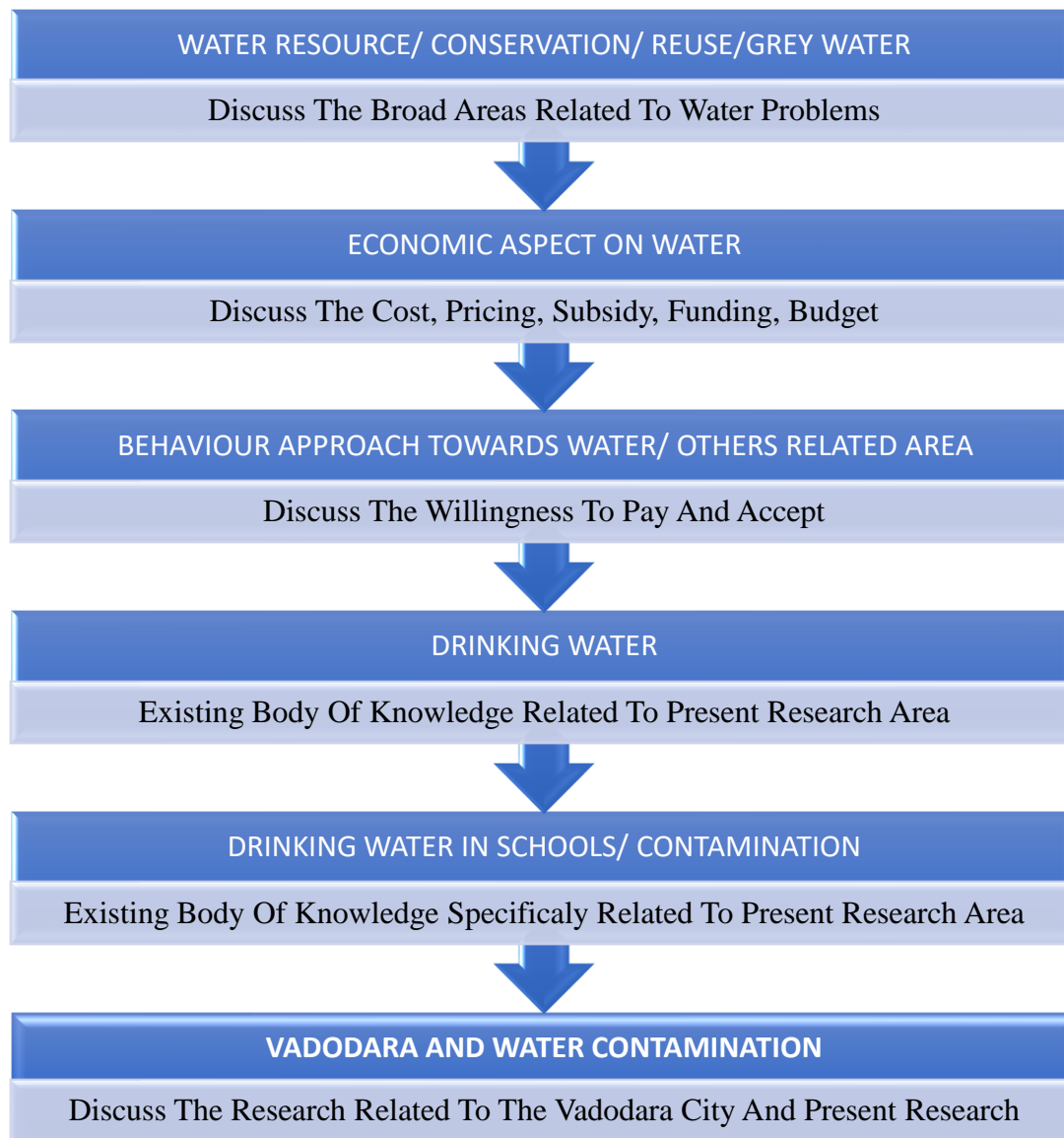## CHAPTER: 2
REVIEW OF LITERATURE

This chapter reviews the literature related to drinking water in the related to health hazards, contamination of water, cost and maintenance of water, projects, and reports on water. The objective of the chapter is to identify the Research Gap in the area related to drinking water. The methodology of the review is done through the online E-resource and print journals, magazines, publications, and available reports. The chapter is divided into sections based on the closely related areas, review of literature from the globe and the review of literature selected within the country. The study doesn't cover the scientific aspect of water like chlorine, Sulphur, magnesium, and many such others, to keep the subject area in the purview Economics. The literature related to the testing of water quality, its micro- organic component and properties or the areas of pure science are not included in the review of literature.

The Review of literature is based on sub theme at threshold details the broad subject matter on water resource/ conservation/ reuse/grey water and then narrowed down to the Drinking water in Schools. The researcher has undertaken the review of research studies at broader sense to under the problematic area related to water and how those problems can be related to the present study.

Section 2.1 Water resource/ conservation/ reuse/grey water discuss the broad areas related to water problems, 2.2 Economic aspect on water discuss the cost, pricing, subsidy, funding, budget, 2.3 Behaviour approach towards water/ others related area discuss the willingness to pay and accept 2.4 Drinking water details the existing body of knowledge related to present research area. 2.5 Drinking water in schools/ contamination related to existing body of knowledge specifically related to present research area. 2.6 Vadodara and water contamination discuss the research related to the Vadodara city and present research

Table 2.1

Brief Overview of Literature Review

WATER RESOURCE/ CONSERVATION/ REUSE/GREY WATER
Discuss The Broad Areas Related To Water Problems

ECONOMIC ASPECT ON WATER
Discuss The Cost, Pricing, Subsidy, Funding, Budget

BEHAVIOUR APPROACH TOWARDS WATER/ OTHERS RELATED AREA
Discuss The Willingness To Pay And Accept

DRINKING WATER
Existing Body Of Knowledge Related To Present Research Area

DRINKING WATER IN SCHOOLS/ CONTAMINATION
Existing Body Of Knowledge Specificaly Related To Present Research Area

VADODARA AND WATER CONTAMINATION
Discuss The Research Related To The Vadodara City And Present Research

2.1   WATER RESOURCE/ CONSERVATION/ REUSE/GREY WATER

The study under the water resource, conservation, reuse, and grey water covers the related review of literature which is important from the perspective of the present research. The researcher tried to take insights from this review to develop the macro understating of the water related issues in different aspects of water problems. This gives the bird eye view of water issues in selected areas.

