting that past studies have overlooked moderating effects in the TPB model. In addition to the TPB variables, PWR further improved the prediction of intention to install water-efficient appliances. Results also suggest that water-saving procedures should be differentiated into curtailment and efficiency procedures.

Mahdavi (2021) conducted study to determine how native farmers support different policy options to reduce agricultural water consumption. Structural equations modeling was used to construct structures derived from the ‘theory of planned behavior’. For each policy option, a separate model is proposed and the modeling data supports the view that attitudes, subjective norms, and perceived behavioral control have a positive and significant effect on the intention. Attitudes, and perceived behavioral control, have the strongest effect on intention. Significantly, intention also have a positive impact on farmers’ behavior. According to the results of the present research, the variance explained is over 85 per cent for intentions and the variance explained for the farmers’ behavior on water policy options is above 45 per cent which is a result that indicates the high ability of the ‘theory of planned behavior’ in predicting policies achievement on saving agricultural water resources. It is argued that the field of psychology, and in particular environmental psychology, can play an important role in understanding more of the drivers to reduce agricultural water consumption and contribute to the social research program for water policy.

Marcos et al. (2021) analyzed that water conservation with rainwater harvesting is an adaptation and mitigation effort to these problems, but Indonesia's application is still minim. This study scrutinizes rainwater harvesting by looking at literature review that had applied in various countries and discussed the advantages and challenges of these methods. Besides, to understand people's behaviour intentions, this study uses self-evaluation as the data to be analyzed using an extended theory of planned behaviour model. This study indicates that rainwater harvesting can have a positive impact on water conservation, such as cut down surface water deterioration and mitigate seasonal disasters. These impacts can felt like a whole if those systems are implemented on a wide scale. On the other hand, the extended theory of planned behaviour model shows that 16.4 per cent of the intention to utilize rainwater harvesting with the highest variable is the attitude variable. Recommended approaches for improving attitudes in rainwater harvesting are described in this paper

Russell et al. (2010) they argued that the field of psychology and environmental psychology in particular can make a vital contribution in understanding further the drivers of residential water demand. A growing body of literature in environmental psychology has examined the determinants of water conservation behavior, and this research has many potential applications for water demand policy. In this paper we offer a review of current psychological research that examines the five broad causes of residential water conservation behaviors: attitudes, beliefs, habits or routines, personal capabilities, and contextual factors. We assess how psychologists have studied water conservation behavior to date, identify shortcomings, and indicate how this research can be used to further promote residential water conservation and to inform evidence-based policy and practice.

Sethuram (2014) described water security, policy changes and to analyze the policies and adaptation strategies. The paper uses mixed- method and accidental sampling for data collection. The data show that, even with 700mm and 1100mm of annual rainfall, Chennai still had water insecurity. The survey results implied that an increase in water use efficiency was much needed. Resulted the water supply was irregular, unreliable and inadequate. This was due to accessibility issues in certain areas. Contamination was mid to high due to domestic and other wastes and, hence the water-borne disease spread during summer.

Warner et al. (2021) made a study to examine whether connectedness to water could improve the predictive power of the Theory of Planned Behavior on outdoor water conservation intentions. We adapted the well-established Connectedness to Nature Scale to measure connectedness to water. Using quantitative survey data from 3,596 residents, we used multiple regression to examine relationships between the connectedness to water construct and Theory of Planned Behavior variables. Connectedness to water increased the predictive power of the Theory of Planned Behavior and importantly, exceeded the predictive power of any of the theory's individual variables.

Zhong et. al, (2019), examined that Water-saving irrigation behavior (WSIB) is important for sustainable economic and social development in river basins and is promoted by improving water-saving awareness. Understanding the factors of WSIB could facilitate water demand management and information campaigns. Using the theory of planned behavior, this paper analyzes the influence of subjective attitude, perceived behavioral control and subjective norms on behavioral intention and final behavior with a structural equation model (SEM). Moreover, comparative study of the upper, middle and lower reaches of a river basin is also carried out to examine the regional differences. These findings highlight policies that (1) strengthen economic interests and increase the transformation of water-saving awareness into WSIB; (2) strengthen public awareness and neighborhood interaction, setting good examples to promote WSIB; and (3) increase farmer participation in relevant decision-making.

