J. Environ. Sci. & Natural Resources,10(2):1–10, 2017 ISSN 1999-7361

Opportunities and Challenges for Promoting Sustainable Water Services to the Urban Poor in Dhaka City

S. Roy*[1] and S. Dutta[2]

[1]Department of Environmental Science and Resource Management, Mawlana Bhashani Science and Technology University, Tangail-1902

[2]Department of Occupational and Environmental Health, Bangladesh University of Health Sciences, 125/1 Darus salam, Mirpur-1, Dhaka-1216

*Corresponding author: shimul.roy84@gmail.com

Abstract

Dhaka is one of the densely populated megacities in developing countries with rapidly growing urban population. A significant portion of Dhakaôs population lives in informal settlements and is truly deprived of adequate water services. The study was intended to explore obstacles behind promoting sustainable water services to urban poor in Dhaka city as well as to find out opportunities in this regard. A questionnaire survey was conducted amongthe officials of 3 government organizations and 3 non-governmental organizations. In Dhaka city, water services provided by the Dhaka Water Supply and Sewerage Authority is largely groundwater dependent, and a small amount of supplied water comes from surface water sources. The study revealed that compare to rising water demands, supply is absolutely unsatisfactory to city dwellers mainly due to poor infrastructures, lack of sustainable planning and management practices, population pressure and financial constraints. The study showed that conjunctive use of surface water and rainwater, with limited extraction of ground water could be better way for providing sustainable water services to urban poor in Dhaka city. Moreover, effective coordination between government organizations & NGOs and incorporation of private sectors and local community in the service sectors can help to provide sustainable water services.

Key words: Dhaka city, Informal settlements, Population growth, Urban poor, Water service

Introduction

Water plays the most significant role for human existence on earth, and it is related to all kinds of development activities as well as sustainable development aspects. Massoud *et al.* (2010) asserted that water is a vital limited resource for human existence and availability of adequate and safe water connects strongly with sustainable development concept. Dhaka is one of the fastest growing megacities around the developing world where urban population is increasing rapidly (Rana, 2010) and most of the growing population takes place in the informal urban settlements such as slums and squatter settlements (Akbar, 2007). As a result, water demand is increasing rapidly which becoming a challenging task for the concern authorities in terms of providing adequate water supply services to meet the over-growing demands (Rana, 2010).

In Bangladesh, as urban population is increasing rapidly, but speed of basic services such as water supply, sanitation, electricity, waste management etc. are not functioning satisfactorily (Rana, 2010). Although basic utility services are very essential for city dwellers in their everyday life, services provided to them seen to be inadequate and not satisfactory at all. Moinuddin (2010) has stated that basic urban services in Dhaka city are very poor and irregular in terms of supply. Moreover, inconsistent growth in the urban population has created severe pressure on existing infrastructure and services such as water supply, sanitation, solid-waste collection etc. (Khan and Siddique, 2000). Akbar (2007) asserted that in most of developing countries there observed a huge gap between water demand and supply in the low-income communities. The World Bank estimation shows that, in the developing countries only 18% of low income inhabitants have access to piped water supply (World Bank, 2000).

Dhaka Water Supply and Sewerage Authority (DWASA) is mainly responsible for providing water and sanitation services in Dhaka city (Haq, 2006). In Dhaka city, due to increasing water demand the DWASA is facing the difficulties to meet it. As a result, there exists a significant gap between supply and demand (DWASA, 2010). The present water demand is about 2180 million liters whereas the DWASA is producing 1990 million liters per day. Among 1990 million liters of supplied water 87% is extracted mainly from groundwater by 560 deep tube-wells and the rest of 13% comes from the 4 surface

water treatment plants (SWTP) situated in Dhaka (*Saidabad* and *Chandighat*) and *Narayanganj (Godnail)*where water of the river *Buriganga* and *Shitolakhya* are being treated (DWASA, 2010).