Why these studies are Important from Research point?

The following review of literature gives the broad understanding of the concepts and problematic areas of water. It helps in understanding the advantages and disadvantages on subject matter like water harvesting, grey water, water reuse and water resource: To establish the connection and use the information in the present research for finding and suggestions.

Study conducted by Soufian et al (2021) in Morocco based on bibliographic study on water desalination problems related to energy consumption, carbon footprint and brine management. Review of the study showed that RO technology is used widely to desalinate water which has negative impact on environment due to high energy consumption, carbon footprint and brine disposal. The study suggested the use of renewable source of energy to minimize the negative aspect of the RO water.

He, et al. (2021) in their study showed that the water scarcity among global urban population is expected to increase from 933 million in 2016 i.e., one third of global urban population to 1.693-2.373 billion in 2050 i.e., one third or almost half of the global urban population and India is expected to be acutely affected in terms of growth in water-scarce population of urban area i.e. increase of 153-422 million people. Also, the large cities are supposed to be affected by the problem of water scarcity and effect of scarcity will increase from 193 to 193-284 that includes 10-20 megacities. Through infrastructure investment, two-third of water scare cities can be retrieved. But the probable environmental tradeoffs related with large-scale water scarcity solutions must be guarded against.

The study of Khanal, et al. (2020) to identify the evidence gap between different determinants is associated with Rainwater Harvesting System (RWHS). In study based on bibliographic review of various research works published in valued journals from the year 2000 to 2020 related to the significance of Rainwater Harvesting System amidst scarcity of water around the globe was reviewed. The results of the study showed that the Rainwater Harvesting System becomes economically viable when certain steps associated with risk assessment were carried out in planning and maintain this system. In a nutshell, the research study concludes that the sufficiency of drinking water is possible only when a sustainable drinking water supply system is built via Rainwater Harvesting System.

In the study by Tortajada (2020), he has discussed potential of recycled wastewater. Wastewater, which was not acceptable and not been appreciated until recently, is progressively recognized as a potential 'new' foundation of clean water for drinking and domestic uses,

ensuing in social, environmental, and economic benefits. The methodology of the study was based on review of literature on reuse of wastewater.

Shaikh, et al. (2019) in his study, has discussed characteristics of Greywater (GW) in developed and developing countries. "Several factors such as type of GW, scale of treatment, land availability, reuse applications, post treatment requirements, capital and maintenance costs, and reliability and replicability" must be considered while choosing an appropriate GW treatment technology. The learning of the study also analyzed the health risk linked with the use of treated GW.

The research work carried out by Boretti, et al. (2019) discussed the interrelationship between the exponential growth in world's population and GDP and scarcity of water, which is the outcome of increasing demand for water, limited water resources and pollution of water. Future clean water scarcity may be removed by improvements in the science and technology, water management, clean water supply, increase in awareness of water conservation meanwhile developing nature-based solutions (NBS). In the developing countries political will to enact the global regulations because unregulated development is not sustainable.

According to Gujarat Water Supply and Sewage Board (2019), the Sardar Sarovar Dam is one of the key surface water sources of drinking water for the Vadodara city, temporarily stopped supplying due to complaints about the high sulfur content of the Narmada River for a short period of time. Gujarat Environment Management Institute (GEMI) laboratory at Gandhinagar collected the sample from GWSSB, found that the water contains high Sulphide in water.

The study conducted by Suarez, Kulak, King, Chatterton, Gupta, and Saksena (2019), mentions that Indian households connected to improved water sources still need to purify their water before drinking. In the present study a comparison was made about the environmental effects of three purification options in urban India namely, (a) boiling water, (b) bottled, purified water, and (c) purifying the water with a domestic reverse-osmosis (RO) device. Primary data for the manufacture, distribution, and the use of the RO device were obtained directly from the manufacturer. Water boiled using the liquefied petroleum gas (current practice of urban consumers in India) was found to have higher impacts on climate change and fossil resource use than water from a domestic RO device. The use of the device; however, was found to have higher impacts on water resources than boiling, both in terms of quality (freshwater eutrophication) and availability (water consumption)

Matto, et al. (2017) study showed that urban water management models, study urban water efficiency and conservation, is outdated and unregulated and has an undesirable impact on quality and quantity of present water resources. The methodology is based on secondary data which was used as base line from the CSE's (Center for Science and Environment) background research.

Isabel et al. (2017), in the study have discussed about the water which is the most essential element for survival of living beings on planet earth. To living a healthy life, everyone needs clean and safe water to drink, and it is the responsibility of every government to assure the affordability of the same. On July 28, 2010, right to clean drinking water, has been declared as an essential to the realization of all human rights, passed through UN General Assembly Resolution No. 64/292. Mainly, it calls upon developing countries to provide for safe, clean, accessible, and affordable drinking water and sanitation for all. 2020-21 has been a testing time for the world where an infectious disease named covid-19 has brought all the nation's economy at halt and has been declared as an epidemic. In general, the present paper discusses the impact of this disease on human rights to access to clean water during lockdown situation. Specifically, It investigates the facts related to water scarcity in water stressed states in India.

The study of Kummu, et al. (2016) suggests a first assessment of ongoing sub-national trajectories of blue water consumption, availability renewable fresh water and scarcity of water for the whole 20th century. By adopting the fundamental concepts of shortage and stress scarcity of water is analyzed. It indicates the exploitation of resources and unsatisfied needs of the population. Under the study period, water consumption increased four times while scarcity of population under water increased from 0.24 billion in the 1900s to 3.8 billion in 2000s. Almost all sub-national trajectories depict an increasing trend of water scarcity. Archetypes and shapes of scarcity trajectory is established to characterize the historical movement of water scarcity and recommends the way to remove water scarcity and increase sustainability. To help in tackling these evolving challenges, linking the scarcity trajectories with other datasets might help in understanding of how trajectories relate to historical and future drivers and help in tackling the emerging threats.

