WATER CONSUMPTION PATTERN IN HOUSEHOLDS OF URBAN SOUTH ASIA: A STUDY OF BATHINDA CITY

A

Dissertation submitted to the Central University of Punjab

For the award of

Master of Philosophy

In

South and Central Asian Studies

BY

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2014 July

DECLARATION

I declare that the dissertation entitled 'WATER CONSUMPTION PATTERN IN HOUSEHOLDS OF URBAN SOUTH ASIA: A STUDY OF BATHINDA CITY' has been prepared by me under the guidance of Dr. Kiran K Singh, Assistant Professor, Centre for South and Central Asian Studies, School of Global Relations, Central University of Punjab. No part of this dissertation has formed the basis for the award of any degree or fellowship previously.

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ABSTRACT

WATER CONSUMPTION PATTERN IN HOUSEHOLDS OF URBAN SOUTH ASIA: A STUDY OF BATHINDA CITY

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Keywords	*: Water, Consumption, Households, Perception, Awareness, Bathinda.*

Water is used by human being by different ways; mainly it is divided into three different sectors: Agriculture sector, Industrial Sector and Domestic sector. Three of them have different factors that affect the consumption level of water. Many factors like culture, food habits, working conditions, income, and technological advancement determine the requirement of water in any area. South Asia has been fortunate in having abundant fresh water reserve but the increasing population and overexploitation of surface and ground water over the past few decades has resulted in water scarcity in this region. Water availability in South Asian countries and their cities varies with area and socio-economic groups. That availability leads to varied water consumption patterns at domestic household. People in cities have access to water at all times and places which sent a wrong signal that the water is available in plenty. These type of wrong information leads to wastage of water at domestic household. While many people are known to the fact that water resources are declining day by day but their water consumption patterns at their household are not in favour of water resources conservation. More number of water appliances, bathing and washing habits, method of watering plants at home leads to wastage of water at home. On the other hand, accessibility to fresh and clean water is also a big question. This study is an effort to analyse people behaviour and perception to know the water consumption pattern at domestic household in Bathinda city, fifth largest state of Punjab. Many socio-economic factors affect the consumption pattern, perception and awareness in domestic households. The study is based on primary and secondary data. The household survey was conducted to know the

consumption, availability, access and people awareness for conservation of water in domestic households. Water consumption will be correlated to socio economic factors such as income, household size, education level etc.

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DEDICATED TO

MY LOVING PARENTS

ACKNOWLEDGEMENTS

This dissertation is a milestone in my academic career. I am grateful to a number of people who have guided and supported me throughout my research work and provided assistance me from time to time. I would first like to thank my supervisor, Dr. Kiran K Singh who guided me in selecting the final theme for this research. This dissertation would not have been possible without the unwavering support, encouragement and patience of her and for the help and advice given to me at right time and in right direction. It was her insight, affection, friendly guidance which helped me to complete this dissertation.

My sincere thanks to Prof. (Dr.) Jairup Singh, Vice Chancellor, Central University of Punjab for providing me research facilities to carry out my work. I am also extremely thankful to Prof. (Dr.) P. Ramarao, Dean, Academic Affairs, and Prof. (Dr.) R.G. Saini, Examination Incharge, Central University of Punjab, Bathinda for their direction, valuable suggestions and help. I am also thankful to Dr. V J Varghese, COC, Centre for South & Central Asian Studies, Dr. Nishtha Kaushiki, Dr. Bawa Singh for their inspiration for research work.

I am grateful to the contribution of my friend Gaurav Kumar who always scaled me in high esteem and boosted my morale. I am extremely thankful to all the respondents of this study and my friends Ritu, Irfana Unjum, Husain, Hilal, Mumtaz and Manpreet Kaur for their cooperation and support during M.Phil.

I am also thankful to my younger brother Davinder Singh for his aspirations for my success which always encouraged me to take tough decisions of life. I must submit myself before the blessings of my father and love of my mother which has always supported me in tough moments by giving encouragement and providing the moral and emotional support. To them, I am everlastingly grateful.

Finally, my reverence goes to the God who has made me capable for doing this work.

Amandeep Kaur

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LIST OF ABBREVATIONS

S. No.	Full Form	Abbreviations
1	World Health Organization	WHO
2	United Nations Children's Fund	UNICEF
3	Central Ground Water Board	CGWB
4	Federation of Indian Chambers of Commerce and Industry	FICCI
5	Water Resources Group	WRG
6	Indian Standards	IS
7	Liters Per Capita per Day	Lpcd
8	Billion Cubic Meter	BCM
9	Patiala and Eastern Punjab States Union	PEPSU
10	National Fertilizers Limited	NFL
11	Local Planning Area	LPA
12	Total Dissolved Salts	TDS
13	Presence of Hydrogen	pH
14	Punjab Water Supply & Sewerage Board	PWSSB
15	Punjab Water Supply & Sanitation Department	PWSSD
16	Punjab Urban Development Authority	PUDA
17	Bathinda Development Authority	BDA
18	Urban development Plans Formulation & Implementations	UDPFI
19	Water Treatment Plant	WTP
20	Office of Human Resource Studies	OHRS
21	Municipal Corporation Bathinda	MCB
22	Distribution Resource Planning	DRP
23	Giani Zail Singh Engineering College	GZSEC
24	Central Pollution Control Board	CPCB
25	Food & Agriculture Organization	FAO
26	Central Public Health & Environmental Engineering Organization	CPHEO
27	Asian Development Bank	ADB
28	Water and Security in South Asia	WASSA
29	Indian Water Resources Society	IWRS

30	United Nations Development Programme	UNDP
31	United Nations Environmental Programme	UNEP
32	National sample Survey Organization	NSSO
33	Inhabitants	Inhab

Chapter 1

Introduction

1.1 Introduction- Water is an essential resource for all life on planet. Of all the water resources available on earth, only three percent is not salty and two-thirds of the fresh water is locked up in ice caps and glaciers. At present only about 0.08 percent of the entire world's fresh water is exploited by mankind (Fry 2008). In terms of availability of fresh water, America continent has the largest share of the world's total fresh water resources with 45 percent, followed by Asia with 28 percent, Europe with 15.5 percent and Africa with 9 percent (Brar 2011). By 2000, in terms of resources per in-habitant in each continent, America had 24000 m^3/ year, Europe 9300 m^3/ year, Africa 5000 m^3/ year and Asia 3400 m^3/ year (Brar 2011). Water is a key resource and water management deserves priority in the development and preservation of any area. Water, the need of life, is likely to pose the greatest challenge on account of an increased demand with population rise and economic development, and shrinking supplies due to over- exploitation and pollution (Shaban & Sharma 2007). Population and water resources are closely connected. The availability of fresh water limits how many people an area can support, while population growth, urbanization, and migration all affect the availability and quality of water resources. Population growth increases the demand of water for food production, household consumption, and industrial uses. Rapid growth in water demand is common in developing countries (Sule et al. 2010). Although fresh water supplies are adequate to meet demand for the foreseeable future, the World's freshwater is poorly distributed across and within countries and between seasons. The water scarcity situation is compounded by the major impacts of climate change on the water resources, namely shorter duration of the precipitation seasons and increase in hydrological extremes. The water scarcity situation will get worse in the world's urban areas where it is projected that over 50 percent of the world population will live by 2015 (United Nations 2004). From 2000 to 2030, it is projected that there will be an increase of urban population to 2.12 billion (UN-HABITAT 2004).

1.1.1 Water Consumption- Although, in many countries fresh water is abundant but access to water resources is an emerging problem mainly in developing countries. Water is used by human being by different ways, mainly it is divided into three different sectors: Agriculture sector, Industrial Sector and Domestic sector. Three of them have different factors that affect the consumption level of water. People use water for agriculture, industry and domestic purposes. As population grows, requirements for basic personal use rise proportionately. Rising living standards, which bring such amenities as running water to homes, dramatically increase per capita water consumption. Increasing agricultural and industrial water consumption also reflects changing living standards. Today, the consumption of water resources is increasing. There is huge competition for water consumption for industrial sector, agricultural sector and domestic needs. In future, even more water will be needed to produce food because the earth's population is forecasted to rise to 9 billion by the end of year 2050 (Asian Development Bank 1993). Above all consumption the variation within various uses of water in urban areas is important. According to WHO and UNICEF, 70 % of people in urban areas of developing regions have access to water piped into their dwelling, yard or plot (Velleman 2009). On the other hand, Domestic fresh water is an essential requirement for human wellbeing (Amin et al. 2011).Water consumption in domestic household varies from area to area depending on socio-economic standard of the people, the level of education and development, nature of prevailing climate, the hygienic characteristics of the people, level of provision of sanitation and general sanitary habits of the people (Sule et al. 2010). Many factors like culture, food habits, working conditions, income, and technological advancement determine the requirement of water in any area. This is unfair from the point of view of social needs and economic rationality because tourist activities in urban areas receive preferential treatment simply because of their urban status (Brar 2011). In urban areas, domestic water use for drinking, cooking, bathing and washing etc. must get top priority as basic human right. The second priority should go to general hygienic of the surroundings where population lives. Third priority is to other activities like food production, industry and tourism etc. Water for domestic use needs to be managed by public authorities and personal efforts to sustainable use.

1.2 South Asia- South Asia region contains large rivers systems: Ganges, Brahmaputra, Meghna, Indus, Godavari, Mahanadi and Narmada, which support millions of people. Water availability in this region is driven by these rivers (originates from Himalayan glaciers) and rainfall. Water scarcity is a serious problem in many countries of South Asia; India & Pakistan mainly. Even during the monsoon, a large area of India & Bangladesh suffers from water scarcity and sometimes drought also. Water demand is generally created by three driving forces: increases in population, agriculture and industrial growth. In future, climate change may act as an added factor by altering water supplies (Mirza & Ahmed 2005). In Urban areas, Population increase will create larger water demand but some other factors, play significant role in determining water use patterns. These factors include urbanization, the degree of adoption of water- conservation technology, pricing and personal habits. Currently, in South Asia, water is highly subsidized which encourages inefficient water use, thereby creating, more demand. Household use in developing countries like South Asia, is especially scarce. Water use by developing countries agriculture and households reflects the difficulty many people have in obtaining clean water for personal use. Most people of rural areas in South Asian countries get their water from a public standpipe, a community well, rivers and lakes, or rain collected from roof runoff. But, this pattern is changing dramatically, however, South Asian countries become predominately urban and individual households gain access to piped water through governmental city water supply systems. As cities grow larger, their demand for water is growing substantially. Such demand growth is putting much pressure on urban water supply systems; most of them are inadequate to meet such demand.

1.3 India- India is a vast country and it is divided into three major regions according to its topography- Himalayan region, Ganga-Brahmaputra Plains region and peninsular region. In these regions, rainfall is unevenly distributed spatially and temporally. A review of annual ground water availability, contribution from monsoon rainfall recharge and annual ground water draft in different states falling under overexploited category and the rainfall distribution in space brings a paradoxical situation in the sense that, withdrawal of ground water is not solely responsible for declining trends,

the scanty and low rainfall resulting in meager monsoon recharge is equally important (CGWB 2012).

India faces an increasingly urgent situation: its finite and fragile water resources are stressed and depleting while various sectorial demands are growing rapidly (CGWB 2012). India has been always fortunate in having abundant fresh water reserves, but the increasing population and overexploitation of surface and ground water over the past few decades has resulted in water scarcity in many regions of the country (Jethoo & Poonia 2011).

India roughly accounts for 4.5 percent of world's fresh water resources, while at the same time it accounts for 2.5 percent of total land mass and 16 percent of total population. However, the availability of fresh water per capita itself has come down from about 5,177 cubic meter per head in 1951 to 1820 cubic meter per head in 2001 and it is expected to further go down to 1140 by 2050 (Sankarnarayan 2005). In India, as a result of development, the demand for water is increasing in both urban and rural areas. To meet the demand in different areas ground water as well as surface water is used in different areas of the country. Historically, in India, plentiful water resources have been primarily used for irrigating crops, but with the rise of Indian economy and industrial activities and share of water demand in different sectors is changing rapidly. In addition increasing population and rapid urbanization also put an additional demand on water resources. There are three major sectors in which the fresh water is used that are domestic, industrial and agriculture. "Groundwater is being heavily withdrawn in certain areas such as Haryana, Rajasthan, Delhi and Punjab," a statement given by S. K. Sharma, a groundwater consultant of the Ministry (Brar 2011). India is abundant in surface water also as many rivers flow in different parts of the country. Areas nearby the Ganga and Brahmaputra river system have much surface water for use. While they are not suffering with water depletion but they are facing the problems of declining water quantity. Water quality problems are affecting virtually all of the rivers in India.

The urban water supply and sanitation sector in the country is suffering from inadequate levels of service, an increasing demand-supply gap, poor sanitary conditions and deteriorating financial and technical performance.

It has been observed that water consumption in Indian cities is far lower than the norms laid down by the Bureau of Indian Standards. The lower consumption is mainly because the water supply is not keeping pace with population growth and increasing needs of users. Due to increasing population and Industrialization the demand of water in these sectors are increasing day by day. Water use across various sectors in India is on rise. Various estimates and projections indicate an increasing trend in water demand for agriculture, industrial and domestic uses in the coming decades. India is also projected to move into the category of water stressed nation by 2020 (FICCI 2011). Projected municipal and domestic water demand will also double by 2030, to 108 billion cubic meter (7 percent), industry side will quadruple to 196 billion cubic meter (13 percent) & agriculture will account 1200 billion cubic meter (80 percent), pushing overall demand growth close to 3 percent per annum (WRG 2009). As per Bureau of Indian Standards, IS: 1172-1993, a minimum water supply of 200 liters per capita per day should be provided for domestic consumption in cities with full flushing systems. In Tenth five year plan (2002-2007), the cities with planned sewerage systems are classified into two groups based on population, i.e., metropolitan or megacities and non-metropolitan cities. In the former, the recommended minimum water supply level is 150 lpcd and in the latter 135lpcd (Government of India 2002). The National Commission on Urbanization in 1998 recommended that a per capita water supply of 90-100 liters per day is needed to lead a hygiene existence and emphasized that this level of water supply must be ensured to all citizens; the WHO has categorized the supply of 100 to 200 lpcd as optimal.

1.4 Punjab— Punjab State has its extent from 29˚30'N to 32˚32'N latitude and 73˚50'E to 76˚55'E longitudes. The total geographical area of the state is 50,363 sq. km. The economy of the state is mainly based on agriculture so ground water utilization is high in the state. The major rivers of Punjab are Sutlej, Ravi, Beas and Ghaggar. Sutlej River enters Punjab near Nangal & moves down to plain area at Ropar, passes through Ludhiana and joins Beas River at Harki. The lower Sutlej basin is irrigated by Bist-Doab and Sirhind irrigation system. The north and central part of the Sutlej basin is an area of increased ground water over-exploitation. The

annual groundwater availability is 21.44 BCM and the groundwater extraction 31.16 BCM. Groundwater extraction is much higher so groundwater level is depleting. Out of 137 blocks in the state there are 103 blocks which are over exploiting the groundwater and out of these 5 blocks of central Punjab have critical situation. The Inter-Governmental Panel on Climate Change has concluded that effect of global warming on water availability in the future will be bigger challenge than energy security. Thus, the availability and sufficient quantity of good quality water both for domestic use and food production will be a critical factor for food security and development of a nation. About 66 percent area of the Central districts of Punjab the depth of water table would recede to 50 meters by 2030, Punjab is taking water shortfall to the tune of 1.25 m ha m every year (Tiwana, et al. 2007). As population is growing in urban Punjab, the demand of water in domestic sector is also growing. Today, the consumption of water resources is much more intense because with the increasing population, there is huge competition for water consumption from industrial sector, urbanization and agricultural crops. In India, urban population has grown more than eight fold during the last 100 years and according to census 2011, Punjab is now among the most urbanized states in India having more than 35% of the population living in the urban areas (Singh 2013). In Punjab, people are migrating to urban sector so population pressure is increasing in urban areas as well as water consumption is increasing. As population and infrastructural development is increasing day by day in Bathinda so the water demand and supply are also increasing. But, the water resources are depleting and contaminating, so how could be the city able to complete its water needs in near future, it is the matter to be studied.

1.5 Bathinda City - Bathinda is located in Malwa Region of Southern Punjab, It extends from 30˚4’ 30’’ to 30˚21’ 20’’ N latitude and 74˚ 47’ 50’’ E to 75˚ 10’ 00’’ E Longitude. There is an ancient "Fort" in Bathinda, which is believed to have been in existence for the last 1800 year. With the formation of Patiala and East Punjab States Union (PEPSU) on May 5, 1948, Bathinda district came into existence on August 20, 1948. Its headquarters were originally at Faridkot which were shifted to Bathinda in 1953. Bathinda is one of the oldest cities of Punjab with a population of 2.8 lakhs

(2011) that makes it fifth largest city of Punjab state (Singh 2013). Keeping in view the rapid growth of Bathinda city and in order to check unplanned development, first Development Scheme under Punjab Town Improvement Act, 1922 was prepared by Improvement Trust, Bathinda known as Amrik Singh Road Development Scheme (Veer Colony) in 1973 and ultimately 12 Development Schemes were prepared comprising about 300 acres of land. Similarly first Town Planning Scheme under Punjab Municipal Act, 1911 was framed in 1973 followed by other 16 Town Planning Schemes, which covered an area of 1256 acres approximately. Simultaneously the Department of Housing & Urban Development notified first Urban Estate in 1973 and later on other Urban Estates were framed which cover an area of 720 acres. Besides this, the self-contained townships developed by Guru Nanak Thermal Plant and NFL within their respective areas came into existence during this period. On account substantial industrial development the growth of the city has led to growth outside the limits of Municipal Corporation of Bathinda. Time to time, the limit of municipal corporation boundary was modified, it was done in 1981, after that modified in the year of 1994, then in the year of 2008 and again in 2013. Recognizing the need for regulating the development of the entire influence area Bathinda City, Government of Punjab initially declared the Bathinda Local Planning Area in July 2007 and subsequently further amended the boundaries in January 2009 (Punjab Government Report 2011). After that, in the year 2013, municipal corporation of Bathinda proposed a new project for the boundary demarcation of municipal corporation limit (yet to be approved in month of November), That they have added 5 sq. km area to its existing area. Now, the total urban area under Municipal Corporation is 68.5 sq. Kms.

1.5.1 Climate and Rainfall- Bathinda's climate correspond to semi-arid with high variation between summer and winter temperatures. Summer temperature exceeds up to 48 °C (118.4 °F) and winter temperatures get down to even 0 °C (32 °F) in Bathinda. The major part of the Bathinda district qualifies for aridic moisture regime according to the criteria in soil taxonomy. Soil moisture regime computations employing the Newhall mathematical model indicate that the area has ‘weak aridic’ moisture regime. In the aridic moisture regime, the moisture control section in the

most of the year is dry in all parts for more than half the time. The weather is generally dry but is very humid from mid-May to the end of August. Rainfall is primarily from the south-west due to monsoon weather and is concentrated in the period July to mid-September. Average annual rainfall is in a range of 20 mm to 40 mm. The South-Western monsoon brings the much needed rain bearing depression during summer (July to September). Nearly 70% of rainfall is received during three months (July to September), when South Western monsoons are active in this region. The region is very dusty and dust-laden winds often interrupt the normal life during the hot summer evenings.

1.5.2 Population Growth- Bathinda is 5th largest city and is the major urban settlement of its LPA. The share of population of Bathinda to the total population of the state was 2.17 lakhs in the year 2001 and 2.85 lakhs in 2011.

Table 1.1: Decadal Population Growth of Bathinda City

Years	Population	Decadal Growth Rate (%)
1901	13185	-
1911	15035	14.05
1921	20154	34.03
1931	22771	12.99
1941	24833	9.06
1951	36991	40.91
1961	52253	49.33
1971	65318	25.00
1981	127363	95.12
1991	159042	24.79
2001	217256	36.60
2011	**285813**	**31.00**

Source: Municipal Corporation, Bathinda

The growth rate of Bathinda was 95.12 percent during 1971-81 mainly because of the expansion of limits of Municipal Committee as to include the two major industries i.e. Thermal Power Plant and National Fertilizer Limited which were established during

the decade. During the decade of 1971-81 the population growth was 0.65 lakhs to 1.27 lakhs, which was highest in the state. However during the period of 1981-91 the growth rate dropped to 24.79 percent due to terrorism, but, after normalizing the social and economic conditions in next decade growth rate increased up to 36.60 percent. In 2001 to 2011 the population growth was 31.00 percent.