2.5. Private Sector Participation in Urban Water Supply

Now a days water scarcity were increasing because Globalization, Liberalization, Privatization leads a way to increasing in rapid population growth and urbanization. These are major factors posing fundamental challenges to the global water cycle, with a particular pressure on the urban water supply. Overlaying and intensifying all of these pressures is climate change, including rising temperatures, extreme weather events, rising sea levels, and reduction in river flows and groundwater levels.

Adems et al. (2019), the article synthesized that the literature on historical and emerging institutional arrangements for urban water supply in Sub-Saharan Africa to highlight successes, drawbacks, and opportunities for improving future water access. It traces the influence of decades-long global water initiatives on urban water-policy reforms in the region and reviews evidence on emerging community self-help and partnership models. Finally, it discusses the merits, targets and potential of Sustainable Development Goal 6 to improve urban water access in the region. The findings suggest that improving urban water supply in Sub-Saharan Africa requires innovative governance and institutional arrangements that blend the strengths of public, private and community-based water supply models.

Gulyani et al. (2005) studied about the water for the urban poor discussed that urban poor are served inadequate water by the public utilities and small-scale private water providers. Based on a survey of 674 households, this paper examined current water use and unit costs in three Kenyan cities and also tested the willingness of the unconnected to pay for piped water, yard connections, or standpipe service. By examining water-use behavior of poor and non-poor households, the study brought into question a long-standing notion in the literature that the poor are underserved, use small quantities of water, and pay a higher unit price for it. The study opined that water should be priced and water markets should be created so that service delivery options can be improved without appropriate institutional arrangements, technical solutions such as water kiosks may not succeed in delivering an affordable service to the poor.

Ramachandraiah and Prasad (2004) in their paper on states that the physical environment of Hyderabad city is controlled by the several lakes of the city. The responsible factors for total dysfunctional of the water utilities are rapid urban sprawl of the city and control of state and private agencies. Many lakes of Hyderabad have been shortened. Moreover, due to the industrial and untreated domestic wastewater polluted many lakes. The water crisis in several regions of the city is faced due the bad effect of water bodies. There is the steep decline in water table. The shortened size of lakes and water channels was the one of the important responsible factors for the flood occurred in August 2000. The research also states ignorance towards implementation of existing law and remedies suggested by environmental organizations.

2.6. International Studies on Urban Water Resource

Ali et al. (2012) identified major sources of water supply and consumption at household level spatial and temporal variation in water supply and consumption at household level and To describe determinant factors those affect the consumption of water at household level .The study was based on both primary and secondary sources of the data. Secondary data are gathered from town administration office and water supply and sewage service enterprise office, Nekemte. Primary data are collected through questionnaires focus on the existing water supply systems, their distribution, spatial variation and determinant factors they are used Random sampling. They resulted main water supply for Bakanisa Kesse sub-city where residents used surface water for different purposes, including household activities.

Chen et al. (2017), have highlighted that the normalized average annual runoff depth from urban land of U.S. was assessed. Urban expansion and intensification serve as drivers altering surface runoff. National annual runoff volume increased 10 per cent from 2001 to 2011 due to urbanization. Population change alone is inadequate to analyze the increase in urban development. The L-THIA Tabular Tool is capable of assessing urbanization impacts on runoff.

Daigger (2009) in their paper discussed on Water reclamation and reuse decentralization and resource recovery studied that population growth and improving standards of living, coupled with dramatically increased urbanization, are placing increased pressures on available water resources. The current linear approach to urban water management, which is sometimes called the take, make, waste approach in the sustainable literature when applied more broadly to natural resource use, is becoming increasingly unsustainable.