Kees Roest et. al (2016) in their research study conducted in the Netherland, Amsterdam, to achieve as much as possible cycle closure by applying innovative concepts and technological solutions in the circular economy. "The circular economy is an economic system that is designed to maximize reusability of products and raw materials and to minimize value

destruction ". The finding of the study showed that "The low-tech biofilters installed on De Ceuvel site (grey water purification systems) ensure sufficient water effluent quality for it to be discharged into the ground without threatening the environment, based on Dutch regulation. Concerning toilet waste composting, results on biological indicators show that toilet waste needs to be composted for a longer period of time in order to ensure safe handling and reuse as a soil conditioner", decentralized water purification is costlier than centralized and per capita drinking water consumption is only 5 liters compared to the conventional average of 25 liters for office and 128 liters, needed for drinking water, food making and personal hygiene.

Prakash, et al. (2014), in the present study has discussed about the conflict between peri-urban and urban water users in Mallanpet, a peri-urban village close to Hyderabad city. In Mallanpet and neighbouring villages, around fifteen to twenty tanker companies are operational, nearly all of which are owned by local inhabitants of the area.

The number of tanker companies fluctuates depending on business conditions. Majority of the tanker operators have not procured any legal permission from the authorities to run this business. During the survey, the researchers found that pumping groundwater and selling it to urban consumers required minimal hard work and it yielded maximum returns. Some villagers have been able to grab this opportunity, more so because agriculture is no longer profitable. Based on the data collected from individual pumps and selected tanker companies operating in the village, estimations was made of the amount of water being extracted and the revenue earned by a few wealthy and powerful people in the village. The conflict is concealed at the moment because the water sellers and buyers are more powerful socially and economically, while the people who are at the receiving end do not have a voice. They are not able to avert the withdrawal and sale of groundwater in order to help reduce their insecurity. Though, there are some strong laws like the 2002 Andhra Pradesh Water, Land and Trees Act (APWALTA) which prevents the mining of aquifers, the strong nexus between local authorities, politicians and water sellers helps bypass the law as is very clearly revealed through discussions with different stakeholders.

The study conducted by Biraja (2014) is based on census data 2011 and shows the comparison in availability of water, provision for sanitation and hygiene in slums and non-slum urban areas. The study found that water availability in slums were poor and there is a need for some provisioning in the sanitation and hygiene in slums area.

Arjun Dhakal et al (2013) a case study conducted the Rupa Watershed in the Kaski, Nepal, aims to identify the stakeholder's involvement in lake watershed management and better the livelihood of the economically backward community living around it and develop CBA (cost benefit analysis) to suggest specific investment projects and sharing the cost and responsibility. Study covers drinking water issue as important part of the climate change and community facing problem of shortage of drinking water residing near the watershed. The finding of the study suggested that CBA was helpful in identifying the important stakeholders in developing the project, addressing the problem, negotiation and effective implementation of the project.

Klug, et al. (2012) in their study reveal that over the last two decades in the Alps, drinking water consumption has increased from inhabitants and tourists. To develop the long-term mitigation strategies, the water resource managers of those regions where there is a growing demand on freshwater resources should try to link the research findings with improved water management. For long-term strategic planning, European-level statistics provide sufficient information in order to obtain an overview on drinking water consumption of local residents and tourists in the GAR. Also, for this, regional water resources management strategies might be designed, and present practices adapted. Although, there are limited estimates of actual drinking water consumption based on overnight stays, especially on the NUTS 3 level and it should be encouraged at European level. There are limitations in the coordination and harmonization of data sets from non-European countries like Liechtenstein and Switzerland. Also, there is limited flawless alpine-wide view with focus on tourist water consumption.

Case study by Camille Pannu (2012) highlights the flaws in the water governance policy highlighting the California's water inequality among the rural residents. The study was based on the bibliographic review of west America's policy related to water and its distribution in rural area. The study suggests the need for prioritizing water equality by local stewardship to ensure the visible, concentrated, and affluent public health.

According to the study conducted by Ayokunle (2011) on Packaged Water, optimization of packaged water for sustainable water delivery in developing Nation. Research methodology was based on secondary data through the review of literature, study suggested world model of safe delivery of drinking water technology may not be affordable in majority of the developing country and sachet package drinking water is bridges the gap, if it is under the brand name of government.

According to the study conducted by Rossiter et. al (2010) where ground water bore holes and wells were installed by private, NGO and government and samples collected from boreholes, wells and piped water sources were analyzed for chemical quality. It was found that there was no monitoring of water quality after the installation of improved water source, sample collected across Ghana. Majority of the sources were not functional due to lack of water capacity, equipment malfunction, lack of financial resources and lack of maintenance. Study suggested that issues need to be solved with respect to water quality, coordinated water supply provision and water treatment towards the sustainable improved water resource.

Indira (2008) in her study discussed that regular water supply was not met by the pipeline project in Gujarat and the project was non-viable. Study based on census covering all the villages of Narmada Project.

M. Dinesh Kumar (2008) conducted a study on water harvesting and artificial recharging of natural water scare regions. The analysis was based on data used in the research study in 2006 by the authors. The findings of the study conclude the following result:

"(1) Water harvesting in the "closed" basins have downstream negative hydrological impacts. (2) Due to high inter-annual variability in rainfall and therefore run-off, during drought years the water harvesting structures have become highly unreliable, whereas an attempt to capture run-off during wet years would remarkably increase the unit cost of harvesting water. (3) In closed basins, intensive water harvesting would lead to negative welfare outcomes due to high negative externalities at higher degrees of basin development. (4) Even at the local level, physical efficiency of water harvesting is likely to be poor, mainly due to groundwater-surface water interactions and the poor storage capacity of hard rock aquifers underlying most of the water-scarce regions". Finding of the shows that still the water harvesting in the water scare region is unreliable, inefficient, and costly.

Study conducted by Godfrey et al. (2007) on greywater treatment in the tribal school of Madhya Pradesh, India. The objective was to reuse grey water. the finding of the study showed the increase in the availability of the water in school for basic needs.