1.5.3 Drainage System and Water Sources- Sutlej River is nearest to Bathinda about 100 Kms north to it. A tributary of Sirhind Canal System called Bathinda Branch, a perennial canal, passes by the north side of the city, one of its tributary is known as Bathinda tributary passes by south side of the city, thus encircling the town from north and south sides. Public water supply in Bathinda started around 1955. The water supply system of Bathinda city is dependent partially on ground water and substantially on surface water that is canal water. In Bathinda, ground water is available 12 meters below the ground level, but the quality of ground water is not suitable for drinking purpose due to presence of excessive chlorides and fluorides and high TDS. The ground water of the district Bathinda is alkaline in nature with pH values ranging from 7.45 to 8.24 and a mean pH value of 7.90 (Ministry of Water Resources 2008). Comparing the concentration values of major ions with the standard concentration limits for drinking waters recommended by Bureau of Indian standards 1991, it is found that only about 30% ground water is suitable for drinking purposes as concentration of all constituents are within permissible levels, remaining water is not suitable either due to salinity, high fluoride and high nitrate (Ministry of Water Resources 2008).Due to the shortage of basic infrastructure, 21% of the total population directly depends on ground water which is often contaminated causing health hazards like bent bone, tooth decay, and diseases related to the upper respiratory tract (Singh 2013). The canal is operated and maintained by irrigation Department. Normally closure period of canal is about 12 to 15 days annually. The quality of water is reasonably good. The turbidity varies from clean in winter and summer to muddy in rainy season. At present, canal water is supplied to consumers supplemented by ground water through public distribution network.

1.5.4 Existing Water Supply and Demand- Water Supply, operation and maintenance of water are one of the prime and basic services provided by Municipal Corporation of Bathinda. Approximately, total 500 Km of water supply network has been laid at Bathinda. The existing structure is supplying water to 85% of the present population. Public water supply in Bathinda started around 1955, when a number of tube wells were dug in the inner part of city area and the water supplied through reservoirs located at the Fort and Subhash Park. Later the raw water was taken from the Bathinda branch of Sirhind canal. The Civil station and ITI water works based on slow sand filters were constructed for supplying water to Government institutions like Civil Hospital, Police Lines, District jail Bus Stand, Govt. offices like DAC and Court Complex, Rajindra College and Civil Station etc. by gravity through overhead reservoirs located in water works campus on Bhagu road. Supply, operation and maintenance of water are one of the prime and basic services provided by Municipal Corporation of Bathinda. However, the role of Municipal Corporation is limited to funding the entire cost of the project for maintenance and making the system operational, besides collecting the revenue from the end users. The entire process of planning, construction and laying the major network and construction of tube-wells & OHRS is handled by the state level agency i.e. Punjab Water Supply and Sewerage Board (PWSSB). The Board undertakes this work for and on behalf of the Municipal Corporation and after completing the system it is handed over to Municipal Corporation. Municipal Corporation supplies water to the most of Bathinda city, which covers almost 85% of the total area of the city (Punjab Government Report 2011). Within this area water supply infrastructure is the responsibility of Municipal Corporation. The PWSSB operates and maintains the water supply system in municipal areas on the behalf of Municipal Corporation. Some residential areas are developed by PUDA (now BDA) have their own water supply system. Responsibility of water supply in areas of PUDA is taken by PWSSD.

Municipal Corporation supplies water to the most of the city, which covers an area of about 68 sq. Kms either directly or indirectly. The total coverage is about 85% of the total area of city. The estimated population of the city as per PWSSB for the year 2007 is 2.5 lakhs out of which 2.12 lakhs population is served by a piped water

system. This gives a gross per capita supply of 283 lpcd (Punjab Government Report 2011). The gross per capita consumption includes physical and non-physical losses. If we deduct the losses, which are assumed to be 40% of the supply (based on experience of the other cities of Punjab), the net per capita consumption becomes 170 lpcd. Thus the per capita water requirement is sufficient if it is compared with standards given in UDPFI guidelines i.e. 135-150 lpcd (Punjab Government Report 2011).

1.5.5 Future Planning of Water supply in Bathinda City - PWSSB has proposed a new project to Punjab Government namely 'Providing 100% coverage Water Supply, WTP & OHRS and House Connections including Rehabilitation at Bathinda'(2013). According to that project PWSSB, decided to provide 24×7 water supply in the city. In that sense, whole of Bathinda city has been divided into four Zones, keeping in the view the trend of the future development, existing water supply facilities and area wise population demand. All zones are designed as per norms for projected population of 2030 and 2045. The work of all new water supply construction of these zones, is being funded by MCB. However, keeping in view the financial position balance scope of this allotted work had been taken in this DPR Zone A (Main water works, near Rose Garden) caters to old city area, area of across railway line and area including across Sirhind canal. Major of the population resides in this zone leading to highest density in this area. As much area of this zone includes the old city area, which has less chances of development. Moreover, if any development will occur in future in the outskirts areas like Kheta Singh Basti, Kothe Kame Ke etc. along Malout Road or along Goniana Road, the required water works will be constructed in future based on the development. Hence, this zone has been designed for current population i.e. 2013 year and as per current population demand, the water supply components have been proposed also in this project. Zone B (Govt. Water works at Bhagu Road) caters to urban estates, Model Town, Bhagu Road, Secretariat area, Police lines etc. This zone is maintained by Punjab Water Supply and Sanitation Department (PWSSD). Matter of this zone was discussed by PWSSB & PWSSD authorities and PWSSD told that a project of 1409 Lakhs has been prepared by them to cater the demand of this zone up to year 2045. For the area being maintained by

PWSSB, an OHRS of 2.00 Lac Gallon is proposed on Ajit Road. Filling of this OHRS has been covered by PWSSD under their project. Zone C (Growth Centre water works) caters to areas like Harbans Nagar, Deep Singh Nagar, Mati das Nahar, Udam Nagar, Bangi Nagar etc. From two sides this area is surrounded by railway line to Delhi and Sirsa Railway Line. Hence this zone can be only expanded along Mansa Road and some new water works structures have been proposed by PWSSB. As already a water box exists in Growth Centre area and land is also available, so all the new water works components have been proposed to build in the same water works. Zone D (Giani Zail Singh Engineering College Water works) caters to areas like Anoop Nagar, Sangauana Basti, Amarpura Basti, Dabawali Road etc. This zone is also bounded by railway lines, one side Sirsa Railway Line and other side Bikaner Line. Hence this zone can be only expanded along Dabwali Road. A new water box is proposed in this zone in the premises of GZSEC, which is sufficient to cater the demand of this zone up to 2045.

All zones have been designed for an average demand of 135 liters per head/day including losses. This average demand includes residential, small industry, commercial and institutional demands. The supply is proposed to be continued to minimize the cost of operation and maintenance. The clear water pumps have been provided to pump the total daily demand in 22 hours. The pressure will be adequate for domestic needs of the town where the highest buildings are three storied and will also be adequate for firefighting purposes. The proposal is as per the guidelines laid down in the manual of water and water treatment.

As much part of existing system water supply components lies in Zone A and further this zone had been developed years ago being the old city area, So all the rehabilitation has been suggested in the zone A for existing water supply components. Some of the old city areas like Guru Nanak Pura, Kalia Street, Nai Basti, Khatika Wala Mohalla, Pooja Wala Mohalla etc. have problems of water mixing and leakages. Replacement of old distribution lines has been proposed to be update.

Since the duration for execution of the project is kept as 3 years hence is has been assumed that all the water supply distribution will be laid by 2015 and city will be

under 100% coverage of water supply. Hence all the house connections for year 2015 have been proposed with meter to avoid wastage and proper use of water. Metering will help in measuring the water used and water production which will help in detecting the water leakages in the system, water theft etc. At present spring level of the town is 200.56 m & the worst spring level is 202.84 m. The spring level is highest in rainy season which is 1 to 1.5 m higher than during summer in various parts of the city. In future, it is decide to provide canal water because ground water is not fit for human consumption. PWSSB made this clear that at present no industrial waste is discharged into canal at upstream side of the city. As such there is no pollution of canal water for rendering it unfit for human consumption. They believe that reliability of the source is unquestionable. It is proposed and expected that on the completion of the project, 95% house connections will be released to the consumers. The viability of the project has been found out on the basis of present tariff and assuming 95% connections. It has come out that with the present tariff; there remains a continuous deficit between the revenue and Operating & Maintenance expenditure. This deficit will be met with by Govt. of Punjab/ MC from Value Added Tax etc. The period of completion of this scheme is 3 years on arrangement of funds. On completion of the project 24×7 water supply will be assured.

1.6 Relevance of Study-

At present, the most pressing problem before humanity is not the fear of outbreak of war, epidemic or the collapse of civil administration but the daunting problem of short supply of drinking water (Jethoo & Poonia 2011). But, people in cities have access to water at all times and places which sent a wrong signal that the water is available in plenty. In fact, the progress of the urban water supply sector has been somewhat slow in developing countries, in spite of policy initiatives, because of the improper focus and inadequate reforms in the urban water sector. Such reforms are not useful without people satisfaction as discussed in vicious circle of urban water sector. In urban areas, water is tapped for domestic and industrial uses from which almost 80% of the water supplied for domestic use, comes out as wastewater (CPCB 2010). So, it is necessary to study, the pattern of water consumption in domestic sector. On the

other hand, people perceptions on the quality, quantity and availability of water resources can be used to get results regarding consumer satisfaction, people's level of awareness among declining availability of water and level of adjustment within available water resources. The study of people perception helps municipal corporations and organizations to improve their water supply and conservation strategies by understanding issues such as psychology of the consumer what he/she understands about the present and future availability of water, how the consumer is influenced by the environment where he lives, what are the limitations in consumer knowledge or information. Better understanding of consumer behavior could help in developing newer strategies for successful marketing of water as a social and an economic commodity for enhancing the sustainability of water supply (Jethoo & Poonia 2011). Consumer behavior studies have widespread application in the marketing of goods and services and the application of some of these concepts could be useful in improving delivery of water services (Boland 1997).

1.7 Objectives-

1. To study the water availability, demand and consumption in Urban South Asia.
2. To analyse domestic water availability and consumption pattern of Bathinda City.
3. To study the peoples' perception & awareness about water characteristics in Bathinda City.

1.8 Chapter Scheme-

Chapter 1- (Introduction): This Chapter explores the introductory part of world's water availability and consumption. Brief introduction of South Asia, India and Punjab's water resources as well as consumption is also analyzed. Study area, Bathinda, is well defined with its existing water supply systems and future plans. Relevance of study and Objectives are also given.

Chapter 2 – (Review of Literature): Previous studies related to present study has been discussed in this chapter. Various sections explained the water studies about

water resources, some case studies with special reference to South Asia also and describing importance of studies about people perception & awareness.

Chapter 3 – (Research Methodology and Data Interpretation): The study is depended on primary as well as secondary sources so different methods are used for collection of data. Data collection, data interpretation and model specification has been discussed in this chapter. Limitations of the study have been discussed also.

Chapter 4 – (Contextualizing Water Consumption in Urban South Asia): Water availability and consumption of South Asia has been discussed in this chapter. Increasing demand of water in Domestic sector of Urban South Asia has been contextualized in this chapter.

Chapter 5 – (Water Consumption Pattern in Domestic Household of Bathinda City): Data collected by surveying Bathinda city has been discussed in this chapter. Water availability, consumption, economy of water, peoples' perception and awareness about water quality and quantity has been discussed.

Chapter 6 – (Conclusion): Concluding remarks are given in this chapter.

Chapter 2

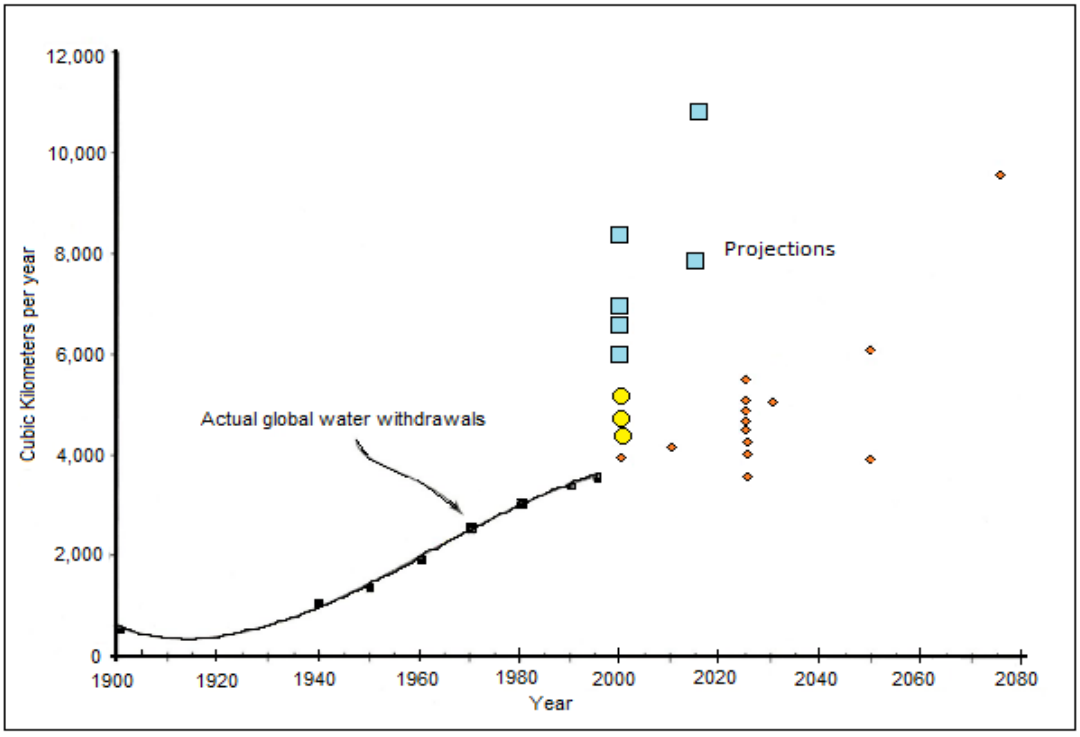
Literature Review

Water, the need of life, is likely to pose the greatest challenge on account of an increased demand with population rise and economic development, and shrinking supplies due to over-exploitation and pollution. Due to the reduction of surface water sources, potable freshwater stress owing to increasing population and urbanization, water use will increase significantly in future. Going back in history, before the industrial revolution, it was possible to withdraw and consume water to everyone's satisfaction. However, times have changed as demographic pressure in the last three centuries, no longer allows for the management of water without cooperation among communities. It is a known fact that water, in a geographic sense, is unequally distributed on earth and population growth varies on every continent. Projections by different organizations show that the demographic patterns of developing countries are becoming more and more significant, in particular in sub-Saharan Africa and South East Asia, where access to clean water is already a challenge for the current population, presenting a high risk of increasing, and irreparable, water scarcity. On the other hand, economic development, increasing population and urbanization have positive impact on the quantity of water consumed in various sectors of water consumptions. Increasing water consumption in domestic sector is mainly influenced by rate of urbanization and population growth. The aim of my study is to analyze the water consumption pattern in domestic household, so the past studies must be studied in this regard. Several studies have been analyzed, on the basis of that studies this chapter has been organized into four sections; section 2.1 Water Resources, Consumption & Environment deals with the studies related to water related problems, its consumption in various sectors & environmental degradation, section 2.2 analyze the studies related to several micro level studies of domestic water consumption in world's various parts, section 2.3 is depended upon various studies of urban South Asia, section 2.4 gives the importance of people perception and awareness about water resources by evidences from past studies.

2.1 Water Resources, Consumption & Environment-

World is in midst of a major transition in water resource development, management and use. Gleick, (2003) examined that the most serious unresolved water problem is the continued failure to meet basic human needs for water. By using different agencies data and future projections of water use and water demand he reached on the conclusion that to meet basic human and ecological needs of water, improving water quality, eliminating overdraft of groundwater, and reducing the risks of political conflict over shared water require fundamental changes in water management and use. He argued that the predominant focus of water planners and managers has been identifying and meeting growing human demands of water. Projections of water use and actual global water withdrawals, as compiled from various projections of global water withdrawals made since 1960s, together with an estimate of actual global water withdrawals as estimated in UN report of water assessment (Fig. 1)

Fig. 2.1: Projections of water Use and Actual Global Water Withdrawals



Source: Gleick, 2003

Symbols: squares- projections made before 1980; circles- projections made between 1980 & 1995; diamonds projections made after 1995.

Domestic water demand is going to increase in both developed and developing countries. Due to urbanization and population expansion, Asia, where many developing countries are developing is also going to face such problems. In the coming century, climate change and a growing imbalance among freshwater supply, consumption, and population will alter the water cycle dramatically, this is analyzed by Jackson et al, (2001). They examined the hydrological cycle and changing climate on earth and its impacts on water availability in coming centuries. By analyzing the situation of surface water, ground water and a case study of Middle Rio Grande of Mexico, they reached on conclusion that over half of accessible freshwater runoff globally is already appropriate for human use, more than 1×10^9 people currently (up to 2001) lack access to clean drinking water and almost 3×10^9 people lack basic sanitation services, this is because of the human population will grow faster than increases in the amount of accessible fresh water, per capita availability of fresh water will decrease in the coming century and climate change will cause a general intensification of the earth's hydrological cycle in the next 100 yr, with generally increased precipitation, evapotranspiration, and occurrence of storms and significant changes in biogeochemical processes influencing water quality. They also suggest that there should be more and more research in this regard to evaluate future water demand and projections about uncertainties about freshwater availability.

Besides, population expansion and climate change, Poverty and Environmental Degradation in urban areas are perpetuated through inadequate water and sanitation services, together with the use of inferior technologies as well. Lundqvist, et al. (2003) tried to link the wide spectrum of social change to the implications of urbanization for water and environmental security. They took three dimensions of urban water and environment that; the possibilities to augment overall supply to cater for the escalating needs and wants, challenge concerns the distribution and use of water within the urban areas, concerns the alarming levels and concentration of pollutants that are generated in these growing agglomerations. With these three dimensions, they analyzed the growth of urban centre its demography, economy and water, supply and distribution of water in urban areas and wastage of water. They also made projections about increasing demand of water and supply problems in least developed countries

especially. They concluded that rapid rates of urbanization in Least Developed Countries with rapidly new challenges like environmental degradation, poverty and water security. Safe guarding water provision to expanding urban centers requires the establishment of some varieties of basin authority and a national water policy. Such arrangements would facilitate the integration and balancing of development objectives and environmental concerns.

'Within the urban areas, the poor urban populations are left without access to officially provided water services, even when they are able to access such services, these are often inadequate in terms of service levels and quality', this is argued by Velleman, (2009). By analyzing pro-poor measures in water utilities, efficiency and viability considerations for service delivery and pro-poor initiatives, with brief case studies of three water providers National Water and Sewerage Corporation Uganda, Manila Water Company Incorporated Philippines and Phnom Penh Water Supply Authority Cambodia, he concluded that many of developing countries, criticism is routinely directed at water utilities for their failure to provide adequate services to poor people in urban contexts. The failure of utilities to provide adequate water services to poor urban in urban neighborhoods represents a lose situation for both users and providers. This paper examined how providers can become more pro-poor by enhancing their low accountability to users, and how users can act to make providers more accountable. On the other hand, presence of the free allowance can result in water wastage and its removal would be an efficient way of reducing water consumption, examined by Dandy et al. (1997). Regression analysis was used to model residential water demand for the city of Adelaide for a sample of households for the period 1978/79 to 1991/92. They found that any increase in price would result in a greater reduction in demand for summer than for winter. Factors such as property value and household size were also used to de significant in determining the level of demand. Their results confirm the expectation that consumption above the allowance is more sensitive to income (or property value), climate variables (summer moisture deficit and winter evaporation), and pool ownership than consumption below the allowance but responds to the need for water as determined by plot size, household size and number of rooms no differently from consumption below the allowance. The

removal of free allowance should not raise any equity concern, because the size of the allowance tended to be related to property value so that the households which benefitted from all allowance tended to be rich rather than poor.