CBSG (2010) report showed that around 3.4 million slum people lives in the Dhaka Metropolitan Areas (DMA) and are seriously deprived from water and sanitation facilities. Although the DWASA is responsible for supplying the pipe-water in Dhaka city, the majority of people who live in the informal settlements such as slums or squatter settlements are not getting adequate supplied-water and many of them are totally deprived from it. As a result, to meet water demands these poor people have to rely on other sources like tube wells, nearby ponds or rivers, dug-wells or rainwater etc. otherwise they have to rely on the water venders. For example, 62.7% of the slum dwellers use municipal taps as source of their drinking water; 33.4% use tube-wells and 3.8% use other sources like rivers, ponds, lakes, and canals (Jinnah, 2007). Although the DWASA is trying hard to meet growing demands of this large number of population, but due to resource constraints of DWASA such as financial and human, their development activities or initiatives are being restricted (CBSG, 2010). As a result, DWSA is facing serious water supply shortage mainly due to the insufficient infrastructural facilities within the sector of water production, distribution and quality control.

Compared to population growth, the speed in service provisions in Dhaka is fairly inadequate and the city is facing numerous challenges and problems in almost all sectors of infrastructure such as water supply, sanitation, solid waste management, sewerage system and so on (Rana, 2010). However, existing infrastructural facilities in water supply and sanitation in Dhaka city are considered as inadequate due to poor governance and management practices, lack of coordination, corruption and lack of financial support. Rahman and Malik (2003) have stated that lack of coordination between local and central government in water supply and sanitation services indicates institutional failure toensuring adequate services. Hossain (2006) has mentioned that in the metropolitan areas of Dhaka city about 60% of the populations have the right to use piped water, 15% of them are served with indirect water supply and the rest of population relies on water from private wells and surface water. Objectives of the study wereto explore challenges for promoting sustainable water services to urban poor in Dhaka City and to find out roles of Government and service providers to overcome existing situation.

Materials and Methods

Study area

Geographically, Dhaka city is located in Bangladesh between 23°42' and 23°54' North latitudes and 90°20' and 90°28' East longitudes. The city is surrounded by the *Buriganga River* on the southern part, *Turag* on the western part, *Tongi khal* on the northern part and *Balu River* on the eastern part of the city (Banglapedia, 2006). With the total area of 360 km^2 (139 sq. mile), Dhaka city is now home of around 14.6 million people (Khatun and Amin, 2011).

Data collection

This study was conducted based on literature review and primary data collection through questionnaire survey among the high officials of relevant service oriented organizations in Dhaka City. To carry out the study primary data were attained fromDhaka Water Supply and Sewerage Authority (DWASA), Dhaka City Corporation (DCC), Department of Environment (DoE), DSK (*Dustha Sastha Kendra*), CUP (Coalition For the Urban Poor) and NGO-Forum Bangladesh. The foremost reason for applying the questionnaire survey among service providers was to explore the opportunities and obstacles for providing sustainable water services in Dhaka city. The questionnaire was formulated with both open-ended and close-ended questions, whereas use of open-ended questions were more frequent to attain more in-depth information from respondents by giving them freedom of answering questions or sharing their knowledge and thoughts, which is supported by Oppenheim, ñthe chief advantage of the open question is the freedom it gives to the respondentsò (Oppenheim, 2000). Secondary data were collected from different sources such as scientific articles, relevant journals and thesis papers, books, annual reports of DWASA, Dhaka City State of Environment reports, studies conducted by government and non-government organizations and from internet.

Sampling procedure

Methodology of the study focused on qualitative investigation where convenience sampling had been followed for qualitative survey part of the study. The inherent reason for choosing the convenience sampling was that convenience sampling is outstanding way of attaining preliminary information regarding some research questions quickly and reasonably (Berg, 2009). Moreover, convenience samples are more frequent and in fact are more prominent within the field of organization studies (Bryman, 2008). Respondents were taken from a total of 6 service-oriented organizations (3 government organizations such as DWASA, DCC and DoE and 3 NGOs such as

DSK, CUP and NGO-Forum Bangladesh), which was the ósampling frameô of the study and each of the organization represents the ósampling unitô of the study. A total of 27 respondents were taken from the selected organizations by using convenience sampling, which represent the sample size (n=27). Among 27 respondents from 6 selected organizations,15 respondents were taken from government organizations and 12 respondents were taken from NGOs.

Data analysis

For analysis of collected data Statistical Package for Social Science (SPSS) was used. Obtained data were coded for statistical analysis. Kothari (2004) has stated that in the stage of data analysis coding operation is usually done that helps to transform the categories of data into symbols, which may be tabulated and counted. After completion of coding operation, coded data was entered in the SPSS computer program whereas frequency and percentage was computed.