Shah (2005) in the present study confirms that sufficient and safe water is supplied at higher cost compared to national level projects. The study is based on the Anantapur project. The study infers that the decentralization of water supply promises safe and sufficient water but at the high cost than the decentralized system.

The above studies give the broad insight of the issues and solutions in the respective areas which are used for giving suggestions related to the reuse of water in schools, greywater use, water harvesting in schools, recharge of ground water are the take aways of the reviews.

2.2 ECONOMIC ASPECT ON WATER

Economic aspect on water looks into the review on the subject matter of Economics like the monetary incentives on water, pricing of water, budgetary provision, government grands, government funds, water and economic development to recommend the suggestions from the existing body of knowledge.

Why these studies are Important from Research point?

For economic analysis researcher surveyed school infrastructure of Vadodara city to obtain the cost of drinking water infrastructure and the cost of packaged drinking water. The review of the economics aspect gives the learning on approach on cost estimation methods used in different research studies for different areas. The review gives various economic parameters of water to the present study and keep the research in the direction of economic aspect not the life science.

According to Padhee (2020),"PaaniBachao, Paise Kamao " programme (save water, earn money) draw attention in the direction of impending policy to address alarming water crises. Under this programme the incentives are provided for efficient use of water and free electricity as incentives, put pressure on sustainable use of water in irrigation. The policy outline is keen towards water sustainability and incentive for farmers in rural India. According to the Punjab State Power Corporation Limited (2018), pilot survey conducted, 2018 six of the state's, 5900 rural power consumers, for computing an incentive, dedicated electric meter was fixed on the tube well user and every month unit was secure for kharif and rabi season and farmers was subsidised @ Rs.4 per unit for every unit saved. Findings of the study showed that farmers earned incentives of Rs.7 lakh (October 2018 to 20th Jun 2019 time period and summer seasons saved 2.06 lakh units and earned incentives of Rs. 8.24 lakh (21st Jun to 20th August 2019 time period.

Delhi Government (Hindustan Times, 2019) declared a waiver incentive for setting up of water meters to raise the functional water meter in Delhi. In the past, the similar exercise, there is an increased number of connections to 2.37 million by 2018-19. The estimated revenue generation had increased.

The research conducted by Obaka Abel Inabo (2019) to study the role of health quality water sanitation and sanitation on economic progress in Nigeria during the time period of 1990 to 2015. Ex-post facto research design and ARDL (Auto Regressive Distributed Lags) estimation method was used. The finding of the study showed that quality of health, Water and sanitation improved the economic progress. Thus, that quality of health, Water and sanitation impetus economic progress of Nigeria.

The research carried by S. Rajenderan et al. (2017) highlighted the use of public river water resources by private sectors for throwaway prices for packaged drinking water and other beverages and suggest that permission should be taken from the concerned authority for use of natural resources, keeping in mind the long-term externalities.

According to the study conducted by Mohommad Mahfuzur Rehman et al (2017) on "Willingness to Pay for Improved Water Supply: A Policy Implications for Future Water Security", aim at compare the present condition and to determine CRA (cost recovery approach) can be determined by willingness to pay (WTP) to improved water supply and future water security. The study was based on the primary data collected from the population size 11605 of which 396 households were surveyed using structured questionnaire in one of the semi-urban areas of Bangladesh. The finding of the study suggested that people are willing to pay more money to ensure improved drinking water supply. Additionally, the money collected from CRA (cost recovery approach) was sufficient to meet the expenditure of maintenance and operation cost

Silali, et al. (2014), study, discuss Trans Nzioa County, in Kenya, objectives of primary prevention of water. Research methodoly is based on primary data of 297 households, Cross-sectional design, using a mixed data collection technique was conducted. The results of the study exhibited secondary, households achieved are critical for efficient implementation of safe and clean water supply compared to primary attained households. The researchers suggested the need well-wishers for Public Private Provision programmers' and more grants in water resource management

Primary survey of two resettlement colonies of Delhi is conducted by Gyana et al. (2013) revealed that public spending towards Utility services in the five-year plan, 2007-2012, seems to be unresponsive and inadequate resulting in poor utility services governance.

The purpose of the paper by Hunt (2011) was to review the recent empirical literature relating to the quantification and valuation of the human health impacts of air pollution, hazardous

chemicals, and unsafe water and sanitation, and their use in cost-benefit analysis, as an input to environmental policy decision-making. An attempt has been made by the researcher to identify the effect of these three environmental hazards, the nature and range of these health impacts. The extent to which these impacts can, and have been, quantified and valued in monetary terms, is described in the present study.

Hamid Balali et al. (2010) study highlights the government subsidy to promote agriculture encourages farmers of Hamadan Bahar Plain at the cost of ground water aquifer. The objective of the study was to analyze the impact of pricing of irrigation water and agricultural policy on ground water aquifer conservation. The researcher has used the simulation method and simultaneous equation by a non- linear dynamic programming method. The results of the study showed the significant reduction in the agricultural demand for ground water aquifer.

According to Arun Kumar Dwivedi et al (2009) Study based on domestic rooftop water harvesting (DRWH)aims to develop the framework for domestic rooftop harvesting for drinking water. The survey of 50 households were conducted in the peri- urban area of Dhule city of Madhya Pradesh. Cost analyses were done through mathematical equation showed that DRWH was economical than market cost and 150 m2 rooftop was only 115/KL.

The studies review the various cost related to the water such as cost of water harvesting, pricing water for households, subsidy and incentives for water use, CRA approach of cost recovery are the important economic aspect of water. From the review of literature research undertakes cost aspect of drinking water infrastructure for the present study

2.3   BEHAVIOUR APPROACH TOWARDS WATER/ OTHERS RELATED AREA

The section briefs on, the behavioral approach discussed in various studies toward their willingness to pay, practices followed by the user, perception, and willingness to conserve, for sustainable and efficient use of water are reviewed

Why these studies are Important from Research point?

The present study reviewed the following studies to know the behaviour of the stakeholder and their perception on drinking water infrastructure and also study the willingness to Pay & Accept towards improved water.

