Sustainable Management of Water Supply in Bahawalpur City, Pakistan

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Abstract:

Current study examined the situation and sustainable management of water supply in Bahawalpur city. A questionnaire survey was conducted in selected study areas i.e. Model town A, Model town B, Satellite town, Shahdrah and Islami colony taking 100 respondents as samples using random stratified sampling. It is revealed that just 10-15% population was consumed municipal water supply that covered only 3% service area. In order to improve existing water supply situation provincial government were inaugurated two mega projects namely Southern Punjab Basic Urban Services Project (SPBUSP) and Punjab Health Engineering Department's (PHED) Rehabilitation and Augmentation of Urban Water Supply Scheme. Survey results indicated that about 53.5% respondents were willing of having municipal water supply, while 46.5% were not trusted on municipal water supply. The major source of water usage was electric pumps (42.4%). Due to income problems, a large proportion of 86%

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respondents were willing to pay water supply charges within the range of 100 to 600 PKR per month. About 95.2% respondents never registered any compliant about water related problem whereas 83% respondents were agreed to admit that access to safe drinking water is a big problem affecting their social life. Cemented or plastic made water tanks mostly used at homes to store water but they were not cleaned regularly as 33.5% respondents clean their water tanks after 6 month, while 13% respondents of Islami colony and Shahdrah admitted that they never clean their tanks. To bring change in people attitude, 80.8% respondents considered T.V as a major source of awareness.

Key words: Water Supply, Bahawalpur City, Sustainable Management, SPBUSP

1. Introduction

Around the world urban areas are sprawling with tremendous pressure of population. Due to increasing population the needs of better quality of water, effective sewage system, dumping of waste, affordable housing and many environmental and ecological demands also elevating. Among these, poor infrastructure of water supply creating many social and economic problems not only in the availability of water but also the supply of potable water. Shortage of drinking water is one of the greatest problems of the human society (Mariolakos 2007). This problem exist many parts of the world particularly in developing countries where the pressure of humans on natural resources including water is indefinite. For instance, the level of water tables in China, India, Pakistan, Mexico and Yemen are dropping by 1 to 3 meters per year (Overpopulation 2010). In Nigeria, less than 50% population has access to improved water supply and sanitation (Ayeni et al. 2009). It is estimated that by the year 2050 almost as much as two thirds of the world population could be plagued by scarcity of water (Haq et al. 2001). To understand the intensity of the matter

there is dire need of public and governance interest to manage the water resources in a sustainable way (Pahl-Wostl et al. 2008) because healthy freshwater ecosystems provide a wealth of goods and services for society (Richter et al. 2003). Although majority of the people in developing countries are living along with major rivers or having heavy rainfall but they are deprived from adequate access of safe drinking water. In 2002, about 158 million people have inadequate water supply in developing countries (UN-HABITAT 2006). Moreover, rapid increase in urban population caused unplanned settlements commonly known as slum areas. These slum areas remain deprived from many basic services including adequate water supply etc. Because most of the slum dwellers used inadequate methods of getting drinking water (Khan and Khan, 2010). In Nigeria the women in rural areas highly rely on unhygienic sources of springs, streams and lakes for water supply and so the children are prone to various water related diseases (Adebo and Sekumade 2013). Another study also shows the acute inadequacy of potable water in Nigeria due to administrative issues in the water management especially funds and equipment (Ekong et al. 2012). About 18% of the world population or over 1.2 billion of people do not have access to improved means of drinking water (UNICEF and WHO, 2008). But now situation is slightly improved with 780 million people without access to an improved drinking water source (UNICEF and WHO 2012). Use of unsafe water to satisfy needs especially for drinking can result in many diseases. Therefore, at least 1.8 million deaths of children under the age of five years have been reported throughout the world every year due to water related diseases (Corcoran et al. 2010).

In Pakistan, the per capita water availability has dropped from 5,600 cubic meter in 1952 to 1,200 cubic meter in 2003 and if immediate action will not be taken, the per capita water availability would decrease to less than 1,000 cubic meter by year 2012 (Khan and Javed 2007). Currently, the service

standard of water supply and sanitation (WSS) services in the cities of entire Punjab province are unable to meet minimum standards (World Bank and Govt. of Punjab 2006). As the population continues to grow the country is approaching the utilization limits of its water resources and Pakistan is becoming a water scarce country. As never before, there is now a strong and growing need to manage this precious resource more carefully and efficiently to ensure water for all on a sustainable basis (Govt. of Pakistan 2002). Due to exceeding overdraft and exploitation of water resources the water tables is falling continuously with degradation of ground water quality and quantity therefore management strategies are not fully successful with high populating pressure (Qureshi et al. 2010) and if this trend continues, 52.8 million people will be deprived of safe drinking water (Govt. of Pakistan 2002) while 43.2 million people will have no access to adequate sanitation facilities in Pakistan (Khan and Javed 2007).