Results and Discussion

Status of water services to urban poor

The study identified similar responses from respondents of Government organizations (GOs) and NGOs regarding present status of water services to urban poor and which is unsatisfactory (Table 1). A similar result was observed in the study conducted by Khan and Siddique (2000), where they noted that compared to the demands urban poor are served with very little amount of water particularly in low-income communities in Dhaka city. The CBSG reportstated that about 30% of slum populations in Dhaka city now are in acute water crisis (CBSG, 2010).

However, regarding capability to meet growing water demands through present services, there were some differences in responses between respondents of GOs and NGOs. For instance, among 15 respondents of GOs, 73.3% mentioned that, it is not possible to meet growing water demands by present services while remainder of them stated that present services are able to meet growing water demands. On the other hand, none of the 12 respondents from NGOs believe that present services will be able to meet growing water demands (Table 1). For example, the report of CBSG (2010) identified that current water supply in Dhaka city is estimated to be about 30% below the demand level.

Table 1. Status of water services to the urban poor

Variable	Respondents from GOs (n=15)		Respondents from NGOs (n=12)	
	Frequency	Percent	Frequency	Percent
Present status of water services				
Satisfactory	-	-	-	-
Unsatisfactory	15	100	12	100
Highly unsatisfactory	-	-	-	-
Present services to meet water demands				
Able to meet water demands	4	26.7	-	-
Unable to meet water demands	11	73.3	12	100

The study also explored following inherent causes for getting inadequate water services by urban poor in Dhaka city:

- Lack of water treatment plants and water pump stations
- Unavailability of water sources and sinking groundwater aquifer level
- DWASAôs water connections do not reach in most slums
- Poor people get less priority to service providers
- Unsustainable planning and improper management
- Urban poor has no reservoir to reserve sufficient water
- Excessive growth of urban population
- Lack of electricity and technological support

Although DWASA is the key organization responsible for providing water services in Dhaka city, however, urban poor who live in slums or informal settlements are still suffering with serious water crisis. Only a few of them getting the services while a majority of them are deprived from water services of DWASA due to their improper planning in service sectors. For example, according to CBSG (2010), only 30% of the slum people are getting sufficient water services from DWASA. As a result, a major portion of them collect water from other sources like hand pump tube wells, dug-wells, untreated or poorly treated surface water such as nearby ponds or rivers or they have to rely on

the water vendors at high costs. Akbar (2007) asserted that water vending is a common scenario in informal settlements of Dhaka due to their very limited access in formal water supply systems. Moreover, due to lack of transparency or corruption among some of the officials in water service sector urban poor are highly deprived from adequate water services. For instance, Akbar (2007) have noted that some public water providerôs staff does not like to provide water to informal settlements because this would decrease their extra income through bribe.

Groundwater based water supply system: Present status of extraction and consequences

It is apparent from the study that water supply system in Dhaka city is mainly groundwater dependent and over extraction of groundwater is responsible for rapid lowering of water table, which leads to environmental degradation. As a consequence, if this trend of groundwater extraction is continued the city will face severe water crisis in near future. Zahur (2010) has mentioned that extraction of groundwater now exceeds the permissible level in Dhaka because every day 1300 million liters of water are extracted by DWASA, instead of recommended limit of 230 million liters/day. As a consequence, groundwater level in Dhaka is declining by 3 meters per year. However, based on current demands of over growing urban population it is impossible to meet water demands by using only groundwater. Haq (2006) affirmed that to meet present water demands in Dhaka, groundwater resources are not sufficient enough. Moreover, extraction rate in many parts of the city already exceeds sustainable level.

Challenges behind promoting sustainable water services

The respondents of government organizations and non-governmental organizations identified some common factors as main obstacles for promoting sustainable water services Dhaka city (Table 2). However, apart from the identified common factors, governmental organizations and NGOs also recognized some other factors independently (Table 2). Among the identified factors rapid growth in urban population, lack of infrastructural facilities and lack of sustainable planning are given to be prioritize. From urban development viewpoint, it can be said that excessive growth in urban population in Dhaka city is indicating negative impacts on its every development sector whereas to provide sustainable water service is the most crucial and challenging aspect to service providers. Moreover, compared to huge number of urban population infrastructural facilities are fairly inadequate in Dhaka, which makes it more difficult to provide sustainable water services to its inhabitants (Fig.1). For instance, Khan and Siddique (2000) has asserted that the size of the urban population, combined with limited financial resources, puts constraints on the development of adequate urban infrastructure, particularly water supply and sanitation.