The research study by Duan et al. (2022) discussed about the behaviour and willingness to use filters in drinking water by middle-aged and elderly residents. The study was based on cross-

sectional study during 1st to 28th July 2021 in the Tengchong, Southwest Yunnan. The survey was conducted using random sampling, questionnaire filled to know the behaviour, sanitation, and perceptions towards drinking water. Descriptive statistics were used to identify the influencing factors of drinking unboiled tap water verses willingness to use filters. Results showed that 35 per cent use without boiled tap water, and 29.8 per cent were willingness to use filter. The perception on drinking water behaviour showed willingness to use filter to certain extent. The researcher suggested water filtration facilities to safeguard and ensure public health safety. The study served as the supporting for doing cost analysis in the chapter 5 where the stakeholders have to take the call for using package drinking water or not? Are they willing to pay or willing to accept?

According to the research study by Kamonashish Halder et al (2021) objective of the study was to assess awareness, perception and willingness of various stakeholders towards the present practices and the prospect of water reuse, in urban area of Khulna city, located in the southwest of Bangladesh.it also analyze the present sectoral performance of the institutional arrangement due to rapid climate changes in the Bengal Delta. Methodology used to carry out this research was based on the primary data collected in the form of questionnaire filled by 385 urban respondent, 32 interviews and one group discussion and 10 interviews with government and nongovernment stakeholders. The finding of the study suggested overall positive behavior among the major stakeholder's group toward the planned water reuse for peri-urban agriculture with respect to, Willingness to pay towards treatment of wastewater, willingness to pay for better quality irrigation water. Adjustments were suggested in the rules and regulations for the wastewater collection and treatment in the public sectors. Further regulation enforcement and alignment among stakeholders plays crucial role in collection and wastewater, and its subsequent utilization for crop production.

Reniko, et al. (2020) in their research work revealed that mostly, there was no water in the town. When the taps become dry, locals have to access water from unprotected sources like streams. Also, the recommended distance to alternative water sources by United Nations is 1000 meters and the study found more distance than the recommended distance. The study reveals that the gender also affects the water consumption, and the women consume more water even when they are denied major decision-making roles at household levels. The study indicated a significant difference in water consumption by age within households. In a nutshell, the trends showed that the factors like demographic and socio-economic factors play a pivotal

role in understanding the factors that influence the domestic water consumption at level of household.

The objectives of the study conducted by Syaukat et al. (2020) was to know the water consumption patterns of community in the Katulampa Village for the purpose of estimating household expenditure towards water consumption and calculate the value of willingness to pay (WTP) for water. This research carried out using descriptive analysis, expenditure analysis method, and contingent valuation method. The results estimates indicated that household consume average 23.9 cubic meter/month, from various water sources, namely PDAM (name of the company) water, wells, rivers, springs, and seepage water. Both Bottled and refilled water are consumed to meet the needs drinking water. Expenditure on bottled water and refill water were relatively less than the average income of resident and non-resident of Griya Katulampa Housing (GKH). Household expenditure for bottled water and refilled water is relatively high. The WTP for improved PDAM piped water was estimated average of Rp (Reference Price) 4,414/cubic meter. Seepage water is consumed for other activities than the drinking.

The purpose of the study by Akram, (2019) is to find out the willingness to pay for improved drinking water services using Discrete Choice Model (DCM). Study was based on primary survey of 120 households from Basupara and Najirghat area of Ward-26 of KCC. For accessing the willing to pay for improved drinking water quality, Multinomial Logit Model (MLM) was used. The study found that people who were willingness to pay BDT 450 (Bangladesh Taka) 9.67 time more than the willingness to pay BDT 250.

Wight, et al. (2021), discusses the strong water scarcity and its impact on people, economies, and environment, and how it is posturing a growing challenge for sustainable development. According to researchers, in order to encounter these challenges, it will require encouragements to boost, sustainable use of water. The methodology of the study builds on several local and high-resolution models demonstrating the potential to increase the economic efficiency of water use. The finding showed that gap between potential and implementation sustainable water use is high.

Study conducted by Deep Jyoti Francis et al (2020), The objective of the research was to highlight the various knowledge resources generated in the areas of water technology related research and development. Methodology based on the secondary data on webliography of worldwide water mission and corroborated research on water, sanitation and allied subject

matter, looking into the activities and programs in water research focused at developing indicators for assessing and forecasting. Further it took the case of India and highlight the resource and emphasis of research since last ten years as consequence of the Sustainable Development Goals. The study suggests the useful information for ministries and departments at state level and National level to formulate and implement strategies suitable for water resources authorities and to construct meaningful indicators and tools for assessment of water.

Moluno, et al. (2018) in their study on willingness to pay for water supply and sustainability water services, research methodology was based on primary data, in Niger Delta Communities carried out in extension and revalidation of a former study done by European Union – Assisted Niger Delta Support Programme (EU-NDSP). " Nine self-selected small towns in two pilot intervention local government areas in Bayelsa state, Nigeria were used for the study. Samples of 660 respondents were initially sampled using Bill Godden (2004) formula for determination of sample size, out of which 610" were used for survey design. It was found that respondents are willing to pay for improved water supply and services.

Ali (2015) in his study has critically evaluated the hype that was created around the Swachh Bharat Abhiyaan at its inception. He is of the opinion that the funding from sources such as the corporate social responsibility coffer is wholly inadequate. The trust on public-private partnerships without firming the abilities of the existing public agencies in the field through ample budget allocations and suitable training of personnel is a sure sign that the ambitious 2019 target for drinking water supply and sanitation is not going to be met.

The study conducted by Bhattacharya and Borah (2014) have made an attempt to assess the availability of drinking water over a period of time in Guwahati City, which is one of the fastest growing cities of Northeast India. The experience showed that the growth of this city is haphazard resulting in a chaotic situation and is not considered as favourable by the residents of the city. One of the problems faced by its residents is problem related to the availability of drinking water. The study also tries to understand and address the challenges related to drinking water in present times. The study is based on both primary and secondary data. Primary data was collected from three selected municipality wards based on their core, periphery, and midpoint locations among the 60 wards of the city.