The problem of insecure water availability in Pakistan is persists in many cities i.e. In Pakistan biggest city Karachi majority of people have inadequate access of drinking water (Ihsanullah 2009). As, millions of residents have no clean drinking water and must rely on contaminated water from tankers while the scarcity of clean water may hit Lahore hard like Karachi (Qadir 2013). Similarly, groundwater in several areas of Bahawalpur district was not fit for drinking. Only 24 filtration plants exist for over four million people in the district. Poor groundwater in Bahawalpur was due to lack of water in river Sutlej, the chief source of water in the region. Government must fulfill its promise of installing water filtration plants at the union council level (Tribune 2013). Moreover, physical access to drinking water (within dwelling) in Bahawalpur was 91% as compare to the 92% overall access to the drinking water in Punjab (Govt. of Punjab, 2009). Residents of several colonies in Bahawalpur city have complained that three water filtration plants installed in Satellite town, Model town A and Model

Bazar by the provincial government are inadequate to meet the potable water demand (Zafar 2012). Bahawalpur is a city leading towards a situation of acute water shortage in future (Anwar and Bureste 2011). Because drinking water supply situation of Bahawalpur is much below as compared to all other cities i.e. the service coverage is about 3% of population (The Urban Unit 2011). The situation of water supply and quality is not satisfactory indicated acute shortage and deteriorating quality of water causing fatal diseases in Bahawalpur city as it is noticed in a study that in Islamic colony about 36%, Satellite town 18.1% and Shahdrah 22.1% residents have been facing serious waterborne diseases (Mohsin et al. 2013). In developed countries, governments start to adopt many strategies to overcome the expected water related problems in future. But unfortunately, in poor countries where situation is worst, this problem is not attaining that concern which it deserves. In order to provide safe water to the inhabitants the immediate steps needs to be taken by federal government. In this way by the adaptation of water resources development (by constructing new dams etc.) and sustainable use of water and water management practices additional 20 million acre feet (MAF) water can be store for increasing agricultural and drinking needs in Pakistan (Pakissan 2013). From environmental point of view, sustainable management of water supply system includes the water supply, water intake, water use and implementation of policies for water conservation is of vital importance.

2. Study Area and Methodology

The absolute location of Bahawalpur city is about latitude 29°-22′N and longitude 71°-37′E. It is known as a water scarce city having extremely hot climate and deficient rain in most part of the year. The estimated population of the city is 560,588 that were 408,305 in 1998 growing fastly with the rate of about

3.08% per annum (DCR, 1998 and Govt. of Punjab 2012) and imposing enormous pressure on limited resources like water. To access the scenario of water quality and its sustainable management various sources have been deployed including Tehsil Municipal Administration (TMA) of Bahawalpur city, District census report (DCR) 1998, The Urban Unit (Punjab) reports, Punjab development statistics etc. while primary data about water usage and supply condition collected through questionnaire survey conducted in Model town A, Model town B, Satellite town, Shahdrah and Islami colony in 2012 using random stratified sampling (Figure 1). Total 100 respondents were selected as samples. Besides, interviews also have been done to city's local government officials, planning experts and residents. The main objective of the study is to find out existing water supply situation and suggests some solutions for sustainable water supply management in Bahawalpur city. In this regard, there are two main steps for development of urban water supply; first, adopt measures to improve existing water supply infrastructure by regular supervision and maintenance of pipes leakage, supply regularity etc. and second, development of new projects for water supply provision according to the projected population (Figure 2). Percentage method was used for data analysis and study area map was prepared in ArcGIS 9.3 software. Results were portrayed in tables with necessary discussion.
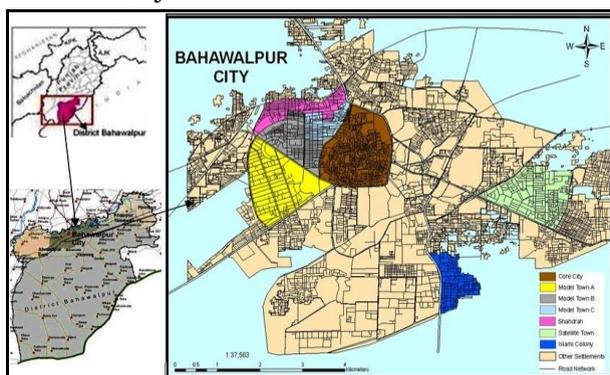