Table 2. Challenges behind promoting sustainable water services

Factor	Responses from	
	GOs	NGOs
Poor infrastructure	✓	✓
Growing population	✓	✓
Lack of sustainable Planning	✓	✓
Lack of water sources	✓	✓
Scarcity of budget	✓	✓
Financial situation of urban poor		
Lack of management	✓	
Lack of electricity	✓	
Govt. Policy		✓

The study identified lack of coordination among government organizations, NGOs or private sectors in order to provide sustainable water services to urban poor in Dhaka city, which is considered as one of the main obstacles behind promoting sustainable water services (Fig.1). Although providing water services is a public sector responsibility but due to limited capacity or infrastructural facilities and resource constraints concern government bodies are failing to provide adequate services, which is recognized as another key obstacle behind providing sustainable water services in Dhaka city (Fig. 1).

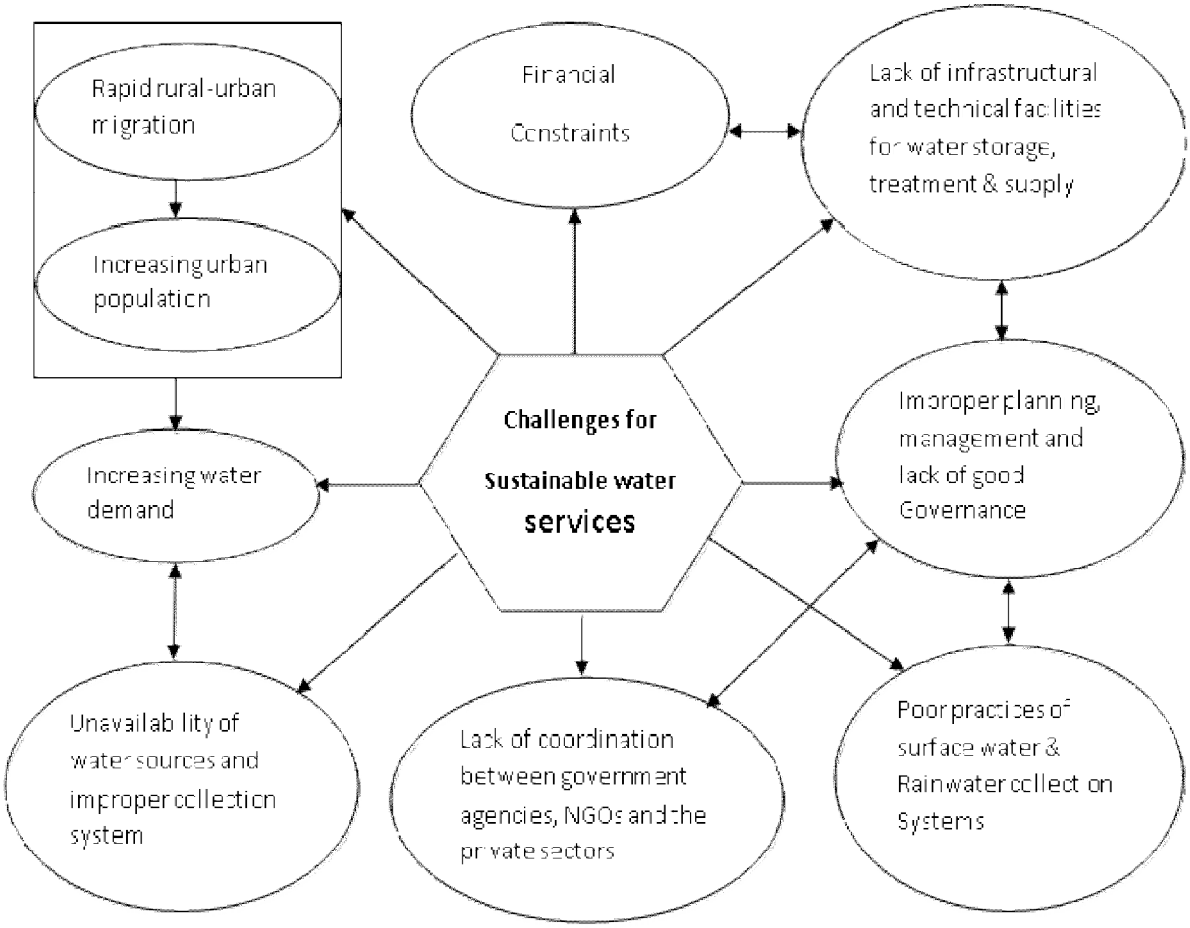

Fig.1. Challenges for providing Sustainable Water Services in Dhaka City.