Objective of the research was to study conducted by Liangxin Fana et al (2012), the consumption patter of different groups to facilitate water conservation globally. The researcher randomly collected the 776 sample of households in the Weinan, Yanglin–Wugong, and Baoji

districts in the middle of the Wei River Basin.finding of the study showed 70.2 liters per capita per day used for domestic use and 31.9 liters were used for outdoor use. Total 20 conservation practices were reported by household out of which 11 were used in majority. It was also found that the residents preferred to implement most convenient and low-cost water conservation practice but not willing to adopt it because of traditional views and behavior and education can bring in the required changes in water conservation behavior.

Deepa (2011) in her study shows that upper caste women obstruct the Dalit women participation. The study also reveals internal competition between Dalit and other minority tribal community and availability of water was almost absent for Dalit women. Study is based on the primary data of the villages of Kumaon in Uttarakhand.

Philippe (2011) in the study throws light on realization of the fundamental right to water in rural areas. The study also revealed that various initiatives are taken for rural drinking water, but courts fail to develop the detailed content of the right and people are not interested in enforcing their right.

Olajuyigbe and Fasakin (2010), Willingness to pay for urban services is often regarded as a means of ensuring the long-term sustainability of such services. This paper examined some factors that explain citizens willingness to pay for improved sustainable water supply in Ado-Ekiti, Nigeria. Such analysis is critical to the success of the government current drive on privatization and divestment on infrastructural financing. Empirical estimates show that factors that significantly affect willingness to pay for improved sustainable water supply include; main source of domestic water used by household, access to improved source of water, distance from main source to house, average time spent to fetch from main source, adequacy of supply from main source, quantity of water used per person per day, quantity of water purchased per day, attack by water borne diseases, performance of supply from designated water institution and average amount spent on water during the dry season. Some policy implications are discussed.

The review under behavioral and related subject, despite of several studies conducted on behavioral and related subject is sparingly on sustainable drinking water practice, provisioning of water availability, water human right status, economic provisioning or compensation for deprivation of water.

2.4   DRINKING WATER

The research study caried related to the drinking water in general is carried to know the area of the study and develop the clear understanding of the problem of the study.

Why these studies are Important from Research point?

To identify the knowledge gap, evidence gap and research gap the following research studies was reviewed.

Suvechha Ghatani et al (2022) Research study based on primary data of the Darjeeling city; 220 households were surveyed through scheduled questionnaire. The objectives of the study were to know the availability status of drinking water. The study found 71 percentage of the sample relied on the municipal source for drinking water and they found it uncertain and unreliable, 20 percentage of the sample depends on natural spring water and 9 percentage of the population depends on private source for drinking water. Further the distribution of the drinking water availability and access influence by the social connections and land-lordship and lover income group had disadvantage compared to higher income group.

In the research work carried out by Ferdous, et al. (2018), suggested that there was a dire need to have safe drinking water in "Debishingpara". The authors identified seven problems about safe drinking water crises such as a smaller number of tube wells, iron in water, lack of water purification system, high elevated land, ground water depletion, narrow roads and high population density. Among these, the pair-wise ranking found three problems and they were lacking in water purification system, a smaller number of tubes well & existence of iron in water. The causes of these three problems were lack of finance, awareness, problem in digging tube-wells, existence of iron layer in the ground water etc. The effects of the problem were like the water becomes unfit for domestic consumption, worsening of health condition, cause water borne diseases, overcrowd in the peak hour of water supply etc.

According to S. Kumar et al., (2018) the rising urban population, there is a need to backup urbanization by providing drinking water and other factors, as the pollution and population increase the pressure on drinking water.

Biswas et al. (2017), discussed the insight of Swachh Bharat Mission. According to the study SBM in pre-urban regions are able to meet the target of universal sanitation but are not able to meet the goals of making safe drinking water available. In this study the data is based on secondary sources from projects supported by Arghyam.

The research conducted by John Mwenda (2016), to know the effectiveness of long handled "Mukombe "cup for controlling the bacteriological contamination of drinking water kept in wide-mouth vessels in the household. The study was conducted among the 238 Hatcliffe household, urban settlement in Zimbabwe, divided into two groups over the period of two month. The finding of the study showed that long handle Mukombe cup improved the quality of stored water while extracting the water from the bucket compared to the other short handled or cups without handles.

Manjur (2015) in the present study concludes that public private partnership will not be able to meet the goal of 2019 for drinking water supply without strengthening the capabilities of the existing public agencies in the field through adequate budget provisioning and trained personnel. The data is based on a baseline survey by the ministry of drinking and sanitation (2012-2013).

The research based on secondary data of India cities conducted by Pranav (2015) mentions that there exists inequality in supply of drinking water in the big cities of India.

Pooja et al. (2014) in her study suggested changes to the reforms in rural drinking water schemes in Maharashtra. Finding of the paper highlights that policy reforms have remained inefficient and suggest policy change.

Parasuraman et al. (2010) conducted a study on the Sardar Sarovar Project which promised to provide irrigation, drinking water and electricity. Study reports that only 30 percent of the villages receive regular water supplies for drinking purpose and other important goals remain unattained.

Philippe (2009) in the present study highlighted the central policy for drinking water in rural areas. It examines old policies and suggests the reforms in ongoing policies to change the rural drinking water supply policy framework.

Govind (2009) in the present study showed drinking water supply disparity is highest in U.P, MP and West Bengal, while Chhattisgarh and Jharkhand with the least disparity. Study is based on secondary day from the accounts general of these states for the year 2007-08.

It is concluded that the research is carried in the areas of drinking water but remained silent on schools' infrastructure in particular. Also, there is no policy recommendation on drinking water infrastructure of schools carried out in the research. The role of private sector is not considered sufficient in supplying drinking water and according to other researcher, private sector only

fulfils the needs of the higher income groups not the lower income groups.it discuss the drinking water dependence on the corporation supply doesn't talk on the infrastructure of the educational buildings.

In the following section the review of the literature on drinking water in schools are reviewed to further obtain information to the body of knowledge and deep insight the subject related to research problem.