Figure 1: Location of Study Area

Source: Authors (2012) and The Urban Unit (2011)

3. Existing Water Supply Situation

Generally the water of the Bahawalpur is alkaline and not fit for human use. Moreover, the subtle growth of population, haphazard urbanization and lack of coordination and monitoring of supply lines further troubling the situation. Although there can be many sources of drinking water for the citizens, but the most common and useful source of drinking water in all over Pakistan is ground water. In Bahawalpur city about 10-15% population consume pipe supply and remaining about 85-90% depends on ground water. While sweet water is just found along Bahawal canal and along the river Sutlej (TMA of Bahawalpur City, 2012). Most of the water in Bahawalpur city is extracted from underground resources and supplied to different residential areas in the city.
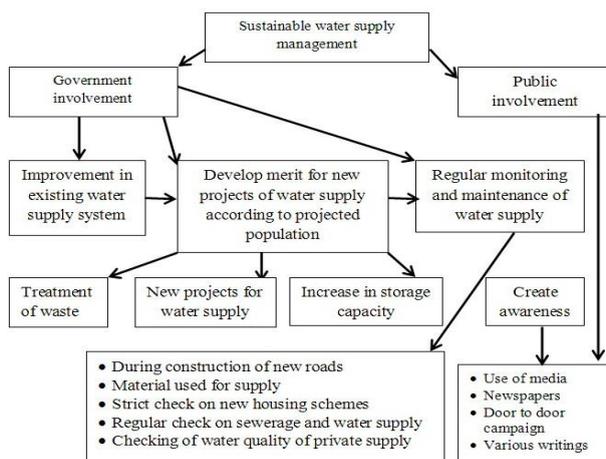

Figure 2: Proposed Methodology for Current Study
Source: Authors (2012)

The main sources of drinking water distribution in Bahawalpur city are follows:
1. Overhead Reservoirs (OHRs)
2. Ground Storage Tank (GST)

3.   Direct Pumping

Overhead reservoirs (OHRs) were the old source of water supply distribution in the city found in eight different locations i.e. Hamatiyan, Muhajir colony, Shahdrah, Model Bazar etc. but now with passage of time has become less effective. Similarly ground storage tanks (GSTs) were absent in municipal water supply system but now been focused in some other mega projects. In direct pumping technique, water is directly extracted and supplied to residential areas. However, if the usage and extraction of water is not equal, the water pressure can breakdown the supply pipelines. The small pipes are attached with the main pipeline so that the water is directed to the any other open or vegetated area. It is risky method because water pressure is more than the other two methods. Proper use of water with respect to extraction of water capacity is necessary otherwise it can break down the supply pipes. The water extraction and distribution is carried on through these two pipelines. Main pipeline of 12 or 16 inches diameter received water from tank. From the main pipelines, pipeline of 4 inches diameter enters into street and opens at home, supply water there with the size of ½ inches or ¼ inches diameter pipes. Table 4 briefly portrays the brief situation of water profile in Bahawalpur city. The per capita consumption of water that was 55 g/day now gradually been increasing with population. Total number of registered connections was 1,918 where 1,911 were domestic and 11 were commercial. While, out of 15 tube wells, just 7 were in working condition. These tube wells supply 0.9 MGD which was insufficient for increasing population water demands. Moreover this supply has been affected by energy crises (World Bank and Govt. of Punjab 2006; TMA Bahawalpur City 2012).