Activities of individual organizations to start addressing obstacles and tasks to other organizations

The study had been explored some key aspects from both respondents of GOs and NGOs regarding their activities as an individual organization where respondents mentioned their respective organizationsô obstacles as well as probable solutions or initiatives in order to overcome existing situation. Apart from their own obstacles and solutions, respondents also suggest that there are some responsibilities of other organizations that could help to provide sustainable water services (Table 3).

Table 3. Activities of individual organizations to start addressing obstacles and tasks to other organizations

Organization	Organizationsô own activities		Tasks to other organizations
	Obstacles	Potential Solutions	
DWASA	Adequate plans or activities are not executed right now to ensure adequate water supply to the urban poor.	Authority is trying to find an alternative way in order to minimum extraction of groundwater	Dhaka City corporation and DESA (Dhaka Electric Supply Authority) have some works like land use planning, electricity supply etc. which are associated with water service system.
		DWASA is trying to make water available for all by increasing the number of deep tube-wells and by improving institutional capacity.	RAJUK (Capital Development Authority of Bangladesh), city corporation, LGED (Local Government Engineering Department) and DESA should increase their cooperation and take responsibility for installing water treatment plants and to provide proper electricity supply.
		DWASA is fighting hard to maintain the supply to all consumers including urban poor	
DoE		Ensure water recycling and ózero dischargeô from industries	Along with DWASA, some NGOsô are also working separately in water and sanitation sector in Dhaka.
CUP	Due to the lack of cooperation from the GOs, it is becoming difficult to ensure rights of urban poor.	Helping at the policy level coordination among NGOsô and GOs.	Water supply is being dealt by the DWASA mainly. Along with DWASA some NGOsô are working in this sector, but most of them are dealing with sanitation as the main focus.
DSK	Due to lack of formal approval from the government side it becomes difficult to execute proposed initiatives in slum areas.	DSK has been implementing õWATSAN projectô in Dhaka city to ensure the rights of the urban poor regarding safe and adequate water and sanitation.	NGOsô can work with DWASA in this sector to provide better services to the urban poor through developing effective coordination mechanism among DCC, DWASA, NGOs and local communities.

Conflicts/unclear areas of responsibility and water problems outside areas of responsibility

The study revealed that a majority of respondents of GOs and NGOs had identified following three aspects as conflicting factors or unclear areas of responsibility of concerned organizations:

- Lack of coordination between government organizations and NGOs
- Lack of coordination in between ministries, DWASA and DCC
- Roles of DCC and DWASA is not clear to ensure the water supply for the urban poor

The study showed a significant difference in responses between respondents of GOs and NGOs regarding the issue of ñwater problems that lie outside the areas of responsibilities of the concern organizations or authoritiesò. For instance, among 15 respondents of GOs, a majority of them (86.7%) mentioned that there are no water problems lie outside the areas of responsibility followed by only 13.3% stated that there exist water problems outside areas of responsibility. On the other hand, all of the respondents of NGOs have agreed regarding the issue that water problems exist outside the areas of responsibility (Fig. 2).

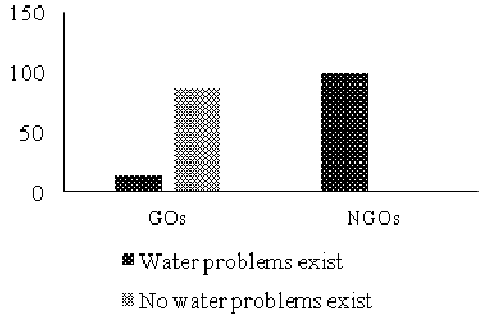

Fig. 2. Water problems outside the areas of water responsibility.