Dakua, M. Mahmood (2016) this study are to perform quantitative analysis of grey water recycling using constructed wetland process (horizontal and vertical flow) and feasibility study of application of recycled water in daily use. It included a residential staff quarter, a residential hostel and a hospital as the subject area. The three different types of water consumption rate in different sectors in these areas and the amount of produced and recycled grey water are studied. This study has found that with the use of recycled water, it can be saved 19.22 per cent of total water in Titumir hall, 17.71 per cent of total water in hospital and 17.62 per cent of total water in staff quarter easily which is used in cleaning, washing, gardening and flushing and availability of recycled water is more than enough for the sectors in which it can be used.

De Clercq et al. (2018) aimed to identified that the most important variables driving urban water supply patterns in China, a region which has seen rapid urban growth in the last few decades. In addition, a principal component analysis-informed urban water sustainability index was developed in order to benchmark cities. The research involved applying statistical learning and other analytical methods to 12 years of urban water supply data for 627 cities across China. The implications of our research effort will be useful for decision makers in water-stressed urban areas around the world who are seeking novel insights in how to leverage statistical learning techniques to gain insights into urban drinking water supply patterns.

Emoabino et al. (2007) in their paper on problems and prospects pointed out that water supply in Nigeria was facing serious challenges and supply-oriented indefinite expansion of water supply infrastructures was stressing the available budgetary allocations to the sector to the limit. Governments have been pursuing water supply programmers and donor agencies also have been making efforts to expand water supply infrastructures. Despite these efforts still a substantial number of people are not covered with safe drinking water and sanitation.

Kholfi et al. (2018) identified domestic water consumption among citizens of Ilam using a segmentation approach based on demographic variables. Water consumption pattern in the study was investigated with a cognitive-behavioral approach. The research population of the study consisted of domestic water consumers in Ilam. From the study population a sample of 313 individuals selected and they are used multistage cluster sampling to respond the research questionnaire.. The result was to indicate that unemployed individuals are usually placed in high consumption clusters.

Rashid et al. (2018) focused that effects of rapidly growing urban life and its impact on water resources in the Muzaffarabad city. The data for that paper come from 20 in-depth interviews with members of the local government, political workers and local residents of the city, carried out during the year 2015, to analyze the way in which increasing urban life is affecting water quality in the area. The findings indicated that waters of both rivers Jhelum and Neelum are being viciously contaminated by the local residents, which results in a scarcity of drinking water and a number of viral diseases.

Van et al, (2018) the studied about that the characterized the water security of cities by developed and applied a new urban water security dashboard. We take a system perspective on urban water security by developed s dashboard of indicators based on the pressure state impact and the response framework. The study used the PSIR frame work and the study are constructed a dashboard of indicators and applied in order to score ten selected cities. The result of the study was ranked obtained based on water security index we group cities based on the resemblance between dashboard score then, we obtained further insight into the system dynamic that lead to a certain level of water security.

2.7. General Studies on Urban Water Resource Management

Water is the elixir of life, a precious gift of nature to mankind and millions of other species living on the earth. Increasing attention needs to be focused on water supply, sanitation, and solid waste management services as these affect the quality of life of citizens and the economic growth of the country. An aspect that is a cause of concern is the neglect of the water supply sector from the standpoint of investments. Good policies, good local governance systems, and sound arrangements to finance public services are critical elements in sustainable urban development and shape the nature and quality of public services provided.