Sr. No.	Item	Value
1	**Coverage**	
	Water Supply Coverage Area	10%
	Population	3%
2	**Source**	
	Ground Water (tube wells based system)	Yes
	No. of Tube Wells	15
	Functional Tube Wells	7
	Capacity of Functional Tube Wells	5 cusec
3	**Water Filter Plants** (installed under UC/TMA / DG/ PSRP or Other Schemes)	
	Total No. of Water Filter Plant	5
	Functional Water Filter Plant	3
4	**Total Supply**	
	Duration (Supply Hours)	8
5	**Total Connections**	1,918
	Domestic Connection	1,907
	Commercial	11
	Industrial	0
6	**Water Consumption**	
	Per Capita water Consumption	55 g/day
	Total Water Consumption	0.9 MGD
	Overhead Reservoirs	8
	Capacity of Over Head Tank (OHT)	0.52 Million Gallon
	Ground Water Storage Tank	Nil
	Capacity of Ground Water Storage Tank	Nil
7	**Water Distribution Network**	
	Type of Distribution Pipe Network	GI, AC, PVC
	Approximate Pipe Length	105 Km
8	**Working Staff**	
	Total Staff for W/S Management	64
	Technical	45
	Non-Technical	19
	Maintenance Teams	8
	Staff/1000 Population for Water Connections	10

Table 1: Existing Brief Water Supply Services Profile of Bahawalpur City

Source: World Bank & Govt. of Punjab (2006) and TMA Bahawalpur City (2012)

Many residents who have municipal water supply in past, complaint that water supply is not adequate as timings are not proper; load shedding disturbs the supply schedule. During survey, residents of Islami colony and Satellite town were disclosed about the mixing of sewerage water with drinking

water supply. Beside, road construction/ repairing works, renovation of houses damaged many existing water supply pipes and leakage from these pipes result in wastage and seepage of water into ground. Improvements in existing supply system can be achieved by keeping it safe from any pollution and second to conserves each drop of water to be waste by damaged pipes. There is also need to aware people about water supply and maintainace departments. So people could report about any problem relating to supply of water immediately to concerned department. As a result problem at initial stage can be handled more easily.
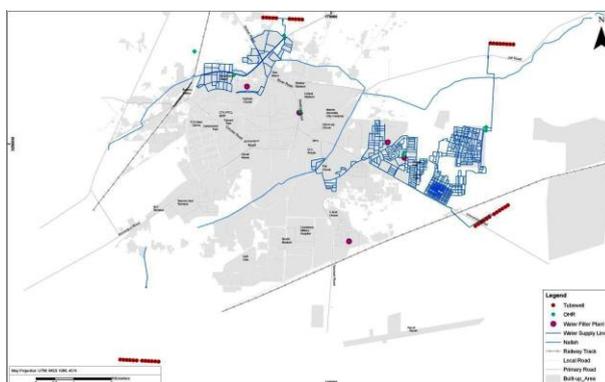

Figure 3: Existing Water Supply System in Bahawalpur City
The Urban Unit (2011)

4. Development of New Projects for Water Supply

Population of Bahawalpur in all census reports and in estimates shows a remarkable increase. Population wise it is 12th biggest city of Pakistan (Govt. of Punjab, 2012). Moreover, Bahawalpur Tehsil accounts 64.5% urban population in overall urban population of the Bahawalpur district (DCR, 1998). This rapid increase in population results in more demand of adequate water supply. The first water supply scheme for Bahawalpur city was approved in 1973-74 with 4.966 million PKR but not proved much effectual. In later years few other

schemes were also been planned and implemented i.e. comprehensive water supply scheme in 1981 and extension of water supply scheme the in 1997-98. In December 2004, Southern Punjab Basic Urban Services Project (SPBUSP) project was inaugurated in Punjab with the financial aid of Asian Development Bank (ADB) to provide basic urban services in 21 Tehsils of 6 districts of Sothern Punjab including Bahawalpur city. Till now total 531.52 million PKR approved for water supply schemes in selected project area within Bahawalpur city and expenditures were made 414.203 million PKR. The overall progress of schemes initiated by SPBUSP is 93% (Table 2). Main objectives of this plan were to provide urban services including safe water supply, improvement in sewerage system, treatment of wastewater, solid waste management and construction of waste water treatment plants for the low income areas within urban limits of the TMA. Later, in 2006, Punjab Health Engineering Department (PHED) was executed Rehabilitation and Augmentation of Urban Water Supply Scheme in Bahawalpur city with a cost of 199.976 million PKR. After in 2010-11 an additional amount of 43.44 million PKR was allocated. The main goals of this scheme were including the construction of 8 ground storage tanks (GSTs) and one overhead reservoir, construction of 24 Pump house (2x2 feet), Provision and installation of 25 sets of pumping machinery, replacement of water supply pipeline from 3 inch diameter to 24 inch diameter, replacement of 6,200 defective house connections, establishment of one water testing laboratory etc. according to latest updates about 80% works is completed under PHED schemes. (The Urban Unit 2011).