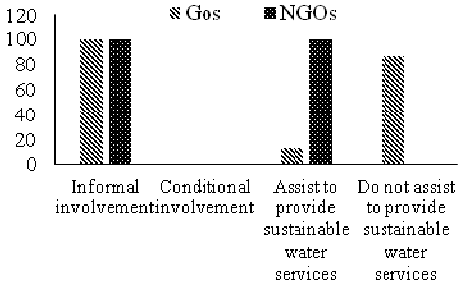

Fig. 3. Involvement of NGOs in the service System.

Coordination gap regarding changes in consumer behavior to water uses

This study also found a huge gap in coordination practices among government and non-government organizations, which ultimately hindering the opportunities to provide adequate water services to urban poor in Dhaka city. For example, result revealed that some of NGOs are involved in water service sectors whereas their status of involvement is regarded as óinformal involvementô (Fig. 3). For providing better water services, NGOs or private sectors are trying to take some initiatives individually but due to lack of formal approval from government side these become postponed (Table 3). Moreover, most of the government officials do not think that integration of NGOs in the service sector can help to provide sustainable water service to the urban poor (Fig. 3). Therefore, it can be said that, without ensuring a better coordination in every sector of water supply such as electricity supply, water collection, treatment & distribution, maintenance of water reservoirs & pipelines etc. it is not possible to provide sustainable water services to urban poor.

Prospects for promoting sustainable water services

The study identified different key factors that could bring the opportunities to promote sustainable water services to the urban poor in Dhaka city. It revealed from respondentsô responses during the study that to overcome existing situation in water services and to meet the deficit in water supply, groundwater based distribution would not be a sustainable solution. Instead of groundwater based supply, treated river water or lake water and rainwater harvesting could be the appropriate strategy that meets the growing water demands. Besides, establishment of more surface water treatment plants can contribute to provide sustainable water services. Regarding involvement of local community in the water service systems some of respondents of the governmental organizations gave their positive views but not all of them, while every respondent of NGOs mentioned that the involvement of local community in utility systems can play a vital role to improve ongoing situations. However, apart from the common factors identified by respondents of governmental organizations and NGOs, some other key factors had been identified from respondents of individual organizations during the survey (Table 4). The following table shows identified factors and respondentôs responses for each of the factors.

Table 4. Prospects for promoting sustainable water services

Factor	Responses from	
	GOs	NGOs
River/lake water treatment	✓	✓
Rainwater harvesting	✓	✓
Infrastructural development for water storage and supply	✓	
Establishment of moresurface water treatment plants	✓	✓
Community involvement in service systems	✓	✓
Involvement of NGOs in formal water service system		✓

Surface water collection system: Opportunities and existing practices

To meet growing water demands by large number of urban poor in Dhaka city there needs to initiate surface water collection system as an alternative approach of water services, which is clearly identified in this study as one of the key opportunities to provide sustainable water service. In Dhaka city available sources of surface water are the 4 main rivers (*Buriganga, Balu, Turag and Shitalakhya*) that surround the city but these are becoming polluted due to untreated or poorly treated industrial effluents which affecting the human health and environment. For instance, the Dhaka City State of Environment Report (2005) showed that these 4 main rivers are receiving enormous industrial and municipal wastes and therefore, water quality of those rivers is now beyond its standard limit to use.

So to reduce pressure on groundwater and to use surface water effectively, there is no alternative to establish adequate number of surface water treatment plants (SWTPs) in Dhaka city, which is recognized as one of the key opportunities to provide sustainable water services in Dhaka city in this study (Fig. 4). However, a little progress has been observed towards use of treated surface water through establishment ó*Sayedabad water treatment plant'* which reduces groundwater extraction rate. For example, in one study Rana (2010) affirmed that out of the total supply of water by DWASA, previously 97% came from the deep tube-wells and remaining were from the surface water while, 15% of supplied water is now collected from surface water sources after establishment of the *'Sayedabad water treatment plant'*. However, urgent initiatives are required from the government side to meet existing gap between demand and supply and to improve service efficiency. The annual report of DWASA provides a good example regarding initiative taken by the government to provide better water services in Dhaka city. For example, installation initiative of ó Sayedabad water treatment plant-phase IIô was adopted by the government through which it will be possible to provide 225 million liters of water per day (DWASA 2010).