Dalhuisen et al (1978), told us about three dimensions of scarcity of water; water quantity, water quality and safety dimension of water (protection from abundance of water such as floods). This paper focused on economies of drinking water, supply and demand of water use, as well as the policy issues concerning the water provision in urban sector. They concluded that sufficient scope to influence water use by prices and changing governmental structures shows less potential as a policy instrument to struggle for sustainable water use. They also suggest that additional research should focus on price responsiveness for various water use functions, effects of changing governmental structures can be studied with the help of synthesis of number of cases where governmental structures are experienced.

2.2 Micro Level Case Studies –

Problem of increasing water demand in urban sector has been started from mid-20th century. Many works have been done since then on the increasing demand of water in urban areas. But, as told before, with increasing population the demand of water in domestic sector is increasing as well. Many case studies were done by different scholars to analyze the increasing demand and consumption of water in different cities of world.

Gottlieb (1963), examined that there has been less study of demand characteristics for domestic use of purified water produced and distributed by urban water works (before 1963). His paper summarized the previous studies, by utilization of water works data for the state of Kansas which was available in annual reports. He took four major variables price variance, price elasticity, effect of price change and multiple regression analysis of previous studies. He concluded that it is indicated from various studies that income elasticity's are less influential than price elasticity's (water). The 1957 Kansas price elasticity's confirm the results of 1957 elasticity regr4ession for the much larger range of experience analyzed for price effect alone. The multiple

regressions also show that some decline was started from 1952. He argued that economy of water use was also fostered by more prompt repair of defective plumbing and by reducing use of water for lawn sprinkling.

Wong (1972), argued that if urban water consumption is to be reduced, that the flat rate pricing policy of water be reformed. He took Chicago City and its outside communities as his main concern of study and water price, income level & summer temperature was major variables studied by him. He applied regression model & cross- sectional analysis and concluded that in the City of Chicago, average summer temperature has the most significant impact on the per capita water demand of the outside communities. In general, the results and analyses lend the support to several earlier studies that have estimated price & income elasticity's for municipal water demand. He also argued that ground water is moiré price elastic than surface sources, since the communities which are more ground water users show much higher price elasticity's than those which mainly depend on Lake Michigan as their source of water supply. In city like Sydney (Australia), the overall consumption levels appear to be trending down in more recent years, a possible reflection of both declining lot sizes of new house development, and behavioral changes in consumption patterns following recent demand management initiatives by Sydney water to promote more efficient domestic water use. Troy et al. (2005) examined the water use patterns in the city by land use survey and consumer survey by surveying 2200 households randomly selected from the city. With the help of tables and several statistical analysis the argued that the greatest potential for securing the future water supply for Sydney, as in other Australian cities, lies in focusing on how demand for water can be best managed. A program of costal subsidies to encourage adoption of new policies could achieve substantial savings in water consumption, especially over long time. There is more external water usage in many higher density developments that contribute to comparable average water consumption levels also. Water consumption varies from one area to another depending on socio-economic standard of the people, the level of education and development, nature of prevailing climate, the hygienic characteristics of the people, level of provision of sanitation facilities and general sanitary habits of people, this is argued by Sule et al.(2010). They also

adopted questionnaire method and surveyed seven hundred households by dividing them into three economic groups as high income group, middle income group and lower income group. By collecting the required data and with the help of tables they concluded that there was a general shortfall in water supply to many areas in Ilorin, the high rates of water supply were common in low density areas and low rates were in high density area. Moreover, public distribution system is not adequate, because majority of consumers still source water from wells of boreholes to meet their basic needs.

2.2.1 South Asia-

Most of the studies on residential water use in the past three decades were carried out in developed countries, and looked at water use and consumption patterns from the economic point of view. As a result, pricing was found to be one of the most important policy variables in managing water demand. In developing countries like South Asian countries, however, the context for water use and consumption studies is quite different. The relevant studies therefore concluded that access to water rather pricing, is the most important variable in determining water use and consumption.

As Shaban & Sharma (2007), concluded that water consumption in Indian cities (mainly Delhi, Kanpur, Kolkata, Ahmedabad, Mumbai, Hyderabad and Madurai) is far lower than the norms laid down by the Bureau of Indian Standards. The lower consumption is mainly because the water supply is not keeping pace with population growth and increasing needs of users. With the household survey of consumption, availability, access and methods adopted for conservation of water in domestic households in seven major cities of India, they reached on the conclusion that majority of the households consume water below the specified norms, by and large, people show satisfaction with available supply. This is mainly because they have limited their aspirations and requirements of water in relation to available supply from municipalities or water authorities. They have analyzed city-wise variations in the supply and qualities of water that Kolkata and Hyderabad are much better than Kanpur & Delhi. Water use is also affected by income level, changes in lifestyle and climate change, since rising temperatures lead to increase in water consumption for

gardening and personal comfort such as desert coolers, as studied by Jethoo & Poonia (2011). They made questionnaire and got 225 respondents from the city, and by dividing them in to three income groups, they obtained required data and with the help of some statistical tools they come to a conclusion. They argued that water use in the household is highly correlated with income of different groups as maximum water consumption is observed in high and middle income groups. The high income group and middle income group incumbents are responsible for large water consumption in kitchen garden and car washing etc. Information dissemination, education, higher tariff may change consumptive habits. Positive Impact of urbanization on the amount of water consumed in domestic sector in cities has been concluded by Joshi et al. (2003). He surveyed 300 houses of urban Kathmandu valley of Nepal & tried to know the existing as well future water consumption pattern by asking several questions. He generalized the increasing trend of quantity of water use in future because if the investment of the government in sanitation education will encourage people to adopt better sanitary habits, consequently demand for more water in future is sure. On the other hand, he found that more number of water use appliances also caused much consumption at domestic household; as his study shows that water consumption is almost three times higher from the households having yard tap to the fully plumbed houses. On the same way, Bhatti & Naso (2010), conclude that economic variables, assess to knowledge, housing characteristics, accessibility to the water source, economic class, water quality, climate & hydrology, water prices & water policy are main functions of domestic water demand. They studied water consumption pattern in Karachi, Islamabad and Rawalpindi cities of Pakistan and forecasts the per capita demand of water & population. They forecast that with the same urbanization growth rate, the urban population will be equal to rural by the year 2030, and demand in urban domestic section will also increase. Then, they give importance to the water awareness especially among women and children because these are prime factors for success of any domestic water project. Several other socio- economic impacts on water consumption pattern has been analyzed by Bradley (2004) that increase in water using appliances in houses like rapid conversions of latrines to flush toilets, use of washing machines and dishwashers by

lower income group people in urban areas increase the amount of water consumed. The consequences of changes in housing type, household size, acceptability, and market penetration of water-efficient appliances, alternative sources of water, economic development and employment opportunities need to be evaluated because he observed their impact in Asian cities. He used secondary sources to evaluate the per capita water demand and conclude that changing lifestyles are responsible factor for increasing water demand in urban domestic sector.

But, except, declining water quantity and increasing demand of water in urban areas of most of the counties, declining water quality is also a major issue has been observed from last two decades. The South Asian countries have agrarian economy and in these countries most of water problems are directly or indirectly related to agriculture. But, in urban areas the scene may be quite different due to industrialization and urbanization. With the problem of declining water quality, people of different communities are willing to pay more than what they are paying currently for improved water. Sarkar & Alam, (2013), argued that water security is a critical factor in economic, environmental and social systems and for life itself. They used contingent valuation method to elicit residential consumers, multiple regression analysis of various variables, by interviewing 150 households. They reached on the conclusion that households are willing to pay more for improved services, which is important for the policy makers in evaluating appropriate water tariff. Household income and education of the head of the family are the most powerful determining factor for willingness to pay for continuous supply of good quality water. Low levels of tariffs make it hard to influence consumers' demand, i.e. no possibility of achieving a price elasticity of demand.

Some environmental issues, including shortage of water, are common in all South Asian countries. Jha (2004) in his article, elaborate that environmental problems have been regarded as a 'common fund' in South Asia, and the problems are compounded by the pressures of the population explosion, industrialization and urbanization, the excessive use of science and technology and acid rain. These common environmental problems include Population & Environmental Degradation, Energy

Insecurity, Food Insecurity, Shortage of water, Loss of Biodiversity, Hazardous waste Dumping etc. Atmospheric issues are now at the top of the international agenda, as scientific evidence mounts on the consequences of the depleting ozone layer and greenhouse effect. He suggested that these environmental problems are required to develop comparable economic and environmental statistics, base line quantity and quality survey of shared resources and early warning capabilities to reduce environmental hazards.

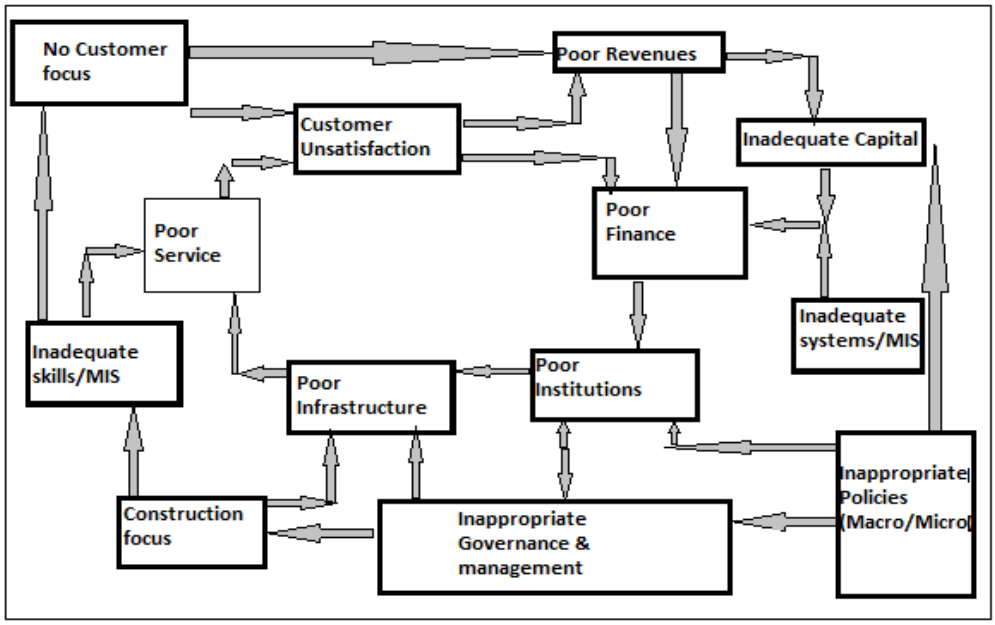
2.3 People Perception and Awareness-

An empirical study on urban residential water use provides first- hand information regarding urban household water use, consumption pattern, household amenities and facilities, household water use habits and behavior, household water perception, household environmental attitudes, and household capacity and willingness to respond to water conservation policy.

The literature is available which shows that better understanding of consumer behavior could help in developing newer strategies for successful management of water as a social and an economic commodity for enhancing the sustainability of water supply. Bajpai & Bhandari (2001) argued that mere access to water is not the only issue- it is also important it be available 24 hours a day and its quality in terms of cleanliness be good, for this data of people perception is best method. This article is based on a data set from a survey conducted by the National sample survey Organization in 1998. With the help of tables and other statistical tools they reached on a conclusion that almost all cities and towns in India many households do not have access to water on tap. They collected data that contains responses to queries on households' perceptions on improving sanitation in general. About 40 percent of households are willing to contribute financially and 30 percent are willing to put their own labor for this purpose. However queries on the 'sufficiency' of water reveal a different picture- more than 80 percent of the households across different segments, consider that they have sufficient supply. They argued that the bulk of these households do not have sufficient access as they supported it by data. As a small survey indicated that the majority of consumers in Delhi would be satisfied with a daily

supply of 5-6 hrs/day. Zhang & Brown (2005) used the basic hypothesis that a good understanding of residential water requires the inventory and analysis of household water use and consumption patterns. They used stratified random sampling in four types of residential buildings and about 400 household were surveyed by them. They also collect data about people perception and awareness and concluded that people in Tianjin were more satisfactory with their current municipal water supply than people in Beijing. Many families were aware to the fact that in Beijing there is short of water than in Tianjin. They also suggest that municipal water system should be prepared for a rapid and ongoing urbanization process. Water demand management, wastewater recycling and reuse, water conservation, and efficiency should lead policy in municipal water supply planning and management. Nallathiga (2005) examined the importance of consumer satisfaction with the help of vicious circle by World Bank. As the other aspects like infrastructure, revenue, governance and policies are important to make adequate water supply in any urban sector, Customer satisfaction is also important for making policies regarding water management in every urban area. The vicious circle of Urban Water Sector (Fig 2) is based on that if there is no proper governance and management at initial stage that leads to poor infrastructure, inappropriate policies, poor financing and consumer dissatisfaction. On the other hand, if consumers are not satisfied with the water supplies that again leads to poor financing that leads to poor infrastructure and policies, in this way this vicious circle works where consumer satisfaction in very much important. The consumer's satisfaction can be analyzed by actually going to the field and surveying people. In this way my study will focus on consumer satisfaction somehow. In this regard, he studied many policies and strategies of government and argued that survey for people perception about supplied water to them and whether they are aware about policies and strategies etc.

Fig. 2.2: The Vicious Circle of Urban Water Sector



Source: World Bank, 1998

2.5 Knowledge Gap- Understanding the way that people use water is becoming increasingly important in water stress countries of South Asia especially India & Pakistan. Despite this, there is limited understanding how people in urban areas of South Asia currently use water in their households, and even less insight into the factors that influence future water use. On the other hand, progress of urban water supply sector has been somewhat slow in South Asian countries, there is need to reform policy initiatives but such reforms are not useful without people satisfaction. People perceptions on the quality, quantity and availability of water resources can be used to get results regarding consumer satisfaction, people's level of awareness among declining availability of water and level of adjustment within available water resources. There is lack of micro level studies to know the consumption pattern, people perception & awareness about available water. To reduce this knowledge gap, an effort has been made by surveying 60 households of Bathinda city.

Chapter 3

Contextualizing Domestic Water Consumption in Urban South Asia

3.1 Introduction- South Asia is an enriched land with abundant manpower; highest glaciated mountains, long blue water coast lines, flowing rivers etc. but unfortunately, the major portion of inhabitants of this region is living below poverty line and suffering with crisis like shortage of food and water (Hassan 2013). South Asia is home to one-fifth of the global population, and this share is likely to increase to one- fourth of the total world population by 2025 (WASSA 2004). South Asia region, consist of eight countries namely India, Pakistan, Bangladesh, Bhutan, Nepal, Sri-lanka, Afghanistan and Maldives, inhabitant of almost one- fifth population of world. These people have access to less than 5 per cent of the planet's freshwater resources. The region is facing many common problems like population pressure, poverty, environment degradation etc. Environment degradation mainly consists of air pollution, stress on water resources, deforestation, mismanagement of waste material. Increasing demand of fresh water and increasing population make any country or region water stress. According to Pringle and Barber (2000), Fresh water is already a limiting resource in many parts of the world. In the next century, it will become even more limiting because of increased population, urbanization, and impact of climate change. Crisis with regard to water also casts a shadow on sustainable development of South Asian region. In South Asia, Pakistan, India and Sri-lanka have seen a large surge in water extraction (Alexander & West 2010). Water crisis & Increasing demand of water is not only caused by population increase and economic development but also by many reasons like, societies are going to have comfort, among other things, demographic transitions, geographic shift of population, technological advancement, growing globalization, degradation of the environment and emergence of water scarcities (Shaban & Sharma 2007). Such factors have been observed in many South Asian countries as these countries are developing countries so that industrialization, urbanization processes are at very fast rate. On the other hand, these agrarian countries are consuming much water in agriculture sector. While, in this region water availability is much in terms of precipitation, river water flow and nearness of Indian Ocean. According to Mirza, lack of freshwater to drink, for use in industry and

agriculture and for multitude of other purpose where water is essential, is a limiting factor- perhaps the most important factor – hindering development in many parts of the globe. In South Asia, increasing water shortage and declining water quality from pollution during the past few decades has drawn attention to the inherent fragility and scarcity of water and led to concern about water availability to meet the requirements of the 21st century. Because of increasing population and changing pattern of water use in South Asia, additional demand is likely to be accompanied by a sharp decline in per capita water availability. While consumption of 1000 m^3 of water per year and per capita is considered a standard for "well- being" in the developed world, projection of annual water availability per capita by the year 2025 for South Asia is mere 730 m^3. This trend is declining in all parts of the world, including those that are considered to have ample water resources. Water availability and demand is going to increase in coming future in all sectors. Water is avail from rivers and ground water. The three trans-boundary river basins assessed in the report include the largest in South Asia: the Ganges-Brahmaputra-Meghna (GBM) river basin which spans Bangladesh, Bhutan, India and Nepal, the Indus river basin in Afghanistan, India, Nepal and Pakistan, and the Helmand river basin which covers Afghanistan, and Pakistan in South Asia. But, a large gap has been observed in water availability & demands on the one hand and water demand & supply on the other hand. Decreasing water availability, increasing water demand due to rapid growth of population & urbanization, and water consumption pattern in urban domestic households in South Asian region has been contextualized in this chapter by analyzing South Asian countries; India, Pakistan, Bangladesh, Afghanistan, Maldives Sri-lanka, Nepal & Bhutan.

3.2 Water availability in South Asia: In assessing the availability of water resources in any region, there are number of data and information problems, including inconsistency in historical data because of changes in the technology of data collection, lack of access to some official data, wild guesses made in water use (both surface and ground), and wide seasonal variations in the regional rainfall (WASSA 2004). Keeping in view all these factors, FAO- Aqua stat data has been used to access overall as well as per capita water availability in South Asian countries. The

total water availability in the countries of South Asian region is summarizes in Table 3.1.

Table 3.1: Annual Water Availability in South Asia (2011-12)

Data	India	Pakistan	Bangladesh	Afghanistan	Maldives	Nepal	Bhutan	Sri-lanka
Areas (1000 Hectare)	328726	79610	14400	65223	30	14718	3839	6561
Population (1000 inhab)	1258351	179951	152409	33397	324	31011	750	21224
Total renewable water resources (10*9m^3/ yr)	1911	246.8	1227	65.33	0.03	210.2	78	52.8
Per Capita total renewable resources (m^3/Inhab/yr)	1519	1371	8051	1956	92.59	6778	104000	2488

Source: Aquastat database (Estimated values on http://www.fao.org/nr/water/aquastat/ data/ query/ results.html, retrieved on 24th February, 2014)

Total renewable water resources of any country are total water resources within national boundary; it includes surface as well as ground water. It is dependent on geographical area of any country; number of rivers or streams flowing in that particular area; rainfall index and presence of aquifers. In this regard India has much renewable water resources due to largest extent of its geographical area and large number of rivers within national boundary. But, water resources are unevenly distributed with in a country. Number of people living in a country also affects distribution of water and per capita availability of water in any country. According to Asian Development Bank, per capita water availability in South Asian region has decreased by 70 percent since 1950. Climate change, rapid population growth and urbanization are causing pressure on South Asia's water resources. On the other hand, rainfall intensity and variability make South Asia highly susceptible to floods, droughts and other disasters. The per capita availability of water in this region is decreasing due to increasing population in all countries of the region. The deficiency or otherwise of water availability in different basins/regions is defined in following way (IWRS 1999):

- Basins with freshwater resources of 1000 to 1600 cubic meters per capita per year are considered water stress zones with major problems occurring in drought years.
- Basins with renewable water resources water resources of less than 1000 cubic meters per capita per year are deemed water scarce basins. In this, water availability is considered a severe constraint on socio-economic development and environmental quality.
- Basins with renewable water resources of less than 500 cubic meters per capita are considered as absolute scarcity basins.

On the other hand, UNDP, UNEP, World Bank and WRI defined that an area is experiencing water stress when annual water supplies drop below 1,700 cubic meters per person. When annual water supplies drop below 1,000 cubic meters per person, the population faces water scarcity.