Sr. No.	Name of Project	Completed Work (%)	Physical Progress (%)	Total Cost (Million PKR)
1	Water Supply Scheme Bindra Basti	100	98	112.816
2	Water Supply Scheme Satellite Town	100	98	95.109
3	Water Supply Scheme	100	98	92.342

	Tibba Badar Sher			
4	Water Supply Scheme Bhatta Jat	Work is in progress	90	197.43
5	Water Supply Scheme Bahawal Colony	Completed and in Operation	98	46.663
6	Water Supply Scheme Quaid-e-Azam Colony	Work is in progress	75	87.256

Table 2: Water Supply Projects under SPBUSP
Source: The Urban Unit (2011)

Main focus of the project is to study the existing water supply and sewerage system and then design a project for water supply up to year 2050 to facilitate projected population to make friendly environment and better living conditions of the people. Consequently, in the beginning of 2013, district government of Bahawalpur announced nine development projects in the district. Out of nine, seven were planed about water supply where three about supply of water to low income areas and four about the expansion of existing water supply in Bahawalpur (Tribune, 2013).

5. Active Public Involvement

After the due responsibility of government, active public involvement is also necessary to solve water supply problem efficiently in Bahawalpur city. People who have sufficient and adequate water available through their powerful electric pumps did not consider drinking water as a problem. But people who fetched water from a distance or purchase it considered water availability as a big problem. To involve public actively or to bring change in their behavior, there is need to have an overview and insight on thinking of people. If people are considering any issue as more serious problem, then it is easy to change their negative attitude and it can assures their active participation as well. The people concerns about water usage and supply discussed here that might helpful to get awareness about their perceptions of water supply issue.

5.1 Residents Knowledge about Water Departments

Table 3 makes it clear that residents' knowledge about any government water concerned department in Bahawalpur was much limited. Only 22.4% people were aware from such departments whereas 77.6% were unaware. The residents of Islami colony with 88% and Shahdrah with 84% were in top of the list of having no knowledge about water supply or any other water concerned departments whereas In Model Town A and Model Town B about 84% and 76% respondents were unaware from any water department respectively. Because of the existence of Pakistan Council of Research in Water Resources (PCRWR) regional office near Satellite Town, about 48% respondents were having sufficient knowledge about government water departments.

Option	Model Town A (%)	Model Town B (%)	Shahdrah (%)	Satellite Town (%)	Islami Colony (%)	Average use (%)
Yes	16	24	12	48	12	22.4
No	84	76	88	52	88	77.6

Table 3: Residents Knowledge about Government Water Departments
Source: Field Survey (2012)

5.2 Residents Complaints about Water Supply

It is observed that majority of the people in Bahawalpur city relied on domestic sources of water i.e. electric pumps etc. while a tiny share depend on municipal water supply. Therefore, due to limited knowledge about government water departments people have no idea to where does registered any complaint regarding water supply. Therefore, 95.2% respondents never registered any complaint about supply or quality of water. In Model town A and Satellite town 8% respondents each were registered their complaints about water quality or supply problem whereas in Islami colony and Shahdrah 4% respondents each were registered their complaints. In Model town B, no single respondent admitted to register any water supply complaint.

Option	Model Town A (%)	Model Town B (%)	Shahdrah (%)	Satellite Town (%)	Islami Colony (%)	Average Use (%)
Yes	8	-	4	8	4	4.8
No	92	100	96	92	96	95.2

Table 4: Residents Complaints about Water Supply
Source: Field Survey (2012)

5.3 Willingness of Residents of having Municipal Water Supply

Inefficient municipal water supply and insecure monitoring and control in Bahawalpur city resulted in loosing trust of residents on public water supply and hence they have installed electric water pumps at their homes compensating on the quality of water that is already contaminated in most part of the inner city. But despite this adverse situation, about 53.5% respondents were still willing of having municipal water supply, while 46.5% were not trusting on municipal water supply (Table 5). Results show that in Satellite town and Model town B 68% and 64% respondents were willing to have a municipal water supply. While in Islami colony and Model town A 52% and 47.3% respondents were willing to have a municipal water supply. In Shahdrah about 36% respondents were willing to have a municipal water supply and 64% were not willing. This is because of originally fair quality of water of this area due to the closeness to river Sutlej. These results demonstrate that respondents of these colonies were in uncertain condition and confused about having a municipal water supply. The situation could be better by taking evolutionary steps in municipal water supply management and distribution.