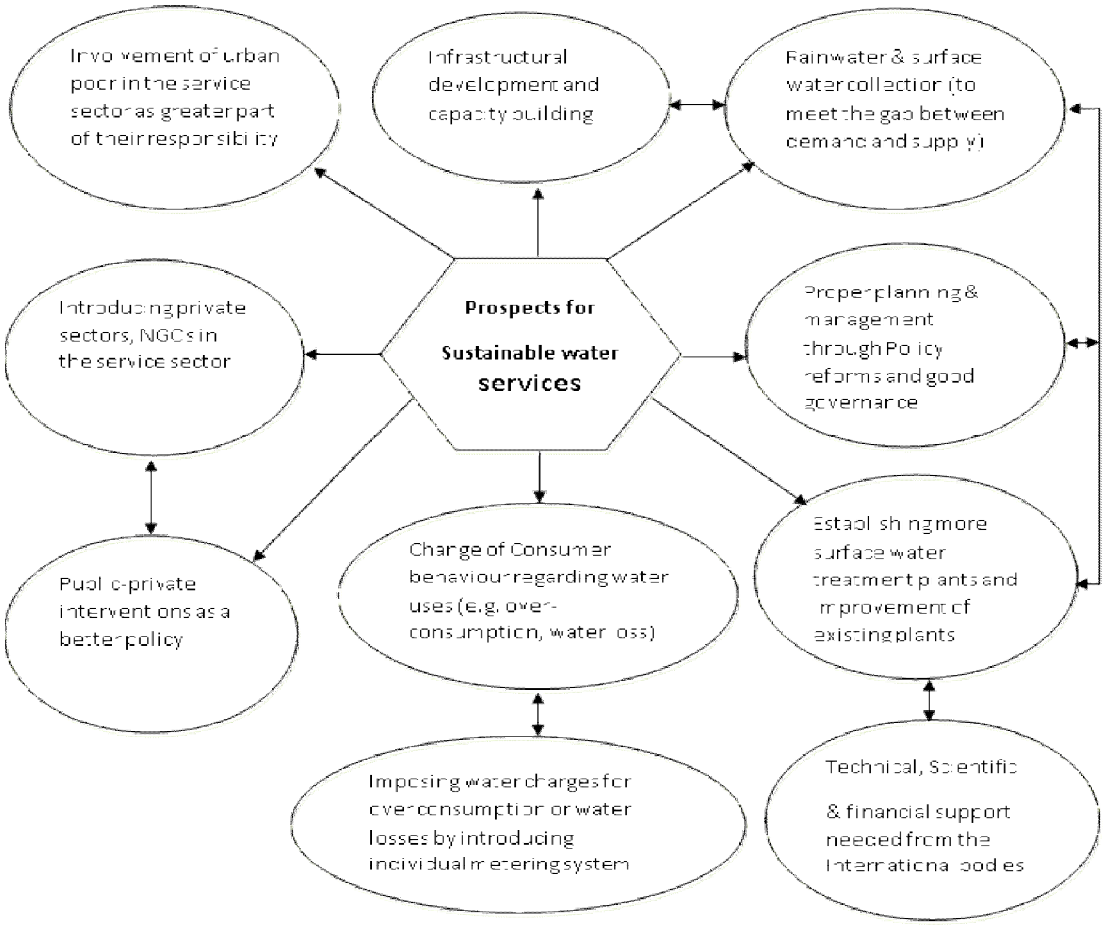

Fig. 4. Prospects for providing sustainable water services in Dhaka City.

Rainwater harvesting as the key opportunity to provide sustainable water services and role of government & DWASA

Apart from surface water collection, rainwater harvesting would become another alternative option that can contribute to provide sustainable water services to urban poor in Dhaka city (Fig. 4). This is because Dhaka city is subjected to heavy rainfall during rainy season and if it can be stored properly then it can reduce the water scarcity in the city. Islam et al. (2010) stated that the average rainfall in Dhaka city is around 2,098mm per year and if this water can be collected properly during monsoon period then it is possible to meet the cityôs water demand. To overcome water crisis in Dhaka city some initiatives have been taken already by concern authorities. For example, according to Haq (2006), in 2002, as an initial effort to collect rainwater, DWASA has used their administrative buildingôs rooftops and outcome was satisfactory. This is because through collected 11.5 million liters of rainwater they became able to meet their buildingôs water demand significantly. After this initial attempt, they have initiated the óDWASAôs Roof top Rainwater Harvesting Projectô where buildings of government, semi-government and autonomous offices were taken to collect the rainwater. So if more buildings of different government and non-government offices, buildings of educational institutions and commercial and residential areas are included within this project then it would be a great initiative through which a significant volume of rainwater could be harvested that can contribute to provide sustainable water services.