2.5   DRINKING WATER IN SCHOOLS/ CONTAMINATION

The study carried out by Vliet, et al. (2021) suggests that there is a need to expand our focus from solely water quantity solutions to both water quantity and quality improvements for achieving 'clean water for all' and 'reducing the number of people suffering from water scarcity' as suggested by SDG 6. But the improvement in water quality and reduction in water scarcity should not compromise the environmental objectives. Additionally, a strong focus on reducing the pollutant emissions is utmost important in achieving the sustainable management of clean and sufficient water.

Recently a case study by Mishra, (2021) on a primary school run by the government in Allapur village of Telangana highlighted the problem of drinking water among the matters of concern.

Turner, et al. (2021) in their study combined the national scale geospatial datasets with hydrologic simulations to calculate the two metrics showing possible contamination of water supplies from point and non-point sources over a hundred United States cities. The authors reveal the huge variety of anthropogenic activities over watersheds in tune with the disparities in the possible contamination of drinking water supplies to cities. Roughly around 5% of large cities depend upon the water that is composed primarily of runoff from non-pristine lands and also four-fifth of all large cities that withdraw surface water are exposed to treated wastewater in their water supplies.

Wagh, et al. (2020) in their research work collected 80 groundwater samples and analyses it for pre and post monsoon seasons of 2012. According to the results found, Ca, Mg, Cl, SO4 and NO3 exceed the desired limit and permissible limit prescribed by Bureau of Indian Standards and the WHO in both the seasons. Due to precipitation and excessive agriculture activities, the content of total dissolved solids, Cl, SO4, Mg, Na and NO3 has increased. The result of PIG implies that 52.5 and 35%, 30 and 37.5%, 12.5 and 20%, 2.5 and 5% groundwater samples fall in the categories of insignificant, low, moderate and high population category

respectively in pre and post monsoon seasons. PC 1 indicates salinity-controlled process due to high inputs of TDS, Ca, Mg, Na, Cl and SO. PC 2 indicates alkalinity influence by pH, CO3, HCO3 and F content. To interpret the water quality data easily, PIG and statistical techniques helps.

On Swachh Bharat Swachh Vidhyalaya campaign study conducted by Subhashree et al., (2020) in the selected 95 schools in Karnataka state of India from Mangalore. The finding of the research showed that 96.8 percentage of the schools provides safe drinking water to promote students' health

Research paper by Deshmukh & Khanna, (2019) in the Sangli district of Maharashtra, focused on water sanitation and facilities given by higher secondary schools. it was identified that the facility provided by the government schools, for drinking water, were poor in terms of quality and the private schools were better.

A. Kumar et al., (2019) study based Arsenic contamination of ground water causing impaired memory and intelligence, a sample of 65 students and water sample collected from 3 handpumps, functional for one decade, of Simri Village, Buxar district of Bihar concluded that change in neuro-behavioral activity caused by arsenic poisoning of the selected sample.

Research by Khandare et al., (2017) based on sample size of 824, case-control, school children living in fluoride affected hilly areas in the Doda district of Jammu and Kashmir, the study found that students were more affected by dental fluorosis and kidney damage.

Rashmi et al. (2017) in her study focuses on assessing determinant of drinking water, its impact on water borne disease, purification behaviour and improved sanitation facility. Study concludes that purification of drinking water is significantly influenced by socio-economic status in the city of Lucknow and Kanpur district of Uttar Pradesh. This study is based on a primary survey of 200 sample units in four zones.

Study by Chaudhry et al., (2017) on prevalence of dental fluorosis among school students in the greater Noida, Uttar Pradesh. Total 1318 students were sample size and the result found that fluorosis was mainly associated with handpump water.

Study conducted by K. Verma et al., (2017) Hapur district,UP, India, a sample of 351 school children. Research study found that 30.2 percent were diagnosed with intestinal parasites and drinking water is one of the preventive measures.

Cross-sectional study conducted by A. Verma et al., (2017) on fluorosis caused by ingestion of fluorosis via food and water among school children, affected by dental fluorosis in Kolar Taluk, Karnataka, India. Sample size of 1026 students was selected by a stratified sampling method. findings showed that the prevalence of dental fluorosis in drinking water is high and affected two- third of the students in private and government schools, especially in government school

The study by Arjita et al. (2016) indicates drinking water as one of the important variables or determining child diarrheal incidence. Study is based on the National Family Survey in India for the period of 2005-06 with a sample size of 109041 households nationwide.

Research by Sidhu et al. (2016) `of the selected schools of Amritsar dist. Punjab on bacteriological analysis of drinking water. 903 samples were collected out of which 360 samples found not satisfactory. 360 unsatisfactory sample consist of 189 from submersible pump, 97 tap supply, 48 handpump supply and remaining from other sources.

A cross-sectional study by Sebastian & Sunitha, (2015) on Intelligence Quotient (IQ) among school students affected by elevated fluoride in drinking water. Total 405 students were taken from villages of Mysore district of India. The results showed that drinking water with high fluoride demonstrated poor development of IQ in with respect to the low water fluoride level. So, IQ level affected by high water fluoride.

The results of research work carried out by Singh, et al. (2015) certain parameters like hardness, chloride and fluoride are more than the permissible limit in the Patiala, Punjab that is highly dense with residential area. With respect to microbiological quality, the overall view of water quality showed unsatisfactory results. Therefore, the authors suggested that water filters at home should be installed, timely serviced and water quality should be checked regularly. To prevent the contamination of drinking water any leakage from sewage pipes should be immediately repaired.

Jasdeep et al. (2015) study showed that drinking water gets contaminated during transmission in Ludhiana which is unsafe and has a serious impact on the health and wealth of the poor. The present study is based on both primary and secondary data. For this study cross sectional data was collected with a sample size of 360 households in the year 2009-2010.

Cross sectional study on sanitation and health facilities in selected 30 urban school (four government ,12 aided and 14 private) of Mangalore city of south India by Joseph et. al (2012).

The study found that more than a quarter of schools had no drinking water purification facility and storage of water was not kept clean in 20 percentage of the surveyed school.