Option	Model Town A (%)	Model Town B (%)	Shahdrah (%)	Satellite Town (%)	Islami Colony (%)	Average Use (%)
Yes	47.3	64	36	68	52	53.5
No	52.7	36	64	32	48	46.5

Table 5: Willingness of Residents of having Municipal Water Supply
Source: Field Survey (2012)

5.4 Sources of Drinking Water

As it is mentioned earlier that electric pumps are the main source of ground water extraction in Bahawalpur city. Similarly, in sample areas majority of the residents used electric pumps to extract ground water. About 42.3% respondents were used electric pumps to extract water from ground and use it directly. Where 68%, 56% and 36% respondents of Shahdrah, Satellite town and Model town A used electric pumps respectively. About 25.6% respondents of all sample areas were used water of Govt. filter plants and 17.6% respondents used electric pumps plus small filter installed at their homes. Rest of the respondents used municipal water supply (4.8%), purchased bottled water (3.2%) and other (6.4%) minor sources of water. Hence, it is proved that electric pumps were the most commonly used device for ground water extraction.

Source of drinking water	Model Town A (%)	Model Town B (%)	Shahdrah (%)	Satellite Town (%)	Islami Colony (%)	Average (%)
Electric Pumps	36	24	68	56	28	42.4
Municipal Supply	16	-	8	-	-	4.8
Bottled Water	-	-	-	16	-	3.2
Govt. Filter Plant	20	32	12	8	56	25.6
Electric Pumps + Small Filter Plants at Home	20	32	4	16	16	17.6
Other	8	12	8	4	-	6.4

Table 6: Sources of Drinking Water
Source: Field Survey (2012)

5.5 Water Purification Methods

Purification of water is so important as so far it is concerned areas like Bahawalpur city that have already water stressed and water is not fully fit for human use due to variety of impurities found in it. Purification methods used to purify water and make it microbiologically fit for human use but

unfortunately these are not in practice on common grounds in Bahawalpur. Therefore in study areas about 88.8% respondents did not adopt any water purification method for drinking purpose while 8.8% respondents have boil water to some extent on particular occasion especially for any patient at home after the prescription of physician. Only 6.4% respondents use any purifying method mainly boiling at their homes on regular basis. Respondents who were use water of govt. water filtration plants or have small filters installed at their homes were just satisfied with the quality of water. About 5.9% respondents admitted that it is their laziness that in spite of all awareness they were fail to adopt any measure or bring change in their behaviors.

Option	Model Town A (%)	Model Town B (%)	Shahdrah (%)	Satellite Town (%)	Islami Colony (%)	Average Use (%)
Yes	8	---	8	8	8	6.4
No	84	92	84	72	92	88.8
To some Extent	8	8	8	20	0	8.8

Table 7: Methods Used for Purification of Water
Source: Field Survey (2012)

5.6 Cleanliness of Water Tanks

In Bahawalpur mostly residents used cemented or plastic storage tanks mounted on the roof of the house for water storage which can also be used in the presence of electricity load shading. Physically these tanks particularly plastic tanks not proved fully durable and capable to kept water safe for a long time particularly for drinking purposes. Moreover, residents are not considered important to clean these tanks within proper time period. Especially in areas where presence of salts, arsenic concentration and sewerage water mixing in drinking water is frequent, regular cleanliness of water storing tanks is essential. Results shown an average 26.3% respondents were clean their water tanks after a month, while 33.5%

respondents were clean their tanks after the duration of 6 months, 20% respondents were clean their water tanks after a year and 7% after two years (Table 8). A large proportion of 13% respondents were admitted that they never clean their tanks mostly in less developed areas of Islami colony (30.4%) and Shahdrah (21.7%). People still considered water as an infinite resource that is why they use water with careless behavior. This awareness could be developed by Govt. or other social and economic departments associated with water relating issues.