Arlosorof (2007) in his paper on found that to combat water scarcities in The Middle East a condition which might accompany the Middle East socioeconomic policies for many years to come is Water Demand Management and/or Water Conservation' as well as the Increase of Water Use Efficiency These three erms have become a major shift of paradigm from the conventional supply side management of water to the management of the demand side producing additional quantities of water for the immediate needs of the society through the creation of Virtual‖ quantities of water, whether by conservation strategies or by increased agricultural and industrial production per unit of water, as well as the import of water intensive agricultural products and decreasing exports of such products

Chini et al. (2018) accessed the energy for water components of the energy water nexus by providing and analyzing a unique primary database consisting of drinking water and waste water utility flow and energy. These anthropogenic fluxes of water through the urban environment are used to assess the state of the U.S urban energy water nexus at over 160 utilities and also it is important to identify geographical and accounting system boundaries. Urban water flux utilizes drinking water and wastewater utility level data; therefore, each utility service area provides the geographical boundary for its respective city. The study concluded the water flux and embedded energy fluctuated monthly in many cities. As the nation's water resources become increasingly was scarce and unpredictable, it is essential to have a set of empirical data for continuous evaluation and updates on the state of the U.S. urban energy-water nexus.

Graham (2016) estimated to describe gender differences in water collection labour among both adult and children (<15 years of age) in the household that report spended more than 30 minutes for collecting water, disaggregated of urban and rural. We analyzed data from the demographic health survey and the countries. He concluded that household spending more than 30 minutes to collect the water and the adult female are the primary collectors of water across all 24 countries.

Gupta et al. (2006) in their working paper on Implications for managing water utilities assessed that data envelopment analysis (DEA) is an analytical tool for measuring technical efficiency. Cities are categorized into two groups (e.g. Municipal Corporations and Government, and Municipal Corporations and parastatal) according to the management structures of their water utilities. The efficiency of urban water supply system in select 27 Indian cities for the year 2004-05 was assessed. The results showed that although the average technical efficiency scorings between these two groups are not significantly different, but the decomposition of this total efficiency indicated that the utilities managed by Municipalities in collaboration with parastatal are relatively scale efficient in comparison to the other group. Moreover, the results also have implications for urban domestic water pricing. Most of the water utilities are operating under decreasing returns to scale (DRS) implying that water should be priced at marginal cost of supply.

Naeem (2017) to establish whether drinking water of urban areas of Peshawar is fit for drinking or not, in view of WHO recommendation. Twenty-nine samples are collected from drinking water sources from different houses of urban areas. Presumptive coliform test was done on all samples according to WHO criteria.

Olufayokemi and Oyesanmi (2018) assesed the water supply and household water consumption pattern in Lokoja metropolis are investigated. Primary data on water supply and consumption was obtained through the interview and questionnaire methods. Copies of the questionnaires are administered to 236 households using the systematic random sampling method. The methods of data analysis involved descriptive and inferential statistics. The study revealed that residents of GRA, Lokongoma Phase 1 and Kabawa areas depended majorly on pipe borne water supplied from the state water board (81.8 per cent, 88.3 per cent and 65.6 per cent respectively). The study used Systematic random sampling was used to sample households in the four residential zones. The results showed households in GRA, Lokongoma Phase 1 estate and Kabawa depended mainly on water supplied from Water Board.

Sadoff (2006) sheds focus on the increase of water in the country Ethiopia. In this country we witness that the centrality of water is clear. Ethiopia has certain problems regarding water security through production of the least platform of water infrastructure and management capacity. They are the water resources infrastructure, tremendous hydrological changeability and seasonality, feeble management institutions and a extremely vulnerable economy as well.

Supriya et al. (2016) made an optimization problem is formulated and that can be implemented by considering the constraints of complete utilization of the available surface water resources with the objective of minimizing total future demand-supply gap. The Genetic Algorithm (GA) result reveals that the optimal water allocation during 2011, a maximum of 70lpcd is provided to the municipalities. Then the minimum of 30lpcd supplied to the village panchayats. The projected optimal water allocation in 2021 and 31, only a minimum of 30lpcd is available for supply and this is due to the increase in urban population and volume of water resources availability remains constant.