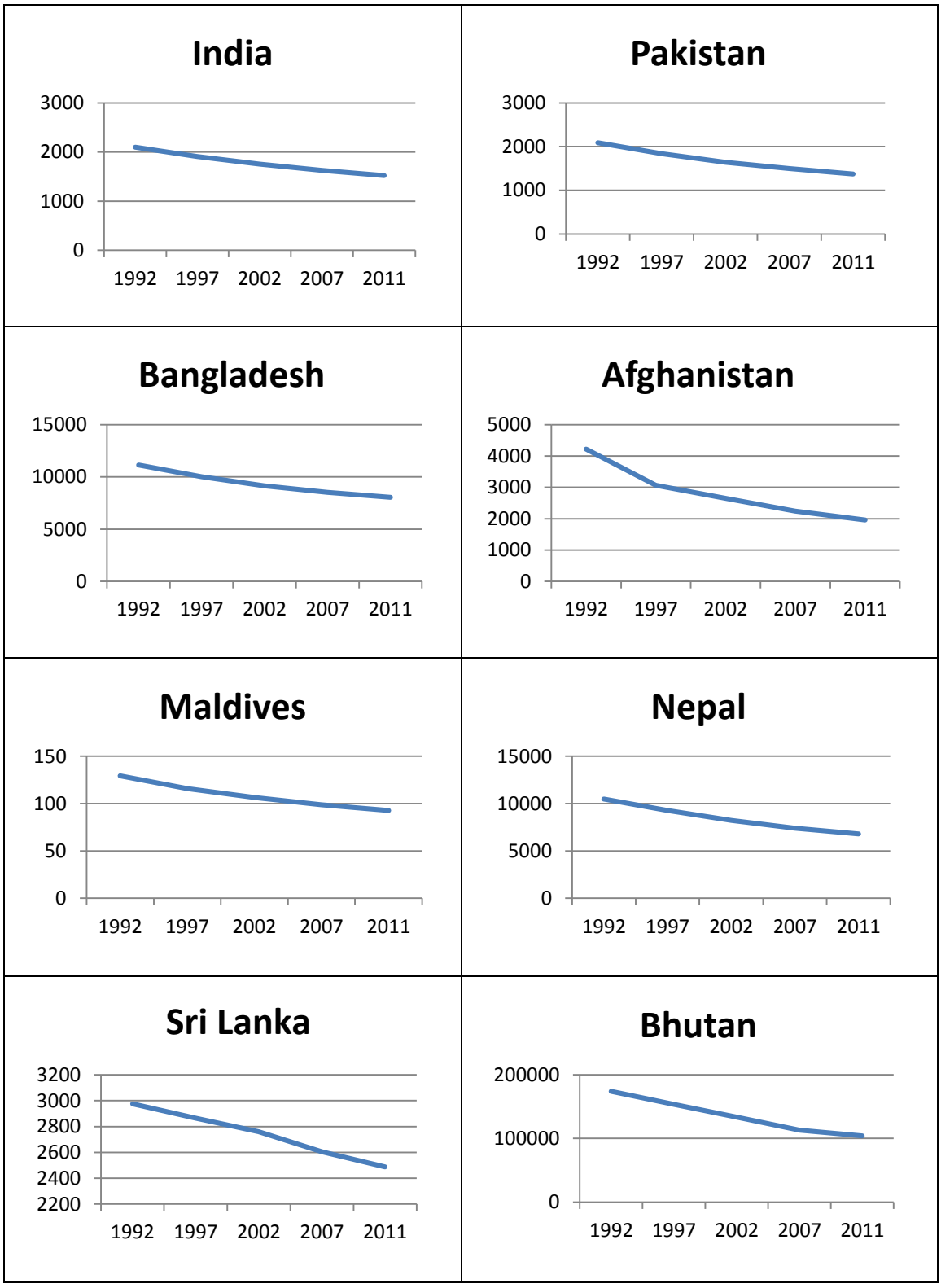
In South Asia, India and Pakistan are water stress countries and Maldives is absolute scarce (water scarcity) area. Per capita availability of water is decreasing in South Asian region from last many decades. After 1990, per capita water availability is rapidly decreasing in all South Asian countries (Table 3.2). Decreasing trend of per capita availability has been shown in Fig 3.1.

Table 3.2 Declining per capita availability of water (m^3/inhab/yr) in South Asia

Country	1992	1997	2002	2007	2011
India	2100	1910	1755	1628	1519
Pakistan	2091	1838	1641	1501	1371
Bangladesh	11132	10027	9139	8523	8051
Afghanistan	4222	3067	2651	2241	1956
Maldives	129.3	115.8	106.4	98.68	92.59
Nepal	10487	9263	8223	7408	6778
Bhutan	173993	153409	133663	113208	104000
Sri Lanka	2976	2865	2759	2605	2488

Source: Aquastat database (Estimated values on http://www.fao.org/nr/water/aquastat/ data/ query /results.html, retrieved on 24th February, 2014)

Fig 3.1 Declining Per Capita Water Availability in South Asia (m^3/inhab/yr)



Source: Aquastat Database (Estimated values on www.aquastat.com retrieved on 24th February, 2014)

3.3 Water Consumption Pattern in Urban South Asia: It has become common to refer to an emerging freshwater crisis of global proportions, likely to be made worse by increasing consumption on the one hand and global warming on the other (McGranahan 2002). Urban South Asia is not far behind from the situation of water stress. As decreasing per capita water availability of water resources that has been discussed in previous section compounded with increasing urban population of this region give more pressure on this problem. As urban areas and population are expanding; the demand for water, energy and other resources are also expanding. Growth of population and the economy is naturally associated with an increase in the demand for water (Lundqvist et al 2002). Urban population is growing rapidly in South Asian countries (Table 3.3). In this way, urban population is increasing; water demand will also increase in domestic households of urban areas. On the other hand, the water consumption pattern of urban areas shows that the need of water will be increase with increasing facilities, improving sanitation conditions and increasing water using appliances at domestic households. Many studies has been done in context of water consumption pattern of domestic households in South Asian cities concluded that with the existing pattern of water consumption and population growth, water demand will be increase. Urbanization has positive impact on the quantity of water consumed.

Table 3.3: Increasing urban population in South Asia (1000 inhab)

Country	1992	1997	2002	2007	2012
India	236399	270360	305667	342714	385544
Pakistan	36672	43434	50644	57595	65738
Bangladesh	22702	27456	32751	38178	44379
Afghanistan	2865	4163	5084	6352	7755
Maldives	59	67	84	110	138
Nepal	1923	2696	3688	4814	6132
Bhutan	98	118	168	225	272
Sri Lanka	3197	3063	2934	2935	3041

Source: Aquastat Database (Estimated values on www.aquastat.com retrieved on 24th February, 2014)

Several Studies have been conducted in South Asian cities to know the supply and consumption pattern as discussed below:

The water consumption pattern of the five municipalities shows that Kathmandu has the highest consumption rate in Nepal; it should be considered while estimating the future water demand as Kathmandu is one of the fastest growing cities in the world and per capita domestic water consumption for owner household is 80 liters while that for the renter households is 46 liters (Joshi et al 2003).

The domestic water demand of Pakistan under scenarios of constant water demand as a base year 2010, will be 1.3 times and 1.6 times more than base year by the years of 2010 & 2020 (Bhatti & Nasu 2010).

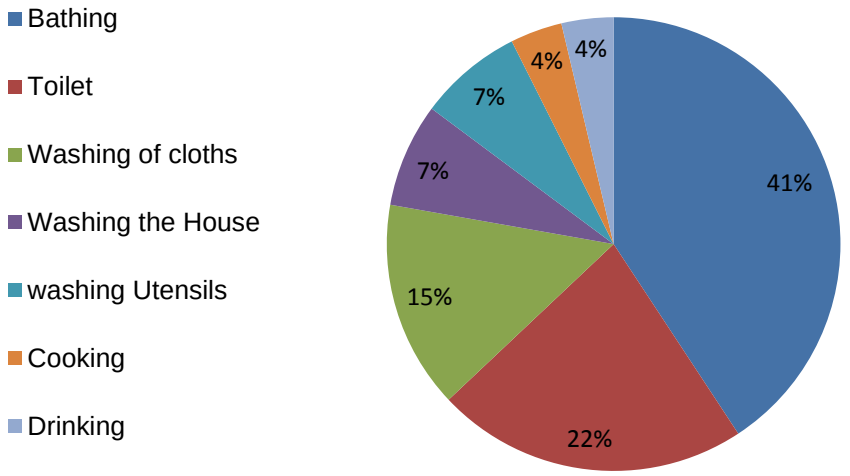
Some household activities also have impact on more consumption of water at domestic households. Cloth washing, bathing, water use in toilets, washing dishes and utensils are the most intensive water consuming activities in the cities. In Indian cities, a majority of households perceive these activities as the most wasteful. The availability and mode of use of water varies with socio-economic classes within the cities. But, on the other hand city wise supply and quality of water are very much. The supply of water in Indian cities is going to be a big challenge in the future. The rapid increase in the population in Indian cities, depleting water resources and enhanced consumer needs are going to create a difficult situation (Shaban & Sharma 2007).

In India, the design of water supply systems has been done using certain standards. Currently the standard being used is BIS 1172-1993, reaffirmed in 1998. As per BIS, IS: 1172-1993, a minimum water supply of 200 lpcd should be provided for domestic consumption in cities with full flushing systems. IS: 1172-1993 also mention that the amount of water supply may be reduced to 135 lcpd for economically weaker sections of the society and in small towns (Modi 1998). This amount is daily minimum per capita requirement of water at households. But, it is important to mention here that in developing countries like South Asian countries water consumed is not determined by demand but the supply. People adjust within the quantity supplied to them. But, water supply is increasing in all South Asian countries excluding some regional variations.

Vishwanath, 2013, had made attempt to understand the break-up of this demand which was then put as 135 liters per person per day (Fig 3.2). The break- up was as follows:

- Bathing: 55 liters
- Toilet flushing: 30 liters
- Washing of clothes: 20 liters
- Washing the house: 10 liters
- Washing utensils: 10 liters
- Cooking: 5 liters
- Drinking: 5 liters

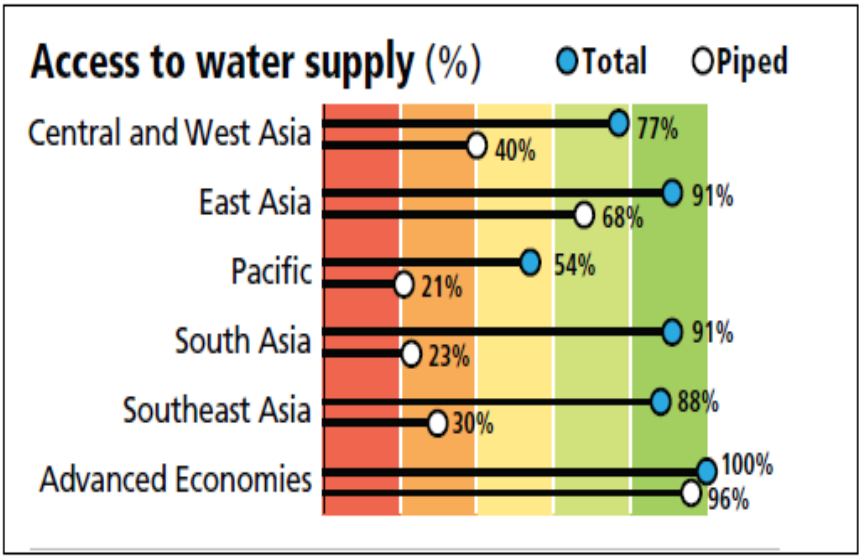
Fig 3.2: Water Consumption Pattern of Indian Cities



Source: Vishavnath, 2013

Total 91 percent of South Asian population has access to water supply but piped water supply is only 23 percent (Fig 3.3). These type of variations are due to rural population and its less access to piped water supply. But this supply of water in urban areas of South Asian region is going to be big challenge with increasing demand.

Fig. 3.3: Access to water supply in South Asia



Source: ADB, 2011

Predicting the future is a hazardous business but one thing is certain, that the world in the future, at least in some respects, is going to be different from today (Figurers 2005). In South Asia, as a result of economic development, urbanization and population growth; water is going to be scarce with increasing demand from various sectors. This may increase tensions and disputes over sharing and command on water. The emerging scarcity of water has also raised a host of issue related to sustainability of the present form of economic development, sustained water supply, equity and social justice, water financing, pricing, governance and management (Shaban & Sharma 2007). On the other hand, with the rapid pace of urbanization in South Asia, there is a critical need to improve not only the current inadequate water supply and sanitation services but also plan and meet future demand. As this demand increases at an accelerated pace, the issues to connect the supply and demand are being mired in various questions related to water availability, water quality, public health and hygiene, and water supply and management. There are many water management issues are taken by national and international organizations. One important project on water supply in South Asian cities (extracted from ADB website) has been discussed.

The Water for Asian Cities (WAC) Programme is a collaborative initiative of the United Nations Human Settlements Programme (UN-HABITAT), the Government of the Netherlands, the Asian Development Bank (ADB) and countries in the region. The programme focuses on three interlinked priorities:

- Introducing demand responsive and demand management strategies to improve efficiency of water use and give more influence to those currently deprived of water and sanitation;
- Scaling-up sanitation provision city-wide through innovative public-private-NGO partnerships, financing mechanisms and appropriate technical choices;
- New pro-poor investments in urban water supply and sanitation with emphasis on serving the urban poor with piped water and formal sanitation facilities.

The programme, was launched during the 3rd World Water Forum in Osaka, Japan, on 18 March 2003 supports the implementation of the water and sanitation-related Millennium Development Goals (MDGs) and targets in Asian cities, specifically promoting pro-poor governance, water demand management, increased attention to environmental sanitation and income generation for the poor linked to water supply and sanitation. The programme seeks to achieve this by mobilizing political will, raising awareness through advocacy, information and education, training and capacity building, promoting new investments in the urban water and sanitation sector and systematic monitoring of progress towards the MDGs. The implementation strategies include public awareness campaigns for good urban water governance. The Board of Directors of ADB has approved a loan of US$200 million for investment in water and sanitation in six cities of Madhya Pradesh, India. The capacity-building activities will begin soon after the cooperation agreement has been approved with the Government of India. A stakeholders' consultation was organized in August 2004 for finalizing the activity plan. In Nepal, one of the least developed countries, UN-HABITAT as part of the Kathmandu Valley Small Towns Water and Sanitation Initiative, a community-based low cost sanitation and water supply project involving and investment of US$1 million for a small town of 46,000 inhabitants. The project will have a direct impact on livelihoods of the people as they mainly rely on growing

vegetables for other larger cities in Kathmandu Valley. This project is being implemented in association with multilateral partners such as ADB and by working with local NGOs and CBOs. In Bangladesh, two parallel initiatives in partnership with community-based and non-governmental organizations are in progress. These involve provision of water and sanitation facilities in selected slum areas and construction of eco-toilets using the mechanisms of rainwater harvesting for poor neighborhoods in Dhaka and secondary towns. UN-HABITAT's initiative in Sri Lanka is in support of an ADB sewerage and sanitation project for Colombo city through public-awareness and advocacy for wastewater treatment and related measures. The project will benefit the city as a whole.

Water supply to all with increased demand is a big challenge among all South Asian countries. But, there is a need to know the consumption pattern of the domestic households before implementation of any management policy. In domestic households, 80 percent of water comes out as waste water. Activities like bathing, cloth washing, house cleaning and utensil washing leads to use of much amount of water in domestic households. There is much effect of changing lifestyles and housing type on domestic water consumption. With this pattern has been changed & people feel that they could not adjust within the supplied water. Water saving measures, use of recycled water may be the alternatives one but such type of activities are very few in South Asian urban households.

3.4 Forecasting Water Demand in South Asia: Water demand can be defined and measured in terms of withdrawals and actual consumptive uses, also called depletion (Rosegrant & Cai 2002). Consumption of water in domestic is going to increase with increasing population, made it important to study. Rosegrant & Cai, projected the water demand in various sectors of water withdrawal. By 2025 the domestic water consumption will be more than industrial sector in world, South Asia and as well as country India (Table 3.4). This trend shows than in near future water demand will be more in Domestic sector due to growth of population. Per Capita Domestic water demand will be increased from 62 lcpd in 1995 to 85 lcpd in 2015 in South Asia (Table 3.5).

Table 3.4: Consumptive Use of Water (km^3) in the non-irrigational sectors

Country/ Region	Domestic			Industry		
	1995	2010	2025	1995	2010	2025
World	169.2	234.6	290.2	156.9	211.3	235.7
South Asia	28.0	43.3	57.7	9.1	17.0	20.5
India	21.0	32.2	41.0	7.2	15.8	31.2

Source: Rosegrant & Cai, 2002 (Estimated 1995 and projected to 2025)

On the other hand in India, It will increase from 62 lcpd in 1995 to 86 lcpd in 2025, which is very less amount according to Indian Standards amount of water. But, if we calculate the growth rate of increasing water demand, that is 13 percent from 1995 to 2025 in India. In this way, in domestic sector, water demand will be increase and water supply will be a big question. These values are minimum required water for per capita use of water in any household of domestic sector.

Table 3.5: Per Capita Domestic Water Demand

Country/ Region	Per Capita Domestic Water Demand (Lcpd)		
	1995	2010	2025
World	86	102	109
South Asia	62	77	85
India	62	79	86

Source: Rosegrant & Cai, 2002 (Estimated 1995 and projected to 2025)

Urban population in every country of South Asia is growing rapidly (Table 3.3). So in future, the population stress will be more in urban areas on the one hand, and deceasing trend of per capita water availability enhance the problem on the other hand. In this way, water demand in urban sector will be increased due to increase in per capita water demand. In this way, domestic sector of urban areas are becoming important for to study.

Chapter 4
Research Methodology

Water availability is becoming more and more of a problem across the globe in the 21st century. As populations rise, so does water consumption is also increasing that is influenced by availability. More than 70 percent of the Earth is covered with oceans, but only 2 percent of all of the water is drinkable. Because of this, conserving water is essential. The first step in conservation is to understand how much water you actually use each day and every way you use it in our domestic household. Domestic water consumption is based on many factors like human behavior & awareness, culture, pricing, economic status etc., there many seasonal variations are also important but above all water availability is important factor. Therefore, the study is not limit up to only one factor or other factors; but it tried to inculcate all the factors collectively. For this analysis, Bathinda city is selected as sample to conduct a survey in domestic households. Interview Schedule has been prepared for survey purpose and 60 households are covered successfully. Selecting representative sample and finishing the work in significant time and limited sources were the major challenges. While the study is concentrated on Urban South Asia, but Bathinda city is selected for primary survey.

4.1 Selection of Bathinda city as area of study- To study the aspects like water availability, consumption, supply, demand etc. there should be a micro area for conducting primary survey. According to Bandyopadhyay 2006, “In South Asia, there has been an absence of effective links between research at the local, regional or global level that constantly produces new knowledge and options for new water management practices leading to relevant policy changes. Such missing link poses a serious problem in the region. He further continues that after the end of British rule in south Asia, the European knowledge base continue to be operational and to guide the increasing no. of engineering intervention of water system. Since water use in Domestic sector is affected by range of factors, which varies across the countries and regions. A study to understand and analyze the pattern of water consumption is very

much pertinent to generate a knowledge base in order to frame management strategies".

According to Bradly 2004, "the uncertainties inherent in the assumptions of each variable, the adoption of a more micro area approach to domestic demand forecasting should result in a more realistic projection of water use. The changes in housing type, household size, acceptability, and market penetration of water-efficient appliances, alternative sources of water, economic development, and employment opportunities need to be evaluated".

By keeping in mind the importance of study micro area, Bathinda City is selected for survey. The major reasons are discussed below:

1. From all South Asian Countries, India and Pakistan come under category of water stress due to less than 1600 cubic meter per capita water availability. Researcher being a native of state Punjab in India felt convenient to carry out the study taking Bathinda as study area and within limited time duration taking distant place would have been a difficult task.
2. In Punjab state of India, there are 19 class I cities. As study is concentrated on urban area and Bathinda, a class I city, is fifth largest city of Punjab with more than 2.50 lakhs residents in it has been preferred.
3. In Bathinda city, people are using canal water that is supplied by Municipal Corporation, and ground water that is extracted by submersible pumps; so it becomes easy to make comparison between perceptions of people. In Malwa region of Punjab, only three cities are supplied with canal water; Bathinda, Mansa &Faridkot.
4. As the city is very near to the university campus, so it was convenient to do the field work. This was the reason why survey could be completed within time.