Timings	Model Town A	Model Town B	Shahdrah	Satellite Town	Islami Colony	Average Use (%)
Monthly	30.4	22.7	34.9	13.1	30.4	26.4
After 6 month	30.4	41	30.4	43.4	21.7	33.4
After I year	17.4	13.6	13	39.1	17.5	20.1
After 2 years	17.4	13.6	-	4.4	-	7.0
Not Clean	4.4	9	21.7	-	30.4	13.1

Table 8: Cleanliness of Water Tanks
Source: Field Survey (2012)

5.7 Tariff of Water Supply per Month

Majority of the people in Bahawalpur city have hand to mouth earning therefore the important question arises that how much it would be charged from residents on monthly/ annually basis of municipal water supply? According to respondents, as it is the duty of government to provide safe water, so charges should be less. There are two ways to collect bills from the residents. First bill should be fixed and minimum, second installation of meters on residents houses. In first case a person with small family who is using less water would pay the same as any large consuming family would pay. Installation of meters would result in more careful use of water but put extra financial burden on poor residents. When respondents asked that how much they could pay for municipal water supply? A large proportion of 86% were willing to pay 100 to 600 PKR for water supply per month (Table 9). About 54.8% were willing to pay

100 to 300 PKR while 31.5% were agreed to pay 300 to 600 PKR per month for constant water supply. Residents who were purchasing water from private companies or covered long distance to fetch safe water were even agree to pay 1,000 or more than 1,000 PKR for safe water supply at their homes on regular basis therefore 7% residents were agree to pay 900 to more than 1,200 PKR per month for safe and regular water supply. But it is notable that TMA proposed tariff during 2010-11 was only 60 PKR per month on domestic connection whereas commercial connection holders were charged 182 PKR per month with registration fee of 735 and 2,774 PKR respectively (Table 10). The ratio of these tariffs was considerably below from the residents' proposals but as it is important to mention that municipal supply is often interrupted due to power outages and limited supply duration of just 8 hours per day (Table 1). Therefore residents were not so interesting to have a municipal water supply connection. In addition, many private companies are supplying bottled water in Bahawalpur city and there is no check on the quality and high charges which they collected from the residents. Government could plan to provide safe water at homes by pipe supply as in past. So residents would be free from the problem of bringing water from a distance or storage of water in cans or bottles and purchased bottled water.

Charges/Month	%age
>100	4.3
100-299	54.8
300-599	31.5
600-899	2.4
900-1199	3.5
1200+	3.5

Table 9: Purposed Tariff of Water Supply per Month
Source: Field Survey (2012)

Connection Type	Amount (PKR)
Registration of Connection fee (Domestic connection)	735
Monthly Service Charges (Domestic Connection)	60
Registration of Connection fee (Commercial Connection)	2,774
Monthly Service Charges (Commercial Connection)	182

Registration of Connection fee (Industrial Connection)	6,590
Monthly Service Charges (Industrial Connection)	500

Table 10: TMA Water Supply Tariff during 2010-11
Source: The Urban Unit (2011)

Supply is not the main issue; assurance of regular supply and quality are the main problems. After regular water supply, by charging monthly or annually government could start new projects and could expand on maintenance of existing water supply schemes. But there is need to develop trust in citizens that if they are paying for water supply, that money too is used only for their welfare. Especially in comparison with private companies, responsibility of government increases many times.

5.8   Water Availability as an Environmental Problem

Water availability is vital to ensure safe human life on earth. About 50% respondents were strongly agreed that access to safe water is a big problem which is affecting their social life. While 32.3% were also in the favor of above mention notion (Table 11). According to 5.7% respondents water availability is a problem to some extent prevailed at a minor level and not so much ominous. Whereas 12.5% respondents still thinking that water availability is not a problem in any case. At this level there is need of creating awareness about the importance of availability of drinking water and on saving each drop of potable water. Need for creating awareness can be explained by simple example that a large proportion of respondents considered water as an environmental problem both in terms of quality and quantity. But they avoid adopting any measures in this regard.

Consideration	%age
To some Extent	5.7
Agreed	32.3
Strongly Agreed	49.5
No	12.5

Table 11: Water Availability as an Environmental Problem
Source: Field Survey (2012)

5.9 Use of Media for Awareness Campaign

Media particularly electronic media is the rigorous source of conveying massage at present time. About 80.8% respondents were considered T.V as a major source for effective awareness campaign. There were two groups with equal proportion of 4.8%, considered T.V. with newspaper and T.V. with mobile phone equally effective for changing the non-serious attitude of residents towards the use of water. While 7.2% respondents were agreed with the others mediums like radio, magazine, mobiles and internet for conveying massage of careful use of water to public. Less share of 2.4% respondents have no idea about spreading message of sustainable water use. In fact people are aware from all above discussed facts, now there is need to bring change in their attitudes. It is not healthy practice to just use purchased water with care. Water we are wasting at present would be charge more taxes from next generation.