Thangamayan et al. (2019) examined that the Municipal Administration and Water Supply Department is responsible for the development of urban areas in the state and for ensuring provision of infrastructure facilities to all the areas of the State. There are 12 municipal corporations, 124 Municipalities and 528 Town Panchayats under the control of Municipal Administration and Water Supply Department. The Government has accorded priority for the provision and access to safe and adequate drinking water to every house hold in the urban local bodies. The Government of India in 2013 has introduced the scheme called Jawaharlal Nehru Urban Renewal Mission (JN-NURM) to encourage reforms driven, fast tract planned development of identified cities with a focus on efficiency in urban infrastructure / service delivery mechanisms, community participation and accountability of urban local bodies towards citizens. The nodal agency for the State of Tamilnadu is TUFIDCO and the concerned department at Government of Tamilnadu is Municipal Administration and Water Supply.

Venkatachalam (2014) analyzed the role of informal markets in fulfilling the water requirements of poorer households in Chennai City, India. They are selected 10 household sample was as a representative ward, and the household survey was conducted here, especially in the low-income settlements. The results suggested that improvements in public water supply would significantly increase the welfare of the poor. The informal markets need to be regulated and monitored so that they can serve the households in a better way.

Literature Gap

Studies on impacts of urbanization like ***(Srinivasan et al. (2013), Arunpandiyan et al. (2015), Sitaram (2014), Pan et al. (2016), Miao et al. (2016), Karthiyayini et al. (2016))*** they are discussed about the impact on urbanization on water resources stated that rapid urbanization brings water at stress level and also they concluded that due to urbanization water quality was decreased and it may leads water borne disease. Many studies ***like (Arisiso et al. (2017), Noiva et al. (2017), Mayurakshi et al. (2013), Singh G et al. (2017), Shah et al. (2015), Thangamayan et al. (2019), Jayaraj et al. (2016))*** are discussed that stress the problems associated with urbanization like gap between demand for and supply of basic infrastructure facilities, inequality in the distribution of water and quality estimates of water resources. The studies like ***(Troy et al. (2004), Victore Istifanus et, al. (2019), Fan et al. (2013) Shaban (2008 Singh (2013))*** are examined that urban domestic water consumption pattern and behaviour, attitude, water supply quantity and its quality. They concluded that mostly lpcd was affected by family size and income level. (Chini ***et, al.(2018), Naeem (2017), Venkatachalam (2014)***) they studied that management of urban domestic water demand and also discussed with informal water markets and its necessity. Some Studies ***(Ali et, al.(2012), S. Sethuram (2014))*** are discussed about the role of climate change on water supply and demand patterns they concluded that climate change leads high pressure in water resources. Studies on Willingness to Pay like that of ***Ifabiyi (2011), Florencia et al. (2012), Suprabha (2016))***, reveal that households are willing to pay more irrespective of their income and that the most important factor affecting willingness to pay is price. Studies on water conservation like ***Carmela (2016), Koop et al. (2019) Economic Review (2012)),*** provides a framework that should be used in preparing, implementing, monitoring and evaluating a Water Conservation Awareness programme, or in reviewing the content and approach of ongoing programmes. ***Marcos et al. (2021), Fielding et al. (2012) Kumar Chaudhary et al. (2017), Russell et al. (2010)*** are discussing the theory of planned behaviour in urban water conservation and promoting rainwater harvesting and water demand in urban areas***. Mahdavi, T. (2021), Zhong et al. (2019), Lam (1999), Warner et al. (2021), Kumar Chaudhary et al. (2017, Russell et al. (2010)***

are discussing about the planned behaviour with rural area irrigation water conservation.

Conclusion

The review of literature collected by the investigator has showed that there are numerous study available regarding to water consumption pattern in rural areas of Tamil Nadu. And there are very limited research on the urban settlement taking place in Tamil Nadu. Very few studies are available towards the water availability problem and consumption pattern of people on basis of their income group. While exploring the literature work, the investigator has found that the willingness to pay for better water for domestic use is restricted especially in the Case of urban areas of Coimbatore city of Tamil Nadu. To widen this gap, the investigator has formulated the current study to study on "**Socio-economic and Environmental Aspects of Urban Water Consumption in Selected Households"** for the upcoming researchers and policy makers.