4.2 The Sample- During Survey 60 households were selected, sample size has taken into consideration; the population to be represented, number of questions in the interview schedule has been filled, precision of the results and total quantum of work. The survey has used Random Sampling for selecting 60 households from Bathinda

City. Survey methodology has been designed to include houses from all areas of Bathinda city as much possible. Household woman is targeted as respondent from each house. Bathinda Base map has been used so that exact location of selected areas can be identified prior to the field visit which saves significant time. Although, map does not include houses built, new wards boundary etc., but location of areas and its additional information like roads etc. became helpful in some ways. The sample size of 60 households was determined by limited time and resources to represent the Bathinda City with 0.17 sampling error at 5 percent significant level.

Sampling error is calculated by using following formula:

$$SE = Sx/\sqrt{n}$$

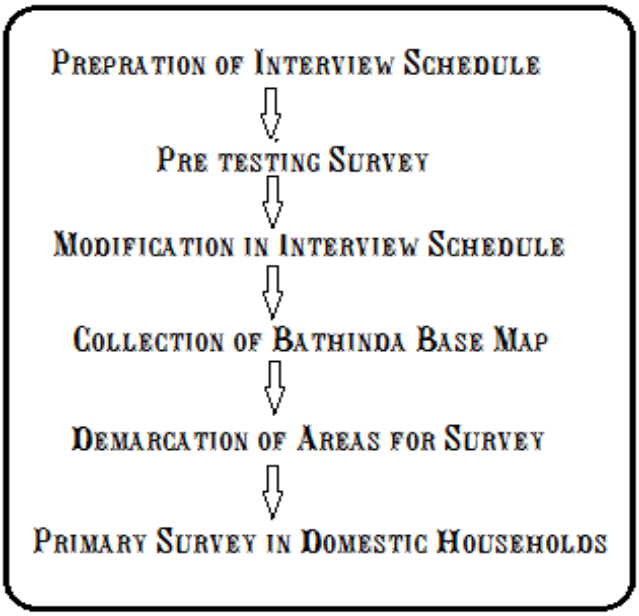
SE= Sampling error; Sx = Standard deviation; n = Number of respondents

4.3 Collection of Data- Two types of the data was required for this study, viz. secondary data & primary data. The time period of collection of data is 10th November, 2013 to 05 January, 2014. Secondary data was mainly collected in month of November. Primary data was collected in month of December and January.

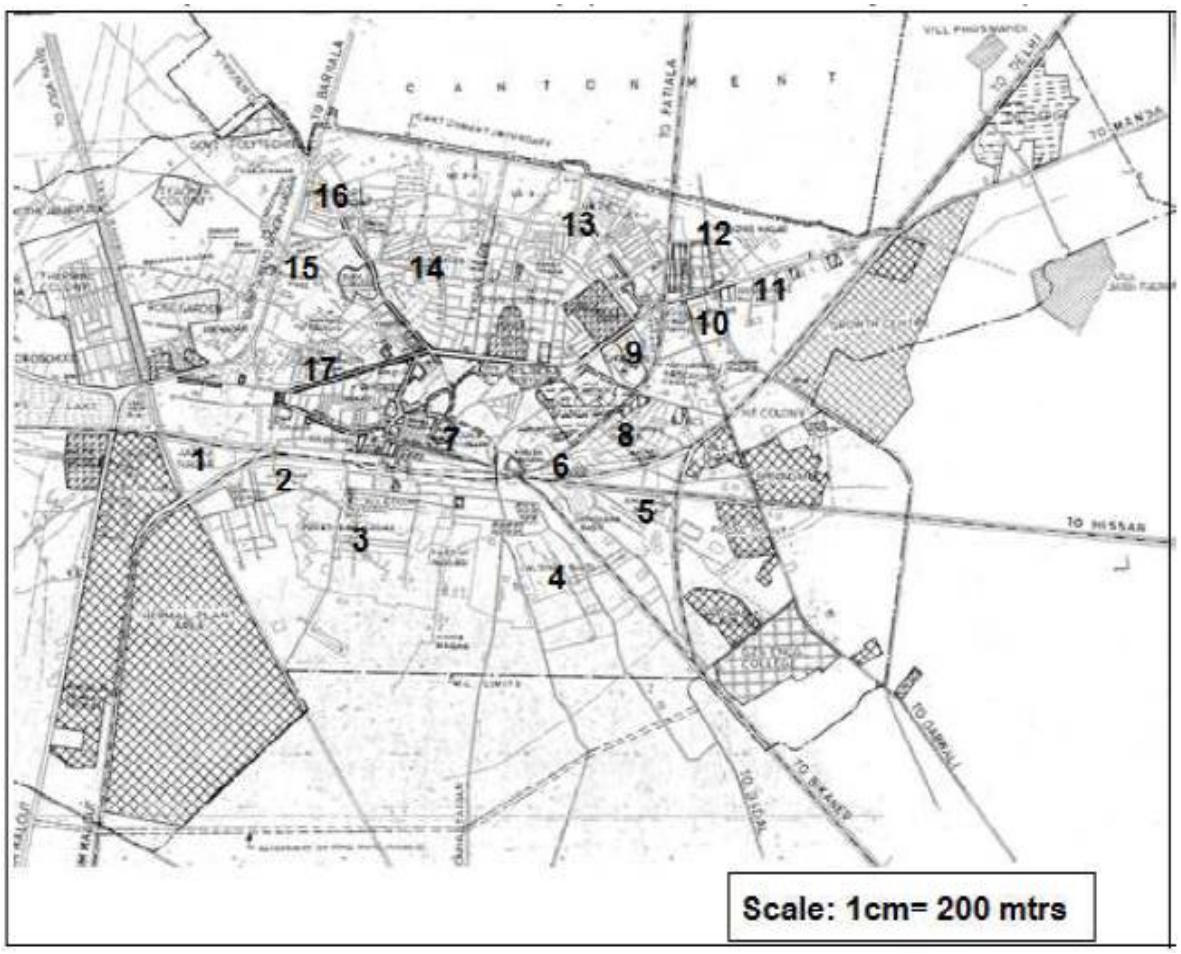
(i) Secondary Data- The study involved people response about public transport in urban areas, but before studying the consumption pattern and respondents' perception or awareness, it is important to know and discuss the water supply services in the city. On the other hand, to study the water availability and consumption of urban South Asia, secondary sources have been studied. Some reports published by various organizations like Statistical year book of various countries, FAO, World Bank, CPHEEO, FICCI has been studied. The data regarding population, water availability & consumption etc. has been downloaded from FAO Aquastat website in the month of January, 2014.To study the existing water availability and supply Master Plan of Bathinda report has used and various governmental offices were visited to collect data in this regard. Municipal Corporation Bathinda, Bathinda Developmental Authority, Water Supply and Sanitation Board, Water Supply and Sewerage Board & Town and Country planning department were visited during the period of 10 November to 25 November.

(ii) Primary Data- Primary data has been collected by two different ways, as mentioned earlier, time period of collection of primary data is month of December 2013 to January, 2014. To conduct a primary survey, first step is to make relevant questionnaire or interview schedule. Interview Schedule was carefully designed targeting objectives of the study. Pre Survey on 10 households was done to know the limitations & interview schedule was modified. The modified semi structured interview schedule was divided into five major sections; socio economic profile, water availability & source, water consumption, water economy & people perception & awareness respectively (Annexure 1). In all sections of interview schedule was of close ended questions but half of the last section consists open ended questions also. In the major water consumption activities, questions were divided into two parts to know the pattern in summer as well as in winter season. Summer season is taken from May to October and winter season is taken from November to April. Bathinda Base map is used for the location of survey areas and 60 households were surveyed in this regard. As told above that household woman was taken as respondent because she is known to major water consumption like in kitchen, washroom & cleaning.

Fig. 4.1: Procedure of Primary Survey



Map 4.1: Bathinda Base Map (location of Surveyed Areas)



Source: Town and Country Planning Department, Bathinda

The time for surveying the household was after 11.00 am, because the housewives were free from household works after that time. In the case of working women, Sunday is selected for the same purpose. While the interview schedule has been made in English language but the questions were asked in Punjabi. Primary survey is done in a procedure of six steps. Firstly, interview schedule was prepared and then pre testing has been done for further modification. After modification in interview schedule, areas were demarcated (for survey), on Bathinda base map (Map 1). Then, the survey has been conducted in 60 households of different areas in Bathinda city (Table 4.1). The six steps of procedure of primary survey are shown in Fig. 4.1.

Table 4.1: Surveyed Areas

Symbol on Base Map	Name of Area	Number of Households
1.	Janta Nagar	3
2.	Jogi Nagar, Arjun Nagar	4
3.	Parasram Nagar	3
4.	Lal Singh Basti	4
5.	Amarpura Basti	3
6.	Sanjay Nagar	3
7.	Pooja Wala Mohalla	6
8.	Deep Singh Nagar	3
9.	Guru Ki Nagri	3
10.	Harbans Nagar	3
11.	Nachattar Nagar	3
12.	Mati Das Nagar	3
13.	Model Town	6
14.	Guru Teg Buhadur Nagar	4
15.	North Estate	3
16.	Silver Colony	3
17.	Ganesha Basti	3
	Total	60

4.4 Data Analysis & Interpretation- The analysis of the collected information from the different sources has been organized into their representative categories so as to come up with logical results. In dealing with the qualitative analysis based on the evidence collected from the different sources, an effort was made to carefully understand and interpret the information to use it together with the quantitative data. Firstly, the respondents have been divided into four income groups; Very Low (>5000pm), Low (5000-10000pm), Medium (10000-20000pm), High (20000-40000pm) & Very High (40000<pm) influenced by socio-economic status of people, so water consumption pattern has been analyzed by following these four income groups. The whole data has been tabulated with respect to number of households in each income groups. After tabulation, percentages of each response falling into different income groups were calculated to examine the impact of income, education, water using appliances, family size, storage & pricing of water on water consumption, people perception & awareness. Data was also tabulated by using 'Likert Scale' for the responses to make them quantitative.

4.4.1 Use of 'Likert Scale'- The data been saved by using Microsoft excel after converting it into 'Likert scale' values. The responses have been divided into four categories mainly by giving them ranking from 1 to 4 or 1 to 5 (Annexure 2). This was done to make calculations easy and to calculate correlation, mean and standard deviation from the qualitative data also. Tabulation of data and various responses in percentages was done after doing this. At the time of calculating percentages, values after decimal, round off values were taken.

4.5 Model Specification- Microeconomic theory suggests that willingness to pay should change across individuals having various differing socio- demographic characteristics, residential characteristics and other (Casey et al. 2006). A multivariate regression analysis is conducted, which is almost similar in the specification with that of Casey et al (2006) and Sarkar & Alam (2013). The specification of the model is as follows:

$$WTP_j = \alpha_0 + \beta_1 X_1 + \varepsilon_t \ldots\ldots\ldots (i)$$

Where $X_1 \ldots\ldots\ldots X_6$ indicate six different explanatory variables (X_1= age, X_2= family size, X_3= plot area, X_4 = education level, X_5 = income X_6 = occupation) and *j* represents improved quantity and quality of water. The variables selection is done on the basis of previous studies. This estimation method of the model is Ordinary least Squares (OLS). This model is important for the study because impact of socio- economic status on water consumption has been observed. So, willingness to pay more for water shows that people are ready to pay more for much amount of water rather than reducing their own consumption.

4.6 Limitations of the study-

1. The education, perception and awareness of household women have been taken into consideration, but the impact of these factors on water consumption is mainly by whole family members.
2. There is expected that many houses includes one or more households, but, they are considered as one and only owner's household was surveyed.

3. The city has many educational institutions with hostel facilities and water is supplied by municipal corporations but they were not taken in survey.
4. To know the amount of water consumed per day, water meter or any equipment to measures the flow of water running from taps with respect to time must be used, but it was not used.

Chapter 5

Water Consumption Pattern in Domestic Household in Bathinda City

5.1 Introduction- 'Household' is a group of person normally living together and taking food from a common Kitchen. In NSSO Standardized definition of word 'Household' exclude temporary visitors but temporary stay-away are included. Thus, a son or daughter residing in a hostel for studies is excluded from the household of his/her parents, but a resident employee or resident domestic servant or paying guest (not tenant) is included in the employer household. Living together is usually given more importance than sharing food from a common kitchen in drawing the boundaries of a household in case the two criteria are in conflict; in the special case of a person taking food with his family but sleeping elsewhere (in a shop or different house) due to space shortage, the household formed by such a person's family members is taken to include that person also. Each inmate of a mess, hotel, boarding and lodging house, hostel etc. is considered as a single- member household except that a family living in a hostel etc. is considered as one household only; the same applies to residential staff of such establishments. Under-trial prisoners in jails and indoor patients of hospitals, nursing homes etc. are considered as members of the households to which they last belonged. Following this NSSO criteria, 60 household were selected randomly from the Bathinda city. In the city, Household survey was conducted to know the facts regarding water facilities, water availability and water consumption. Water consumption, specially the domestic water consumption is mainly influenced by culture, socio economic status and behavior of the people. Better understanding of people behavior could help in developing newer strategies for successful marketing of water as a social and an economic commodity for enhancing the sustainability of water supply. People behavior studies have widespread application in the marketing of goods and services and the application of some of these concepts could be useful in improving delivery of water services (Boland 1997).

During surveying, slum areas (declared by MC) were mainly taken into consideration. From all localities 16 Nagar/ Basati were surveyed, in which 5 were slum areas. In these slum areas, 20 household were surveyed which contribute 1/3 of total sample.

While studying socio economic pattern of the surveyed people, these slum area people contribute in Low Income Group and Lower Middle Income groups. The total respondents of this study covers all socio-economic groups living within the municipal corporation limit, The relationship of socio economic parameters with consumption pattern, awareness and satisfaction level with the present water supply system is discussed in this chapter.

5.2. Scenario Analysis: The scenario analysis is to generalize the future water demand in urban household sector by explaining the impact of socio economic variables on water consumption pattern in domestic household.

5.2.1 Socio Economic Analysis: The socio- economic parameters of the respondents taken for this study were as follows:

Age: The age groups of respondents varied from <30 to 31- 39, 41-49, 50<, which means that respondents covered all age groups. The percentage respondents in different age groups were 15, 30, 28 & 27 respectively.

Education: All the respondents were not educated, viz. 35 percent were uneducated, 28 percent were matriculate, 15 percent were +2, 22 percent were graduate or professional degree holders.

Occupation: In this part, occupation of the respondent has been asked, while the consumption pattern of the whole household has been analyzed. The occupation of the respondents has been divided into four groups that are working women, women engaged in business activities, labor and housewife; out of them 23 percent of respondents were working women, 4 percent were engaged in business activities, 10 percent were labor and 63 percent were housewives.

Family Size: The respondents have been divided into four groups of family members; 9 percent of respondents were of two family members only, 47 percent of respondents were of 3-4 members, 37 percent of respondents were of 5-6 family members and 7 percent of 6 family members.

Income Groups: Total respondents have been divided into four major income groups Low, Lower-Middle, Upper- Middle and High Income groups as taken by Jethoo & Poonia (2007) in their study on water consumption pattern in Jaipur city. The categorization of respondents was done on the basis of a certain monthly income. Income of respondents varied widely, from <5000 to >15000 per month. Around 23 percent were in Lower Income Group (LIG) having a monthly income up to '5000', 27 percent were in Lower Middle Income Group (L-MIG) whose monthly income ranges from '5000 to 15000', 25 percent in Upper Middle Income Group (U-MIG) in the monthly earnings of '15000 to 30000' and 25 percent in Higher Income Group (HIG) whose income excess '30000'. Division of respondents by various income groups is very important because different responses by various income groups vary from each other in terms of water availability, consumption and behavior but on the other hand many similarities about water service, quality, pricing etc. also been observed.

5.2.2 Water Availability: Individual behavior is being influenced by the friends or the society where a person lives. Likewise, the consumption of water depend upon the environment where one lives, which includes the job he performs, his economic status and the society where he lives and above all the availability of water. For example, under normal situations water is cheap and easily available. People use it liberally and quite often waste it also. But, the person will behave differently whenever water supply is limited may be due to fault in supply system or in a place where water supply is not fully done.

Before studying the pattern of consumption of water, it is important to know the availability of water at domestic households. To know the availability, several questions have been asked related to source of water, source of drinking water, and their means of water storage. Mr. Parul Goyal (Sub-divisional Engineer, PWSSB, Rose garden office), stated that due to these storage habits, people waste more water, so the proposed scheme 24×7 water supply, is to overcome the problem of water wastage. He said that if people have 24 hours water in their taps without increasing amount of water by managing pressure & flow of water, so there will be no need to store water at domestic households.

In terms of availability, it has been observed that most of the respondents use municipal water as well as their own submersible or hand pump. According to water supply and Sanitation Board's report, 85 percent of total population is supplied with water by government, the same trend has been observed in selected households. From total surveyed households, 88 percent of them are depended on municipal water supply, while the people of middle and higher groups are using their submersible or hand pumps also.

Table 5.1: Source of water in Domestic Household

Source of Water	Respondents (%)
Only Municipal	35
Municipal+ Submersible/hand pump	55
Municipal+ Shared Tap	3
Submersible/ Hand Pump/Shared Tap	7
Total	100

Source: Field Survey, 2013

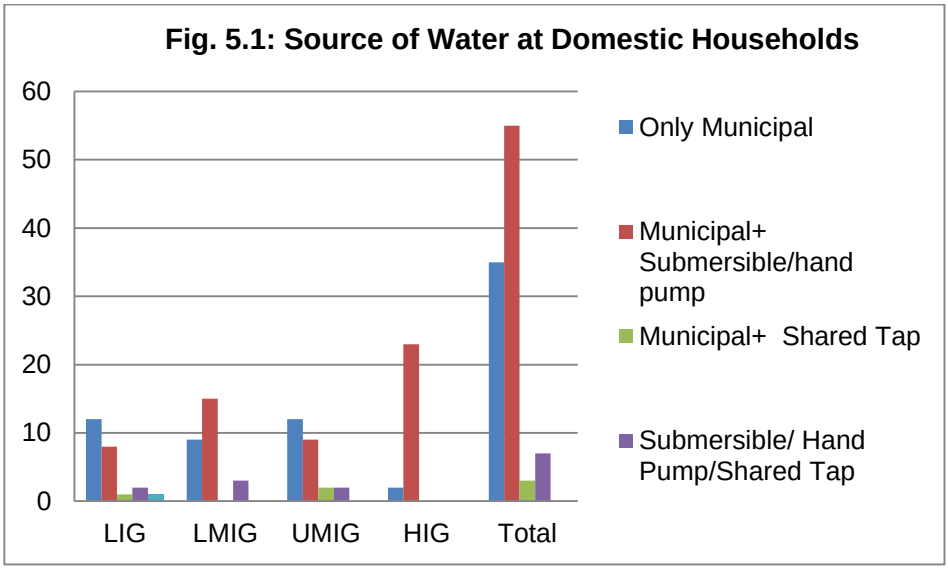


Table 5.1 shows that 35 percent respondents are dependent on municipal water only, 55 percent respondents use municipal as well as submersible or hand pump for domestic use of water. There are only three percent who are using municipal as well as shared tap and 7 percent are using their private source of water. Fig 5.1 shows that in high income group people are getting water from both of the sources Municipal

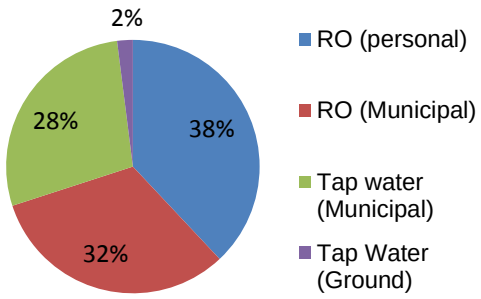
Corporation as well as submersible/hand pumps. The reason is that some of the slum areas are not supplied with municipal water supplies. So they are lacking in governmental water supply.