Means of communication	%age
Television	80.8
Television +Newspaper	4.8
Television +Mobile Phone	4.8
Others	7.2
Don't know	2.4

Table 12: Use of Media for Awareness Campaign
Source: Field Survey (2012)

6. Conclusion and Recommendations

Tremendous pressure of increasing population creates the immense issues of supply, scarcity and quality of water. The situation is much risky in cities of exploding population (i.e. Bahawalpur). Thus current study examined the situation and sustainable management of water supply in Bahawalpur city. Currently, water supply system in city is managed by TMA and about 10-15% population was consumed municipal water supply and remaining about 85-90% depend on ground water

extracted through electric pumps at their homes. Overhead reservoirs (OHRs) are the main method of municipal water supply provision. Average per capita use of water in Bahawalpur city is 55 g/day now gradually been increasing with population. Municipal supply pipeline of 12 to 16 inches diameter covered only 3% service area with the total number of 1,918 registered connections where 1,911 were domestic and 11 were commercial. In order to improve existing water supply situation particularly in low income areas provincial government inaugurated two mega projects. First was Southern Punjab Basic Urban Services Project (SPBUSP) with the financial aid of Asian Development Bank (ADB) initiated in late 2004. The project was design to improve the situation of sewerage, solid waste disposal and 6 water supply schemes in less developed areas of the city. The overall progress of schemes initiated under SPBUSP is 93%. The second mega water supply project executed in 2006 by Punjab Health Engineering Department (PHED) titled Rehabilitation and Augmentation of Urban Water Supply Scheme in Bahawalpur city with a cost of 199.976 million PKR. The main goals of this scheme were including the construction of 8 ground storage tanks (GSTs), one overhead reservoir, replacement of water supply pipeline from 3 inch diameter to 24 inch diameter etc. About 80% works is completed under PHED schemes. In sample areas, about 53.5% respondents showed their willing of having government water supply, while 46.5% were not trusting on government water supply due to failure of power and limited supply hours of water. The major sources of water extraction were electric pumps (42.4%) and Govt. water filtration plants (25.6%). Whereas, small number of respondents were used municipal water supply (4.8%) and other minor sources. Majority of the people in Bahawalpur city belonged to low income class and therefore large proportion of 86% were willing to pay a charge within the range of 100 to 600 PKR for water supply per month. The knowledge of respondents about government water supply

departments was limited. Only 22.4% were been aware of these departments while 77.6% were having no knowledge. Resultantly, 95.2% respondents never registered any compliant about water related. Luckily, the proposed tariff of TMA during 2010-11 was only 60 PKR per month but surprisingly not gained expected appreciation and trust of residents. In sample areas, overall about 83% respondents were agreed to admit that access to safe water is a big problem affecting their social life. Moreover, 88.8% respondents did not adopt any water purification method for drinking purpose. Cemented or plastic made water tanks mostly used at homes to store water but they were not cleaned regularly as 26.3% respondents clean their water tanks after a month, while 33.5% after 6 months, whereas about 13% respondents of less developed areas of Islami colony and Shahdrah admitted that they never clean their water tanks. Therefore to bring change in respondents' attitude the use of media could be substantive therefore about 80.8% respondents considered T.V as a major source to run effective water awareness campaign. A due consideration is necessary to achieve a successful sustainable development on qualitative supply of water for human use (Rabiu and Tukur 2013). Therefore, to bring efficiency and sustainability in the water supply system in Bahawalpur city study suggested; regular monitoring and maintainance of existing water supply system should be made, new projects should be designed to facilitate people in main or periphery of the city, material used for any new water supply should be strictly monitored and tested before use, new water filtration plants should be installed to reduce the long queues of people on existing filtration plants, storage capacity of overhead reservoirs and filtration plants should be increased and make efficient, replacing and inspecting of chemicals and filters at filtration plants should be practiced on regular intervals, new projects about treatment and reuse of water for specific purposes should be launched, citizens awareness campaign should be set up, any

breakage or leakage in supply pipes immediately reported, new projects should be designed in such a way that any new road or building construction should not damage water supply pipes, any new housing scheme should not be approved until proper water supply infrastructure, sewerage system along with water supply system needs to supervise carefully for any outflow or damage, there should be a strict check on quality and price assurance of bottled water.

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