Another study on prevalence of dental fluorosis by Shekar et. al (2012) showed that drinking had concentration of fluoride in an endemic fluoride belt of Andhra Pradesh. Study conducted in the 3 selected school from the 5 mandal with 59 students. It found that fluoride prevalence and severity is very high.

In the current study Suthar (2011), has made an attempt to present an overview of drinking water quality in the rural territories of northern Rajasthan, India. In this region availability of fluoride is an endemic problem to the groundwater, but the recently other anthropogenic chemicals have been also reported to the local groundwater. Recent case studies reveal that nearly 95 percent of locations of this region comprise a higher fluoride level in groundwater than maximum allowable limit as decided by the Bureau of Indian Standards. Nitrate (as NO-3) contamination has surfaced as a new anthropogenic threat to some intensively cultivable rural habitations of this region. Also, biological contamination has occurred as another concern of unsafe drinking water resources in rural areas of the state. The studies conducted recently are claiming that there is existence of a wide range of pathogenic bacteria including members of the family Enterobacteriaceae in local drinking water resources. This shows that in all, the quality of drinking water in this area is not up to the safe level, and much work is still required to establish a safe drinking water supply program in this area.

According to Yadav et. al (2009) on fluoride distribution in the ground water of Jhajjar dist. Of Haryana found significant concentration in drinking water.

Study of 15 schools of Bongaingaon, Bongaingaon district of Assam to assess the suitability of drinking water, study conducted in the selected school by Roy & Thakuria (2007). it was come to the notice that sixty seven percent of the water samples were acidic and 40 percent were above turbidity limits and samples from well were found bacteriologically contaminated.

Research study by Tooley et. al (2007) on private schools and the millennium development goal of universal primary education of the slums of Hyderabad based on a census survey of the school. Research showed that private of unaided schools were superior to public schools in drinking water infrastructure.

The review of literature in the drinking water in schools subject is silent on the economic aspect of the drinking water infrastructure, financial and budgetary aspect of drinking water

infrastructure of school, and the sustainable solution on drinking water in the school but provide the grants for drinking water facilities to school.

2.6   VADODARA AND WATER CONTAMINATION

From the report of the ASER, (2018), Annual Status of Education Report compiled from the 2010, 2012, 2014, 2016 and 2018 on drinking water status showed that there were schools with "No Provision" of drinking water was 17 per cent in 2010 which came down to 13.9 per cent with approx. reduction of 4 per cent point. In case of "Provision Exist But Unusable" was reported 10.3 per cent in 2010 and increased to 11.3 per cent with increase in 1 per cent point. For drinking water "Usable" was recorded 72.7 per cent in the initial year and increased to 74.8 per cent with approx. 2 per cent point increase. Thus, it shows that Drinking water problem with "No Provision" was 14 per cent approx. and 11.3 per cent with "Provision Exist But Unusable" and the status of drinking water found no improvement since 2010 to 2018.

Study conducted by Agrawal et al. (2016) with the objective to assess the ground water quality of Vadodara taluka on water parameters such as pH, calcium, magnesium, chloride and Fluoride. Geographical Information System (GIS) was used collect the data and mapping was done on the basis of severity of quality of water (comparing with BIS) into three categories of zone: Fit, Moderate and Unfit. The finding of the study showed that only 72 % of area of study found as FIT and acceptable for drinking purpose.

From the news report of the local media with District Collector Shalini Agarwal was served as a record for concern over the schools of Vadodara over the acute water shortage. There is a need to address the problem of water shortages in the schools and quick remedy was suggested by Collector. Rainwater Harvesting would help in meeting the daily water requirement of the schools for next four years.

Study conducted by Sharma (2015) using water Quality Index of Metropolitan city of Vadodara with the objective of assessinng water quality. Fifteen water parameters were used for calculating the ground water quality Index of pre-monsoon and post-monsoon. The finding of the research showed that most of sample resulted in improvement in the drinking water quality and ground water of Limda, Harni, Nandesari and Makarpura rated as Unsuitable for drinking purpose. Similar research study Himani et al. (2015) conducted measuring the ground quality found the poor quality of water and not fit for drinking

Research study by Smruti et al. (2022) on assessment of ground water quality of Vadodara and Chhota Udaipur Districts was conducted. The study was based on the 162 samples on pre-monsoon and post-monsoon was collected from 63 villages during. The result found the overall ground quality was comparatively good but increased nitrate level was reported in significant number of samples and a serious concern.

Local media reported on report by The Indian Express (2022) that VMC has admitted/ confessed the regular complaints of contamination of drinking water due to overloading of stormwater drains in the cluster of residence. The authority has spotted 50 locations of contamination due to mixing of sewage network with water supply.

Another study on ground water quality was conducted by Barodawala et al. (2018) in the area of Vadodara city (Gorwa, Nizampura, Harni, Gotri, Sayajiganj, Fatehgunj, Ajwa Road, Tandelja, Lal Baug, Makarpura and Tarsali). The quality of water Index was compared and found that electrical conductivity, TDS, turbidity and alkalinity were high. In addition, it was found that less developed areas were better in water quality than developed areas. The researcher suggested, use of water filtration or treatment to avoid contamination.

Identification Of Research Gap

The entire review revealed that there is plethora of studies on water scarcity, water contamination, water and health hazards, economic aspects of water, water disputes at national and international levels, water inequality, the economic aspect of water infrastructure of schools but there is paucity of studies conducted in the infrastructural aspect of drinking water infrastructure in schools in rural as well as urban areas. The literature review unfolds the research gap on the basis of which the present study was undertaken with the objective of bridging the research gap, evidence gap and the knowledge gap through empirical and perception study.

Major research work studies are confined to the contamination of drinking water and the issues of widening the gap of availability of drinking water and safety of drinking water concern for school going children. At micro level researcher has come across no research work on the drinking water infrastructure of schools and analysis of cost of it in the educational Institutions.

Thus, researcher has not come across any inductive study carried on the drinking water infrastructure of the schools of India in general and Vadodara in particular. The proposed

research would be a unique contribution in the field of cost analysis of drinking water infrastructure of the selected educational building of Vadodara city.

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