Ground water quality of Bathinda city is polluted due to disposal of fly ash along water bodies and untreated water into them and dumping of solid wastes into open water bodies also contributes towards their contamination and subsequent pollution (Singh 2013). Table 5.2 shows that 70 percent of total respondents are using RO water for drinking purposes either it is personal RO or Municipal RO water. Even 28 percent respondents are using tap water which is supplied by Municipal Corporation, they are known to the fact that the corporation is supplying canal water to them, and canal water is not as much contaminated as ground water (Fig. 5.2). But on the other hand, two percent people are still using ground water for drinking, because they think that taste of water is good so they are consuming that.

Table 5.2 Source of Drinking Water

Source of Drinking Water	Respondents (%)
RO (personal)	38
RO (Municipal)	32
Tap water (Municipal)	28
Tap Water (Ground)	2
Total	100

Fig. 5.2: Source of drinking water



Source: Field Survey, 2013

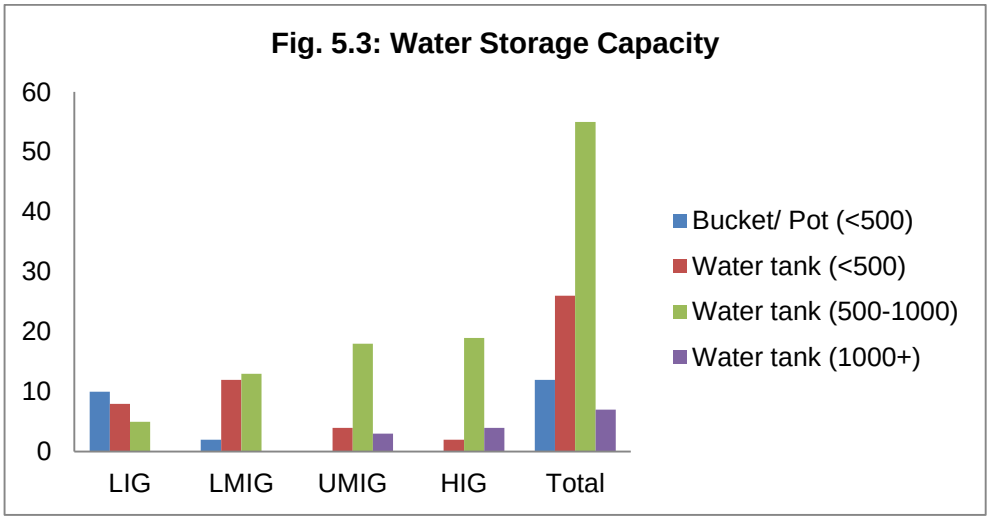
One official Chanan Singh, Objective Engineer Water Supply and Sanitation Board, Div-3, Bhagu road, 15 November, 2013) gave a statement that “If the groundwater is contaminated then surface water is also polluted”. In that sense, water quality of both sources is not good for drinking (directly). . Though drinking water is a basic necessity for all human beings, but other water consumption activities such as bathing, washing and other social activities will depend upon the life style of the people and availability.

Water storage capacity of any household is also influencing factor of amount of water consumed per day. People store water in their household because they get 5 hours water supply by government, so for 24 hours supply in their taps most of the people made water tanks. They fill tank with municipal water or by their own submersible pumps and use that water whole day. Since there is irregularity in the timings of water supply (municipal water), so people collect the whole water in the tanks which is supplied by Municipal Corporation. Different sizes of water tanks are used by various income group people according to their demand and socio- economic status. Table 5.3 shows that 80 percent from the total respondents have water tanks up to 1000 liters capacity. 12 percent use bucket/pots because they don't have water tanks and 7 percent have water tanks of more than 1000 liters capacity.

Table 5.3 Water storage capacity of Households

Source (capacity in liters)	Respondents (%)
Bucket/ Pot (<100) (without any tank)	12
Water tank (<500)	26
Water tank (500-1000)	55
Water tank (1000+)	7
Total	100

Source: Field Survey, 2013



Source: Field Survey, 2013

Fig 5.3 shows that buckets/pots are used to store water mainly by people of lower and lower middle income group. Water tanks more than 1000 liters capacity are mainly found in the houses of upper middle and high income groups because they have more consumption of water. Water tanks up to 500-1000 liters capacity are used by people of lower middle, upper middle and high income group people.

5.2.3 Income and Water Consumption- Socio Economic status, educational background, water using appliances at household, size of family members etc. are major influencing factors on water consumption pattern at domestic household. All these factors are obtained through questionnaire. Firstly, the socio economic status that can be obtained through income groups as it has been observed that water consumption is high in High Income Group due to use of more water using appliances, existence of lawn and kitchen garden and vehicles etc. The water consumption is highly correlated to income groups. It was observed by correlating income groups with major water using appliances. As income groups are divided into four categories like LIG, L-MIG, U-MIG, HIG major water using appliances were also divided into four major groups (Annexure 2), in which group 1 included those who has one toilet flush/ one hand basin + <5 taps, group two included who have two/one toilet flush + one/two hand basin + one washing machine + one shower+ 5-8 taps, group three included those have two toilet flush+ two hand basin + one washing machine+ 2 shower + 9-12 taps, group third included who have equal or more than three toilet flush + three hand basin+ one/ two washing machines + three shower + <12 taps. While calculating the correlation in these two variables, the outcome is 0.78, it shows that both are highly correlated to each other. This trend shows that socio-economic status of any society or area affects the consumption of water at domestic household. For instance, if a person is having more than 50000 per month income then he/ she can afford a two/four wheeler vehicle, two/ three bathrooms at his/her home with full flushing system, showers, more number of taps, two/three hand basins and moreover in kitchen they will prefer water sink to wash utensils. It is a type of behavior of people that these things are meant as symbol of status. So, with the increase in income, expenditure on water using appliances will definitely increase.

One more observation has been made that storage capacity of household water is not influenced by size of family but it's influenced by number of water using appliances that are main indicator of socio-economic status. Correlation was calculated in family size and storage capacity of household and on the other hand between income groups and storage capacity of household. To serve this purpose all variables were categorized from 1 to 4 by using 'Likert Scale' (Annexure 2) and Correlation was calculated. Correlation between family size and storage capacity of household was found 0.02. On the other hand, correlation between water storage capacity and income groups came 0.63 which shows that storage capacity of any household may be dependent on income of household. The reason is that people of high income group have more water using appliances at their households and they need much water for their daily use. As calculated above, income groups and water using appliances are correlated to each other by getting value of 0.78. In that sense, socio economic status influence the water storage capacity, water using appliances as well as amount of water used per day.

Table 5.4 Correlation between different variables determining consumption

Variables	Values
Income & Water using appliances at household	0.78
Family Size and Storage Capacity of Household	0.02
Income & Storage Capacity of Household	0.63

Source: Field Survey, 2013

5.2.4 Water Consumption Pattern: Water consumption is very much influenced by the type of plumbing of the house (Joshi et al. 2003). The above study shows that water storage capacity is influenced by income of any person and more water using appliances are found in high income group people. To know the amount of per capita water consumption, a question was asked about water consumption in liters as per activities like bathing, cloth washing, utensil washing, cleaning etc. but respondents did not give proper response. So, this question was deducted from the study during analysis. Another reason why amount consumed could not be calculated on the basis of per day per capita supply of 135 lcpd by Municipal Corporation because 63 percent

of the respondents (Table 5.1) are dependent on their submersible pumps or hand pumps so the calculation would have been ambiguous and wrong. Many people are purchasing RO water from outside so actually there is no uniformity in the source of water supply thus the calculation of water consumption was not done in this study. The amount of water extraction by submersible pumps or hand pumps is difficult to measure without help of any equipment. As told in the limitations of study that no such equipment has been used so that amount could not be evaluated. To study the water consumption pattern, major activities in which the water is used for domestic purposes are taken from previous studies. The most amount of water is being used in major activities like Bathing, Toilet, House Cleaning, Utensil washing, Cloth Washing, Vehicle washing and watering the plants of kitchen garden or park at households.

Bathing: To know the bathing habits, the question was asked in the context of respondents' habit to take bath daily. The response varies with the occupation of the respondent and varies with season also. As household women bathing habits varies with summer to winter season. In Punjab, as well as in Bathinda city, there is extreme hot in summer season & extreme cold in winter season, so the response varies between summer & winter season.

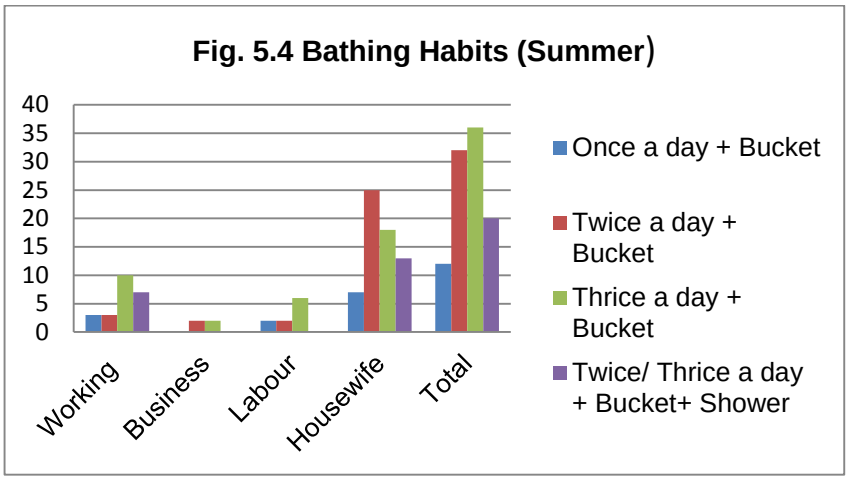
Table 5.5 Frequency to take bath daily

Daily	Summer (%)	Winter (%)
Once a day + Bucket	**12**	**96**
Twice a day + Bucket	**32**	**2**
Thrice a day + Bucket	**36**	**2**
Twice/ Thrice a day + Bucket+ Shower	**20**	**0**
Total	**100**	**100**

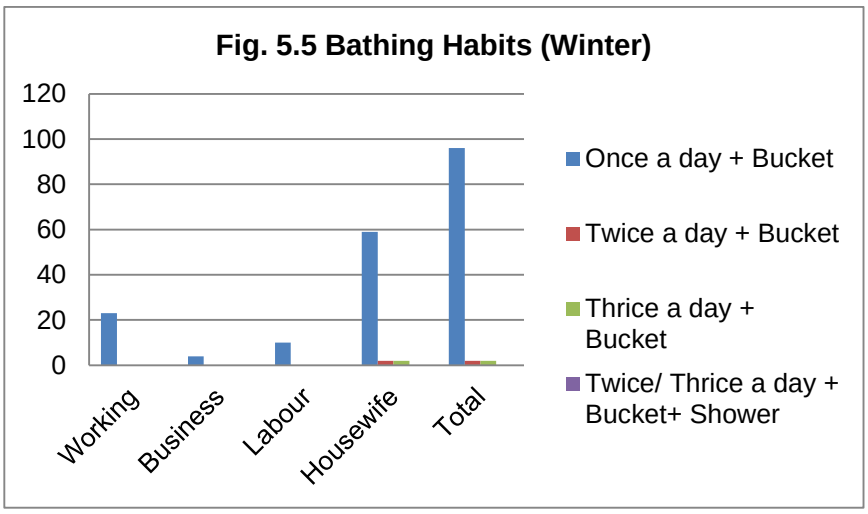
Source: Field Survey, 2013

In summer season, respondents prefer twice or thrice bath per day, on the other hand once a day in winter season (Table 5.5; Fig 5.4). 20 percent of the respondents use shower during bath in summer season only. Bathing tub is not been observed in any

of the household from selected respondents. In summer season, twice or thrice a day bathing has become habit of the woman in Bathinda city. This habit is not affected by any income group, occupation and water availability.



Source: Field Survey, 2013



Source: Field Survey, 2013

Fig 5.4 and Fig 5.5 shows the bathing habits of respondents in summer as well as winter season, but the pattern of bathing in summer season is almost equal to all respondents from various occupations. But, in winter season 4 percent of total respondents which are housewives prefer to bath twice or thrice a day. But, in other three occupation groups, respondents prefer to take bath once a day only. This pattern shows that the consumption of water by housewives on bathing is more than

other because the other occupational women do not have much time. On the other hand, in winter season due to low temperature people prefer to take bath once a day.

Cloth Washing: Consumption of water is influenced by types of cloth washing facilities. Even, consumption is also influenced by washing habits whether people wash the cloths daily, after two days or once a week etc. But, here the role of climate cannot be ignored, because in summer season cloths get wet by sweating so there is a need to wash them earlier. In winter season washing clothes is not required on daily basis. But in Bathinda city, people prefer to wash their cloths daily as per their habits. Here the question is not only for the respondents' consumption of water on cloth washing but for the total household. Table 5.6 shows that in summer as well winter season people prefer to wash their cloths daily of after two days. There are about 58 percent people who prefer to wash their cloths daily in summer season and 45 percent in winter season. Some people about 15 percent prefer to wash their cloths once a week in summer and 20 percent prefer to wash their cloths in winter season (Fig 5.6).

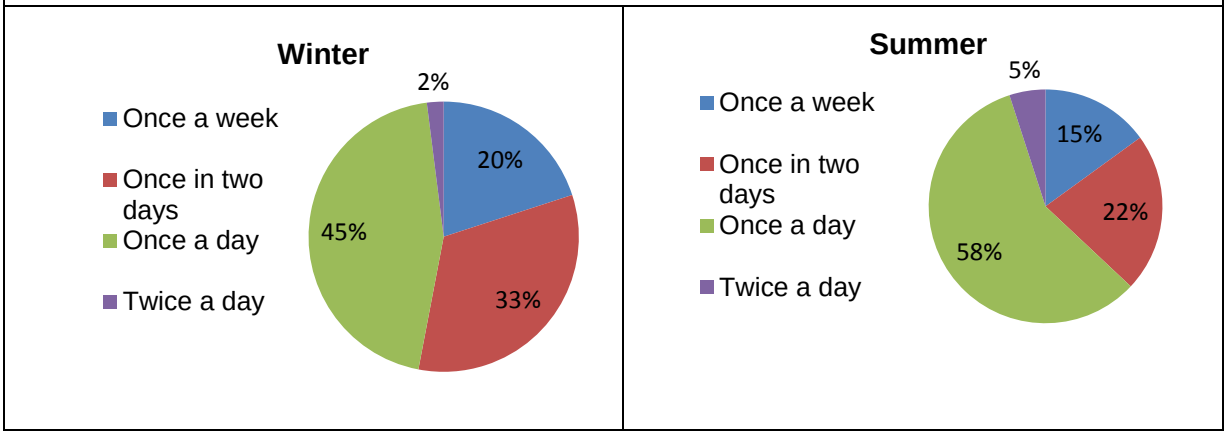
Table 5.6 Cloth washing

Daily	Summer (%)	Winter (%)
Once a week	15	20
Once in two days	22	33
Once a day	58	45
Twice a day	5	2
Total	100	100

Source: Field Survey, 2013

The pattern of washing the clothes is almost equal in all income groups so the observations between different income groups have not been made separately. But, the pattern and consumption varies with the mode of cloth washing whether washing machine is used or cloths are washed by hand. From total surveyed people 62 percent people are using washing machines for wash the cloths (Annexure 3).

Fig. 5.6: Cloth Washing



Source: Field Survey, 2013

Utensil Washing: In kitchen, much water is used to wash the utensils. In kitchen, water is used for cooking also but amount used is very less. In modern type fully plumbed kitchen more water is consumed. By washing utensils in basin with running tap, more water is utilized. Here, the impact of socio economic status has been observed that the household with fully plumbed kitchen consume much water rather that households which are using water filled bucket or tub for washing the utensils. Utensil washing three times a day is common practice in all types of households but some people do it more than three times also. The utensil washing practice in domestic households in Bathinda city is shown in table 5.7. Table shows that people wash their household utensils minimum three times a day. 57 percent of respondents wash their utensils in running tap.

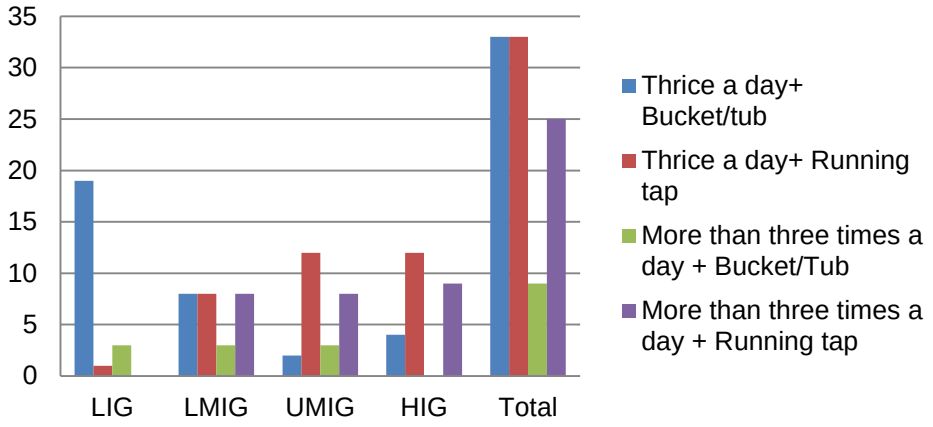
Table 5.7 Utensil Washing

Daily	Respondents (%)
Thrice a day+ Bucket/tub	**33**
Thrice a day+ Running Tap	**33**
More than three times a day + Bucket/Tub	**9**
More than three times a day+ Running tap	**25**
Total	**100**

Source: Field Survey, 2013

Utensil washing by running tap is more prevalent in middle income groups and high income group people (Fig 5.7). Most of the respondent from the lower income groups wash their household utensils by filling a bucket or tub. Very less percentage of lower income group people wash utensil in running tap but the tap is not in kitchen because their kitchen was not plumbed and the tap (where they wash their utensils) is somewhere outside the kitchen.

Fig. 5.7: Utensil Washing



Source: Field Survey, 2013

House Cleaning: House cleaning by running water is observed in the household of respondents. Cleaning of house at least one time a day, is prevalent activity of most of the households. Even 8 percent of the households do the cleaning twice a day (Table 5.8). As it has been observed that mode of house cleaning does not vary in seasons so seasonal observations are not made separately. Some people use both modes of house cleaning like mopping as well as cleaning with running water; those are taken in the category of running water.

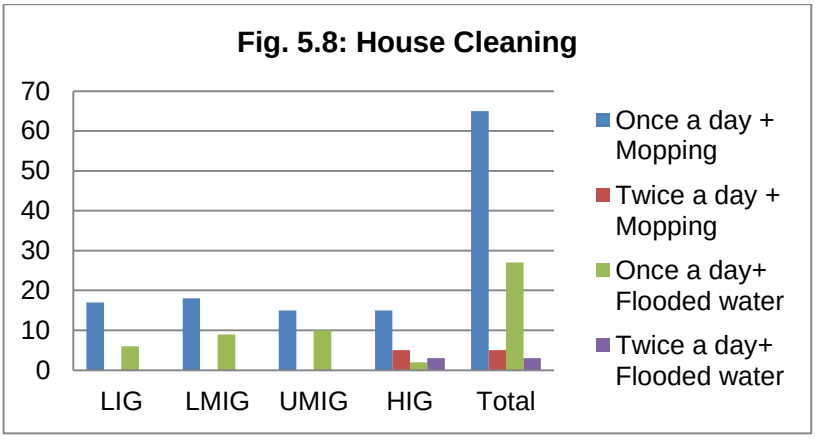
Table 5.8 Mode of House Cleaning

House Cleaning	Respondent (%)
Once a day + Mopping	65
Twice a day + Mopping	5
Once a day+ Running water	27
Twice a day+ Running water	3
Total	100

Source: Field Survey, 2013

House cleaning by two times a day has been observed in High income group (Fig 5.8). House cleaning with running tap is observed in all income groups because presence of thermal power plant in the north side of the city causes the ash & other particulate matter from the chimneys to spread across so people have to clean their house by running tap. According to respondents outdoor cleaning with mop is not effective at all. Even the whole floor of the house is cemented (in lower income group) or marbled (in middle & high income) so people prefer to clean them daily.

Fig. 5.8: House Cleaning



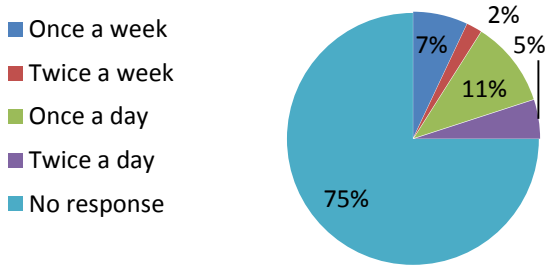
Source: Field Survey, 2013

Watering Plants/ Lawn/ Kitchen garden: Occurrence of lawn or kitchen garden is very less in surveyed households. Only high income group people have laws in their households. So, the consumption of water is increased by increasing the source of water consumption.

Table 5.9 Watering Lawn/Plants/Kitchen garden

Watering Plants	Respondents (%)
Once a week	**7**
Twice a week	**2**
Once a day	**11**
Twice a day	**5**
No response	**75**
Total	**100**

Fig. 5.9: Watering Lawn/Plants/Kitchen Garden



Source: Field Survey, 2013

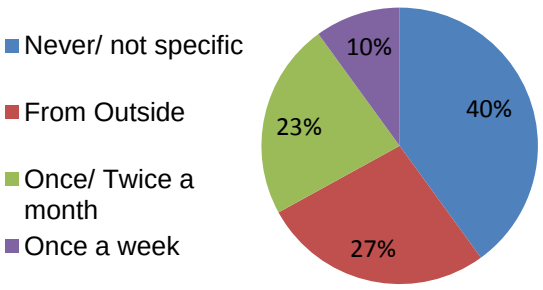
There are 5 percent households who water plants/plants twice a day. The consumption of water is increased by watering plants daily or twice a day. Mostly, people water the plants daily whether it is summer or winter or once a week in the case of lawns mainly. The category of no response in table 5.9 as well as fig 5.10 means that 75 percent give no response because they do not have any lawn/ plants/ kitchen garden in their households. People use ground water for this purpose so they have their own submersible pumps to serve this purpose. They use pipe to watering the plants and no household was found with sprinkling or other type of watering to save some water.

Vehicle Washing: Washing the vehicles at households also comes under household water consumption. 40 percent response is never or not specific because these people have no vehicle. Table 5.10 and fig 5.11 show that 33 percent of total respondents wash their vehicles at home by using ground water. From total respondents 10 percent wash their vehicles once a week and 23 percent wash once/ twice a month. Even, 27 percent wash their vehicles from outside so the consumption of that water does not come under household water consumption.

Table 5.10 Vehicle Washing

Mode of Washing	Respondents (%)
Never/ not specific	**40**
From Outside	**27**
Once/ Twice a month	**23**
Once a week	**10**
Total	**100**

Fig. 5.10: Vehicle Washing



Source: Field Survey, 2013

Total household consumption pattern in domestic household mainly dependent on water using appliances and socio economic status of the people. In this modernized society especially in urban areas, the houses are made with full plumbing system; in kitchen running water is used to wash utensils, in bathrooms showers are used to

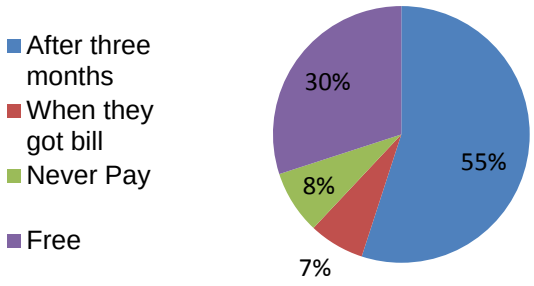
take bath; cemented or marbled floor is being washed by flooded water. So such activities increase the water consumption that lead to increasing demand of water in domestic households by coming decades. The Government of England tried to reduce the per capita water consumption from the present 150 l/day to 130 l/day by 2030 through understanding and changing household attitudes and behavior towards water consumption (Shove et al 2010).

5.2.5 Economy of water: Public demand in context to making payments for water supply and sanitation system is low in spite of the high social cost assigned in polluted sites (Deoras, 2006). In Bathinda city PWSSB has taken fixed charges per month which includes cost of water, supply and sewerage. People got bill after every three months for water, supply and sewerage. There is a policy of government that any household with less than 100 yards plot area will not pay any amount for water and sewerage. On the other hand, who are taking water from Municipal Corporations RO, they have to pay 40 Rs per month for drinking water also. People got bill after three months so the question was whether they pay bill within stipulated time or not.

Table 5.11 Mode of Bill Payment

Mode of payment	Respondents (%)
After three months	55
When they got bill	7
Never Pay	8
Free	30
Total	100

Fig. 5.11: Mode of bill payment



Source: Field Survey, 2013

Table 5.11, shows the various response of the respondents that 55 percent of total respondents pay their bill after every three months, there are 7 percent respondents who claimed that they did not get bill on proper times, sometimes they got bill after 6 months or after one year, but they pay it when they get bill. 8 percent of total respondents never pay any bill, because either they did not get bill or some people

say that they thought these bills will be canceled by government. 30 percent of the respondents have less than 100 yards plot area so they have not paid any bill for water.

Then the question asked that whether people are willing to pay a bit more amount if the quality and quantity of water is improved. To what percent of present bill amount must be increased, almost all respondents who are willing to pay more said that they can pay up to 5 percent increase of present amount of bill. Only 38 percent of respondents are willing to pay more (Annexure 3). People from lower income group are not willing to pay more for water services; even the people who are not paying anything for water services presently (less than 100 yards plot area) are not willing. Most of the people from higher income group are willing to pay a bit more than present amount of water bill.

The Determinants of Willingness to Pay- The multivariate regression analysis provided us an insight into the relationship between the demographic, socioeconomic factors and willingness to pay. An OLS method is used to study respondents' decision on willingness to pay more for improved quality & quantity of water.

Table 5.12 Estimates of factors influencing Willingness to Pay for improved Quality & Quantity of water

Model 1	**Coefficients**	**Standard Error**	***t- test***	***p-value***
Constant	1.960	0.318	6.151	1.037
Age	0.058	0.062	0.937	0.352
Family Size	0.045	0.079	0.567	0.572
Plot Area	0.119	0.075	1.578	0.120
Education	-0.372	0.068	-0.541	0.590
Income	-0.209	0.072	-2.896	0.005
Occupation	-0.080	0.052	-1.514	0.135
Model Summary	$R^2 = 0.257$, $F = 3.066$; (No. of Observations =60)			

Table 5.12 shows that the demographic and socio-economic factors influence the decision of respondent to pay more. With improved quality and quantity water supply in their homes, the $R^2 = 0.257$ shows that model is significant.

In the model, only one factor, income, appears to be significant predictor α= 0.05 levels because the *p*- value for income is 0.005 is less than 0.05. Other important factors are plot area and occupation of respondent (Significant at 13.5 %).

5.2.6 People Perception- People perception about quality as well as quantity of supplied water by Municipal Corporation as well as about ground water is necessary to analyze in this study. This is also done to know the satisfaction of people at present status of water. If the people are not satisfied with present quantity of water that means they need more water for their domestic needs, on the other hand in the case of quality of water, it is their basic right to access good quality of water. To generalize people' perception about many characteristics of water like purity, color, taste, pressure, amount; the responses have been divided into five categories namely 'Excellent', 'Very Good', 'Good', 'Bad' and 'Very Bad'. 7 percent of the respondents do not have Municipal Corporation water supply so they are not able to give response about the different characteristics of water that is supplied by Municipal Corporation. By using 'Likert Scale' the responses were given rating from 1 to 5.

Table 5.13: Respondents perception about characteristics of Water

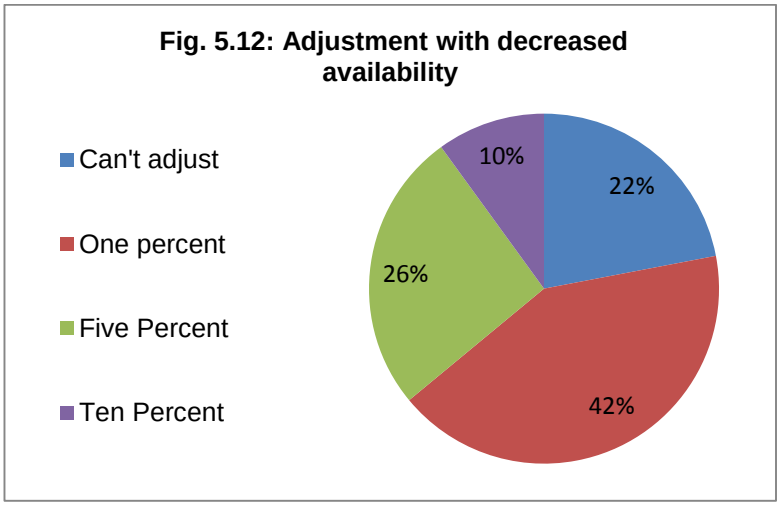
Characteristics	Mean		Standard Deviation	
	Municipal Water	Ground Water	Municipal Water	Ground Water
Purity	2.78	3.58	0.14	0.15
Colour	2.73	2.89	0.14	0.14
Taste	2.86	3.53	0.14	0.15
Pressure	2.65	2.67	0.13	0.10
Amount	2.58	2.67	0.13	0.11

Source: Field Survey, 2013

To know the overall perception of respondents, mean value as well as standard deviation is calculated (Table 5.13). It shows that mean value for municipal water characteristics vary from 2.86 to 2.58, by taking round off these values can been considered as 3 because standard deviation is 0.13 or 0.14 for these values, it means actual data is 0.13 or 0.14 values deviated from mean value. So, the overall response can be considered as 3. The value 3 is given to 'Good' category. It can be estimated that the purity, color, taste, pressure & amount of municipal water is good for

domestic use. By applying same values to the ground water, standard deviation values vary from 0.10 to 0.25 means that actual data is deviate up to this value from mean value, and mean values vary with different characteristics. Mean values of purity and taste are 3.58 and 3.53 respectively, by taking round off value, it can be considered as 4. In this way, people perception is that ground water purity as well taste is 'Bad'. All other characteristics are good as municipal water, because mean values are almost equal in both cases.

People's behavior is greatly influenced by needs also. Price also exerts considerable influence on people's behavior, as with increasing price, demand will decrease to some extent. As this is well known fact, availability of fresh water and per capita water availability is going to decrease with the increasing demand in coming decades. A question is asked about whether people are ready to adjust with decreased availability (from present availability) of water at domestic households. Several options were asked whether they can adjust from 1 percent to 10 percent decrease of availability or could not adjust even 1 percent decrease. Fig 5.13 shows that 22 percent do not want to do any adjustment, but there are 10 percent people who can adjust with 10 percent decrease.



Source: Field Survey, 2013

Then, a question was asked that in which activity they can decrease their demand then most of response was concentrated on house cleaning, vehicle washing and

bathing. Such type of responses shows that people are using much water in these three particular activities presently.

5.2.7 Awareness- The awareness about a commodity depends upon the environment where one lives, educational qualification and age (Brar 2011). To know the awareness level of respondents, several questions have been asked about hydrological cycle, total water availability on earth surface, total number of rivers in Punjab, water recycling etc. Several responses for different questions about awareness are shown in fig 5.14 to fig 5.17. 82 percent of total respondents are not aware about hydrological cycle and 65 percent of total respondents are not aware about the concept and process of recycling of water. 35 percent respondents are aware to water recycling then question about use of recycled water was asked. From the view point of respondents recycled water can be used to flush toilets and cleaning purposes.

On the other hand, questions were asked about surface water availability on earth surface and in state Punjab. About surface water availability the question was asked that how much surface area is covered with water. About water availability in Punjab state number of rivers was asked. 63 percent of total respondents don't know the total surface area of earth covered with water.

Fig. 5.13 Awareness about hydrological cycle

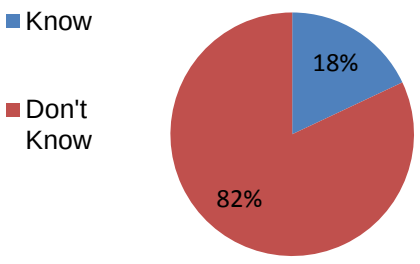
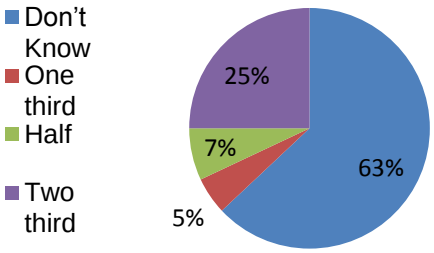


Fig. 5.14 Awareness about total water on earth surface



Source: Field Survey, 2013

Punjab is called land of five rivers, Sutlej, Beas, Ravi, Chenab & Jhelum, but after partition; Chenab, Jhelum and downstream part of Ravi has been given to western

Punjab, that is situated in Pakistan presently. 30 percent respondents still believe that Punjab is a land of five rivers, and 7 percent respondents believe that there are seven rivers in Punjab. So, such lack of awareness give a wrong signal to people that they have abundant water resources in their state. On the other hand, 75 percent of the total respondents are not aware about availability of water on earth surface.

Fig. 5.15 Awareness about total rivers in Punjab

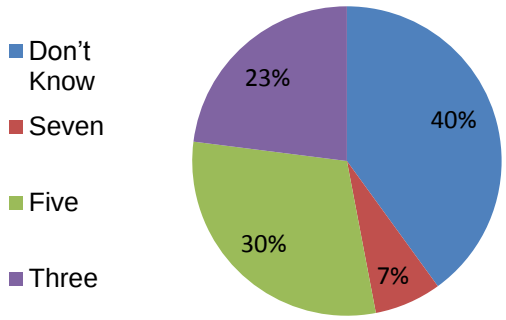
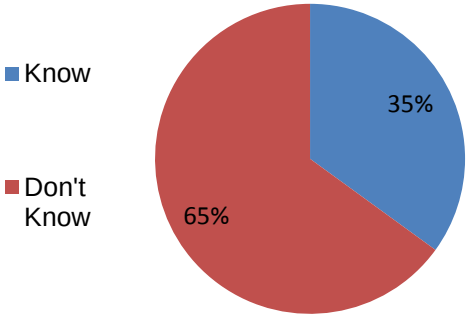


Fig. 5.16 Awareness about Water Recycling



Source: Field Survey, 2013

To study the relation between awareness about water availability and age, education level, income and occupation correlation is calculated. Table 5.14 shows that education has impact on the awareness level of respondent but correlation value is low. There is little impact of income and occupation is observed but no impact of age because correlation value is in negative value.

Table 5.14 Correlation between Awareness level and demographic & socio-economic variables

Variables	Total water on Earth	Total number of rivers in Punjab
Age	-0.19	-0.25
Education	0.60	0.60
Income	0.21	0.32
Occupation	0.26	0.29

Source: Field Survey, 2013

5.3 Discussions & Suggestions by Respondents: As the type of interview schedule was semi-structured consists of some open ended questions. These are

discussion type questions mainly and end of interview schedule suggestions were asked. About the source of water, mostly people got water from both sources canal water supplied by Municipal Corporation and ground water by their own sources. They prefer canal water for domestic use mainly because quality of ground water is very poor. Ground water could not use for drinking, bathing and cloth washing because of more salt contents in it. When, it is asked that why the ground water get contaminated then the most response was that due to leakages of sewerage pipes this water got contaminated. Most of the respondents said that they were observing such contamination from last 10-15 years.

All respondents were known to the fact that ground water is contaminated and water is going to be stressed in near future. Whether, they discussed this topic with their family members, friends and society meetings. Very few respondents give positive response to this, most people never discusses this with anyone. On the other hand they have very positive view that such discussions can be useful to decrease the wastage of freshwater in domestic sector especially.

Then several questions were asked to know the awareness of household women about governmental policies, laws or pricing schemes of water. No respondent were aware of such type of laws, pricing schemes etc. They were only aware of that people having less than 100 yards plot area do not pay any bill for water to government. This response is not affected by any education, occupation or age of respondents.

According to peoples' perception that the houses near to the water tanks got more water than who are living away from the tanks. Response of respondents varies by such locations, because the respondents whose houses were near to water tanks were not in favour of such perceptions. But, the respondents who are living away from the water tank they strongly favour such perception. By asking cause of such problem they answered that pressure is water has decreased by increasing distance from water tank and some people use water motors to extract water from pipes. Mr. Parul Goyal, Sub Divisional Engineer (PWSSB office, near Rose Garden, Bathinda) explained diagrammatically (during collection of secondary data, 11 November, 2013) about the decreased pressure with length and bends in water supply. He explained

that water need much pressure to across every bend in the water sully pipes, due to this reason water tanks are constructed on heights to solve such distance problems. Then the respondents were asked to tell the possibilities to reduce domestic water consumption for available water at domestic household. Most of the respondents gave the view that there is possibility for reduction in consumption by changing house cleaning activities and bathing habits. In spite of cleaning house with flooded water, mopping is best measure. On the other hand, by taking bath three times a day, two times can be adopted. But, some respondent argue that nobody will their habits or nobody will listen to them if they tell such possibilities to reduce their water consumption.

In the last part, suggestions were asked and respondents keep their view points that everyone should save water. As there was no household, where any water saving measure is available. But, people also suggest that water should not be wasted by cleaning floors, streets etc. vehicles should be washed from outside. On the other, respondents also suggest that government should supply good quality water to their household. According to respondents, there is water supply breakdown period from 10 to 15 days in summer season (during cleaning of canal), water should be provided to them. It was also asked that 'is there any possibility of utilizing waste water released from RO' people responded positively. They suggested that this water can be used for floor cleaning. One respondent said that they were using this water for bathing also but in few years their hair turned grey and white so this water should not be used for such purposes.

Results of the field survey were obtained in qualitative terms but at some places qualitative responses were converted in quantitative values for analysis. This study faced several limitations and difficulties. This micro level study covered very small number of samples so generalization can't be done but it gives some idea about the consumption pattern in the Bathinda city.

Fig. 5.17: Thermal Plant in Bathinda City

Source: Worldview data, accessed on 10.11.2013

5.4 Conclusion- The trend of water consumption by the households of Bathinda city shows that area has adequacy of water resources because people are enjoying Municipal Corporation water supply as well as ground water extraction. People are aware about declined quality of ground water so they are not using it as drinking water. But, on the other hand, duo to socio economic development people need more water for sanitation purposes as well as other household activities. Income is determining factor of willingness to pay more for water with improved quality and quantity. In future, demand of water in domestic household is going to increase even with present water consumption pattern due to population growth, urbanization and economic development.

Chapter 6

Conclusions

South Asia has abundant water resources but these vital resources are facing a number of threats from high population growth, unsustainable consumption patterns, poor management and use of available water resources, pollution and inadequate investment in infrastructure as well as environment change. Climate change is leading to water shortages in all the river basins in the long term due to reduction in glacial run off which feeds rivers. Indus basin is the most resources stressed, based on water availability per person and variation in precipitation and it is most exploited among three major river basins of South Asia. On the other hand, Ganga-Brahmaputra-Meghna and Helmand rivers basins are not currently water stressed. India & Pakistan countries of South Asian region come under the category of water stress because of less than 1700 cubic meter per capita annual water availability.

With the rapid pace of urbanization in South Asia, there is need of sustainable development of water resources in this region. Urban Population is increasing so the demand of water is going to increase in urban sector. In urban areas water is mainly used in two sectors; industrial and domestic. Population growth in urban areas demand of water increases at an accelerated pace. It is difficult to provide water to this increased population with decreasing availability & limited supply. There is a need of proper management of water resources for provisions of cost effective water resources to all. On the other hand, this issues increase the need to study the consumption pattern and behaviours of water users in urban areas.

At present, in almost all cities and towns in India many households do not have access to water on tap. The progress of urban water supply sector has been somewhat slow in India, in spite of the policy initiatives, because of the improper focus and inadequate reforms. In the areas, where water supply is adequate, wastage of water resources is much more in those areas. As it has been observed that 80 percent of total consumed water at domestic household comes out as waste water. But, in country like India, which comes under water stress category due to decreasing

per capita water availability on the one hand, increasing urban population on the other hand, is going to face a big challenge for water supply in all households of urban domestic sector.

Bathinda, a Class I city of country India has been selected to conducted a primary survey to know the water consumption patterns and people perception & awareness about water resources. Consumption of more water is highly influenced by income of people. Water consumption in the households is highly correlated with the income of people. Maximum water consumption has been observed in High Income Group and Middle Income Groups due to presence of more water using appliances. On the other hand, these two income groups are responsible for large water consumption in kitchen gardens/lawns and vehicle washing. People from these income groups are willing to pay more for improved quality and quantity of water, leads to more consumption in near future. Water consumption is also affected by climate change and seasonal variations, since rising temperature mainly in summer season lead to increase in water consumption for more baths per day, washing cloths and watering the plants. Quality of ground water is low in this city so people are using surface water for domestic purposes that are provided by Municipal Corporation, but ground water is also extracted with the help of submersible pumps/hand pumps.

Lack of information also leads to such type of consumption pattern because people think that they have much water. Impact of education and occupation on awareness level of respondents has been observed in the study. People's demand for more quantity of water in domestic sector leads to more demand for water in near future. In this way, there is a need to make policies for sustainable management of water resources to decrease the gap between demand & supply incoming decades in urban areas.

Recommendations

This study is an effort to analyze the water consumption pattern in domestic households of urban South Asia. To know the pattern of water consumption, people perception & awareness; 60 households were surveyed in Bathinda city. Considering

sample size of the study any recommendation may not be appropriate. Even though effort has been made to give few recommendations on the basis of finding of this study and respondent's suggestions.

1. In Bathinda city, 85 percent population is supplied with piped water. On the other hand, in urban India 89 percent of population is supplied with piped water supply. In this regard, some part of population can't access to water resources (Municipal) at their households; those areas should be supplied with water facilities by government so that water supply could not be inadequate. Many slum areas like Lal Singh Basti, Amarpura Basti, Sanjay Nagar etc. are not supplied with water that areas should be taken into consideration.

2. While, 24 hours water supply in households is essential, but, people are ready to adjust with less amount of water supplied to them. So, such pattern of water availability may lead to more water wastage at households. Implementing body should make strategies in a way that could satisfy people demand and reduce wastage of water as well.

3. There should be fixed timings for Municipal water supply, whether water is supplied in morning or evening or any time in day. The irregularities in timings led to wastage of water.

4. Quality of supplied water should be improved because according to people water get contaminated due to leakages of sewerage pipes. Either pipe lines of clean water &sewerage water should be separated or maintenance should be done time to time.

5. Billing system should be improved because people do not get bills on proper time and amount of bill should be according to amount of water use. Less than 100 yards plot area should not be the reason for free supply of water in urban area. Implementation of water meters should be done so that amount of water use can be checked and bill should be according to used water.

6. There should be any organization or programme to make people aware about declining quality & quantity of water. On the other hand, government rules or laws should be known to people. In this way, awareness among people can be increased.

7. Some projects related to conservation of water and water recycling should be implemented in the city & government should make people aware regarding these projects so that people can save water at their households on small scale also.

8. People should understand the value of fresh water, people can escape from wastage of water by changing their personal habits; bathing, cloth washing, utensil washing and mode of house cleaning.

9. Rain water harvesting measures should be adopted because rain water is major source of fresh water.

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Annexure 1
(Interview Schedule)

Water Consumption Pattern in Households of Urban South Asia: A Case Study of Bathinda City

Date of Survey:

Name of Respondent:
Household Address:
Ward No.

Section I - Socio Economic Aspects

1. Family Member Profile:

Member	Gender	Age	Occupation	Education Level

2. Family Income (monthly):

< 5000 ☐ 5001-15000 ☐ 15001-25000 ☐ 25001-35000 ☐
35001-45000 ☐ 45000-5500 ☐ 55000< ☐

3. Number of Vehicles:

Bicycle ☐ Bike/Scooter/Scooty ☐ Car/Jeep ☐ Tractor ☐
Truck/Tempo ☐ Any Other ☐

4. Approximate Area of house and lawn (in Sq. meter):

House Area: <100 ☐ 100-200 ☐ 200-300 ☐ 300-400 ☐
400-500 ☐ 500< ☐
Lawn: 0 ☐ <20 ☐ 20-40 ☐ 40-60 ☐ 60-80 ☐ 80< ☐

5. Total Built Up Area:

0-25% ☐ 25-50% ☐ 50-75% ☐ 75-100% ☐

Section II Household Water Availability (source), Consumption & Behavior

A. Water Availability (Source)

6. a. Source of Household Water Supply:

Municipal Water ☐ Private Tube well/ Submersible Pumps ☐

Hand Pump ☐ Shared water/Tap ☐ Paid RO water ☐

other, if specify ☐

b. If you are using more than one water resources (above), which one you prefer the most? why?

7. For how many hours (daily) you get municipal water? (in Hours)

Summer: <2 ☐ 3-5 ☐ 6-8 ☐ 8-10 ☐ 10-12 ☐ 12< ☐

Winter: <2 ☐ 3-5 ☐ 6-8 ☐ 8-10 ☐ 10-12 ☐ 12< ☐

8. Municipal Water Break Down:

Summer: Once in week ☐ Twice a week ☐ Once a month ☐

Twice a month ☐ Once in two months ☐ Once in six months ☐

Any Other ☐

Winter: Once in week ☐ Twice a week ☐ Once a month ☐

Twice a month ☐ Once in two months ☐ Once in six months ☐

Any Other ☐

9. Major Source of Drinking water:

Tap Water ☐ Submersible water ☐ RO/Filter(personal) ☐

Bottled Water ☐ RO/Filter(any agency) ☐ Any Other ☐

10. Personal RO capacity?

10 liters ☐ 15 liters ☐ 20 liters ☐ 25 liters ☐

11. Do you need 24 hours water (municipal) Supply?

Yes ☐ No ☐

12. a. Currently, if you are getting 4 hours water supply (2+2 hours), do you adjust with in it?

Yes ☐ No ☐ We don't get even this much ☐

b. How much hours it should be provided, without increasing the amount?

6(3+3) ☐ 8(4+4) ☐ 10(5+5) ☐ 24Hrs with meter ☐

24 Hrs without meter ☐ Present Status in enough ☐

13. How would you rate the water provided to you?

a. Municipal Water:

	(1) Excellent	(2) Very Good	(3) Good	(4) Poor	(5) Very Bad
Purity					
Color					
Taste					
Pressure					
Amount					

b. Other Source:

	(1) Excellent	(2) Very Good	(3) Good	(4) Poor	(5) Very Bad
Purity					
Color					
Taste					
Pressure					
Amount					

B. Water Consumption & Behavior

14. Use of water on daily basis (amount in liters):

Summer: Drinking ☐ Kitchen ☐ Washing Clothes ☐

Bathing ☐ Vehicle Washing ☐ Garden/Lawn Sprinkling ☐

Any Other ☐

Winter: Drinking ☐ Kitchen ☐ Washing Clothes ☐

Bathing ☐ Vehicle Washing ☐ Garden/Lawn Sprinkling ☐

Any Other ☐

15. Major water use appliances and their number?

Shower ☐ Toilet Flush ☐ Hand Basin ☐

Washing Machine ☐ Bath Tub ☐ Any Other ☐

16. Total Number of taps:

0 ☐ 1-4 ☐ 5-8 ☐ 9-12 ☐

12-15 ☐ 15< ☐

17. a. Do your Taps leak?

Often ☐ Sometimes ☐ Never ☐

b. How much time it take to call mechanic to repair it?

One day ☐ One week ☐ One month ☐

Not specific time ☐

18.a. What is your bathing frequency?

Summer: Once a day ☐ Twice a day ☐ Thrice a day ☐

Once in two days ☐ Once a week ☐

Winter: Once a day ☐ Twice a day ☐ Thrice a day ☐

Once in two days ☐ Once a week ☐

b. what is the method you use , while taking bath?

1 Bucket/ Tub ☐ 2 Buckets/Tub ☐ Shower ☐

Running Tap ☐ Depend on available water ☐

19. How frequent you wash your clothes?

Summer: Once a day ☐ Twice a day ☐ Once in two days ☐

Once a week ☐ Twice a week ☐

Winter: Once a day ☐ Twice a day ☐ Once in two days ☐

Once a week ☐ Twice a week ☐

20.a. What is the mode of utensil washing?

Tub/bucket ☐ Open Tap ☐ Filled wash basin ☐

Double Washing ☐ Any Other ☐

b. Frequency of utensil washing?

Summer: Once a day ☐ Twice a day ☐ Once in two days ☐

Once a week ☐ Twice a week ☐

Winter: Once a day ☐ Twice a day ☐ Once in two days ☐

Once a week ☐ Twice a week ☐

21.a. Mode of house cleaning with water?

Flooded water/pipe ☐ Bucket& wiper ☐ Mopping ☐

Any other ☐

b. Frequency to clean house?

Summer: Once a day ☐ Twice a day ☐ Once in two days ☐

Once a week ☐ Twice a week ☐

Winter: Once a day ☐ Twice a day ☐ Once in two days ☐

Once a week ☐ Twice a week ☐

22.a. Mode of watering plants/lawn/kitchen garden?

By pipe ☐ Open tap/flooded ☐ Sprinkling ☐

By Bucket ☐ Any Other ☐

b. Frequency of watering?

Summer: Once a day ☐ Twice a day ☐ Once in two days ☐

Once a week ☐ Twice a week ☐

Winter: Once a day ☐ Twice a day ☐ Once in two days ☐

Once a week ☐ Twice a week ☐

23. Frequency of Vehicle Washing?

Summer: Once a day ☐ once a week ☐ Twice a week ☐

Once a month ☐ Once in 2 months ☐

Winter: Once a day ☐ once a week ☐ Twice a week ☐

Once a month ☐ Once in 2 months ☐

Or from Outside- ☐

Section III Water Economy , Adjustment & Perception

A. Water Economy

24. Mode of bill payment:

Monthly to Corporation ☐ After 2 months to Corporation ☐

Annually to corporation ☐ Bill to other agency ☐

Purchase daily ☐ Free ☐ Any Other ☐

25. Do you pay bill within stipulated time?

Yes ☐ No ☐ Fined Sometime ☐ when we get Bill ☐

Any Comment…..

26. Do you know how much you pay for each day?

Yes ☐ No ☐ Any Other ☐

27. Municipal Water charges cover the cost of:

Water Only ☐ Supply Only ☐ Water + Supply ☐

Water +Supply+ Sewerage ☐ Don't Know ☐

B. Adjustment & Perception

28. At present water supply Scheme is designed @ 135 Liters per person /day, what is your opinion?

Sufficient ☐ Not Sufficient ☐ More than need ☐

29. a. Which of following aspects you need improvements in Municipal water?

Quality ☐ Timing ☐ Price ☐ Billing System ☐

Maintainance ☐ Water During breakdown Period ☐

Any Other ☐

b. if above aspects will improve then would you pay more price for water?

Yes ☐ No ☐

30. a. Do you have any water saving measure or water storage system at you home?

Yes ☐ No ☐

b. Source of Stored water? Their number?

Water tank ☐ Bucket ☐ Pot ☐ Any other ☐

c. its capacity (in liters)?

<500 ☐ 500-1000 ☐ 1000-1500 ☐

1500-2000 ☐ 2000< ☐

d. frequency to fill that?

Once a day ☐ Twice a day ☐ Once in two days ☐

Once in week ☐ Twice in week ☐

e. why you need for that?

31.a. At what percent you would adjust within available water supply? If it would decrease by-

1% ☐ 5% ☐ 10% ☐ 20% ☐

Can't adjust even 1% decrease ☐

b. where you decrease your demand?

Drinking ☐ Kitchen ☐ House cleaning ☐

Bathing ☐ Cloth washing ☐ Vehicle washing ☐

Garden ☐

32. a. Have you ever discuss water related topic in family/ friends/ society?

Yes ☐ No ☐

b. Do you think this type of discussions/ steps may give some possitive results?

Yes ☐ No ☐

33. Satisfaction level of whole water service by Government?

	Water Quality	**Water Quantity**
Highly Satisfied (1)		
Satisfied (2)		
Average (3)		
Not Satisfied (4)		
Can't say Anything (5)		

Section IV Awareness

34. Do you know hydrological cycle and changes in it due to climate change?

Yes ☐ No ☐ To some extent ☐

35. How much earth surface is covered with water?

1/4 ☐ 1/3 ☐ 1/2 ☐ 2/3 ☐ 3/4 ☐ Don't Know ☐

36. Total number of rivers in Punjab

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ Don't Know ☐

37. a. Corporation is providing you canal water or ground water?

Canal Water ☐ Ground Water ☐ Don't Know ☐

b. Which is best for domestic use mainly for drinking?

Canal Water ☐ Ground Water ☐ Don't Know ☐

38. a. Do you Bathinda region is suffering with water contamination?

Yes ☐ No ☐

b. From how many Years you observing this?

<5 ☐ 5 ☐ 10 ☐ 20 ☐ 20< ☐

39. Why the water get contaminated?

40. Do you think water resources of this region will be stressed by increasing population and economic development?

Yes ☐ No ☐ To some extent ☐

41. Do you prsesent water supply scheme and price deceided by government?

Yes ☐ No ☐ To some extent ☐

42. Do you know any new policy of government to overcome water related problems?

Yes ☐ No ☐ To some extent ☐

43. Have you ever attented any governmental or any other institute's water awareness program?

Yes ☐ No ☐ To some extent ☐

44.a.Do you know about any water laws or treaties or rules made by governmet?

Yes ☐ No ☐ To some extent ☐

b. Why government made these type of rules etc.?

45.a. Do you aware of recycling of water?

Yes ☐ No ☐

b. where it should we use recycled water?

Flushing Toilets ☐ Double Flush ☐ For Lawn Irrigation ☐

Cleaning Purpose ☐ Any Other ☐

46. What is good quality water?

Good Taste ☐ Low in salt content ☐ Low in turbidity ☐

Chlorinated water ☐ Low in microbial content ☐

Clean by seeing ☐ Don't Know ☐

47. Do the nearness from the water box affect the amount of water? Why?

48.Tell the possibilties to reduce water consumption in domestic household?

49. Suggestions (to people, municipal, government).

Annexure 2

Codes given to responses by using 'Likert Scale'

Table 1: Socio Economic Analysis

Age	Education Code	Occupation Code	Family Size	Income Groups (monthly income)	Built up area	Plot Area (yards)
1. <30 2. 30-39 3. 40-49 4. 50<	1. Uneducated 2. Matriculate 3. Secondary Education 4. Graduate/ Professional Degree	1. Working 2. Business 3. Labour 4. House Wife	1.upto 2 2. 3-4 3. 5-6 4. more than 6	1. LIG= <5000 2. Lower-MIG= 5000-15000 3. Upper MIG = 15000-30000 4 HIG= 30000	1. 100% 2. 75% 3. less than 50%	1. up to 100 2. 100-200 3. 200-300 4. more than 300

Table 2: Sources of water

Source	Drinking	Need	Appliances
1. Only Municipal 2 .Municipal+ Submersible/hand pump 3. Municipal+ Shared Tap 4. Submersible/ Hand Pump/Shared Tap	1. RO (Personal) 2. RO (Municipal) 3. Tap water (Municipal) 4 .Tap water (Ground)	1. Present is enough 2. 4+4/ 5+5 hours 3. 24 hours + meter 4. 24 hours without meter	1. Toilet Flush/ hand basin + <5taps 2. Two/One toilet flush+ one/ two Hand Basin+ Washing Machine+ Shower + 5-8 taps 3.Two toilet flush+ 2Hand Basin+ Washing Machine+ 2Shower + 9-12 taps 4.Three toilet flush+ 3Hand Basin+ Washing Machine+ 2/3Shower + 12< taps

Table 3: Economy & Perception

Bill Payment	Perception (135 l/p/day)	Water Box Nearness	Willingness to pay more	Adjustment
1. After Three months 2. When they got bill 3. Never pay 4. Free	1. Sufficient 2. Not Sufficient 3. More than need 4. Can't say	1. Yes+ People habits 2. Yes+ pressure 3. Yes+ Pipes length/ height 4. No	1. Yes 2. No	1. Can't Adjust 2. 1% 3. 5% 4. 10%

Table 4: Storage

Storage (liters)	Frequency to fill tanks/buckets
1. Bucket/ Pot+ <100	1. Twice a week
2. Water Tank + < 500	2. Once in two days
3. Water Tank + 500-1000	3. Once a day
4. Water Tank + 1000<	4. Twice a day

Table 5: Awareness

Hydrological cycle	Water on Earth	Rivers	Water Recycle	Years observing
1. Yes	1. Don't Know	1.Dont Know	1.Yes	1. <5
2. No	2. One-third	2. Seven	2.No	2. 5-10
	3. Half	3. Five		3. 10-20
	4. Two-third	4. Three		4. 20<

Annexure 3

Table 1: Frequency to fill water tanks

Frequency	Respondents (%)
Twice a week	13
Once in two days	13
Once a day	45
Twice a day	29
Total	100

Table 2: Use of Washing Machine for Cloth Washing

Use of Washing Machine	Respondents (%)
Yes	62
No	48
Total	100

Table 3: Willingness to pay more amounts for water

Willingness to pay	LIG (%)	LMIG (%)	UMIG (%)	HIG (%)	Total (%)
Willing	0	9	10	19	38
Not Willing	23	18	15	6	62
Total	23	27	25	25	100

Table 4: Adjustment with decreasing availability

Decreased amount	Respondents (%)
Can’t adjust with any decrease	22
1%	42
5%	26
10%	10
Total	100

Table 5: Source of Water

Source	LIG (%)	LMIG (%)	UMIG (%)	HIG (%)	Total (%)
Only Municipal	12	9	12	2	35
Municipal + Submersible/hand pump	8	15	9	23	55
Municipal + Shared Tap	1	0	2	0	3
Submersible/hand pump/ Shared Tap	2	3	2	0	7
Total	23	27	25	25	100

Table 6: Source of Drinking Water

Drinking Water	LIG (%)	LMIG (%)	UMIG (%)	HIG (%)	Total (%)
RO (personal)	0	3	15	20	38
Ro (Municipal)	5	13	7	5	32
Tap Water (Municipal)	18	9	2	0	28
Tap Water (Ground)	0	2	0	0	2
Total	23	27	25	25	100

Table 7: Means of Water Storage

Storage	LIG (%)	LMIG (%)	UMIG (%)	HIG (%)	Total (%)
Bucket/ Pot (<500)	10	2	0	0	12
Water Tank (<500)	8	12	4	2	26
Water Tank (500-1000)	5	13	18	19	55
Water Tank (+1000)	0	0	3	4	7
Total	23	27	25	25	100

Table 8: Bathing Habits of Respondents

Bathing Habits (S)	Working (%)	Business (%)	Labor (%)	Housewife (%)	Total (%)
Once a day + Bucket	3	0	2	7	12
Twice a day + Bucket	3	2	2	25	32
Thrice a day + Bucket	10	2	6	16	36
Twice/ Thrice a day + Bucket + Shower	7	0	0	13	20
Total	23	4	10	63	100
Bathing Habits (W)	Working (%)	Business (%)	Labor (%)	Housewife (%)	Total (%)
Once a day + Bucket	23	4	10	59	96
Twice a day + Bucket	0	0	0	2	2
Thrice a day + Bucket	0	0	0	2	2
Twice/ Thrice a day + Bucket + Shower	0	0	0	0	0
Total	23	4	10	63	100

Table 9: Utensil Washing

Utensil Washing	LIG (%)	LMIG (%)	UMIG (%)	HIG (%)	Total (%)
Thrice a day+ Bucket/tub	19	8	2	4	33
Thrice a day+ Open Tap	1	8	12	12	33
More than three times a day + Bucket/Tub	3	3	3	0	9
More than three times a day+ Open tap	0	8	8	9	25
Total	23	27	25	25	100

Table 10: Mode of House Cleaning

House Cleaning	LIG (%)	LMIG (%)	UMIG (%)	HIG (%)	Total (%)
Once a day + Mopping	17	18	15	15	65
Twice a day + Mopping	0	0	0	5	5
Once a day+ Flooded water	6	9	10	2	27
Twice a day+ Flooded water	0	0	0	3	3
Total	23	27	25	25	100

Annexure 4

Photographs taken during Survey and interaction with respondents in various area of Bathinda City

Jogi Nagar

Arjun Nagar

Guru Ki Nagri

Lal Singh Basti

Hand Pump and Shared Water Tap (Municipal water Supply) are being used by people at 'Janta Nagar'