However, depending on adequacy of rainwater currently rainwater harvesting is being practiced by some residents of the city to meet their water demands but due to population density, congested and unplanned housing conditions it becoming complicated for the city dwellers to collect rainwater properly. So there needs some appropriate strategies from government side such as renovation of existing buildings and its rooftops, enforcement of new rules for establishment of new buildings etc. so that rainwater could be harvested and stored effectively. According to Islam et al. (2010), currently government is implementing new rules where each new building has to be designed with rainwater harvesting system, which is a positive sign towards use of alternative water sources.

Importance of NGOs, private sectors and local community in water service sector

The study revealed that involvement of NGOs in formal water services could be a good practice for promoting sustainable water services in Dhaka city. For example, as a non-governmental organization DSK has been working in some slum areas of Dhaka city to ensure water service to urban poor where they are acting as the ñintermediaryò between slum communities and the DWASA without the formal approval of DWASA. According to CBSG (2010), although activities of DSK is supported by DWASA, but no formal program has been taken from their side in cooperation with the DSK to ensure water services in slums. Usually, projects are initiated by the NGOs and DWASA approved it on a temporary basis. So it can be said that in order to provide sustainable water services, better cooperation is essential. Incorporation of private sectors and local community can play a vital role towards improving the service efficiency and to provide sustainable water services. Khan and Siddique (2000) stated that participation of private sectors in water service system can reduce shortage in water supply and improve service value to customers, and their effective participation is not only considered as a source of new investment but also provide management expertise and technologies. Rana (2010) asserted that to ensure better services, local community involvement in service sector could be a better strategy, through which urban poor of the society or people deprived from adequate services can get the opportunity to lift up their demands.

Conclusions

As a home of gigantic amount of urban population, Dhaka city is now facing numerous challenges in its every development sector, where water service is one of the prominent sectors. Although it is the ultimate responsibility of the government to provide or ensure adequate water services to its citizens, however, a large number of the urban poor who live in the slums or informal settlements are still out of the governmentôs formal water service systems. To overcome the existing situations this study suggests that conjunctive use of surface water (e.g. treated river water) and rainwater, with the limited extraction of ground water could be better way for providing sustainable water services in Dhaka city. This study also recommends that effective coordination between government organizations & NGOs and incorporation of private sectors and local community in service sectors can also help to provide sustainable water services. Moreover, technological and financial support is also needed to improve the existing service efficiency and to install new water service infrastructures (e.g. surface water treatment plants). Finally, it can be said that by taking suggested initiatives urgently it is possible to promote sustainable water services in Dhaka city, which could also be a good example for concerned authorities of

other megacities in South Asian countries to promote sustainable water services.

References

Akbar E. A. 2007. Community water supply for the urban poor in developing countries: The case of Dhaka, Bangladesh. *Habitat International*, pp. 24ï 35.

Banglapedia 2006. TheNational Encyclopedia of Bangladesh.[Available online at]: http://www.banglapedia.org/httpdocs/HT/D_0147.HTM.

Berg, B. L. 2009. Qualitative research methods for the social sciences. Pearson International Edition.

Bryman, A. 2008. Social Research Methods. Oxford University Press.

CBSG (Capacity Building Service Group) 2010. Ensuring Services to Slum Dwellers. Dhaka WASA Organization for Low Income and Slum Community Water Service Delivery. Water and Sanitation for Urban Poor (WSUP). London, UK. pp. 1-49.

Dhaka City State of Environment Report 2005. Department of Environment, Ministry of Environment and Forest, Government of the Peopleôs Republic of Bangladesh. [Available online at]:http://www.rrcap.unep.org/reports/soe/dhaka-soe-05/2-1dhaka-Introduction.pdf.

DWASA 2010. Annual Report 2009-2010. Dhaka Water Supply and Sewerage Authority.

Haq, K. A. 2006. Water Management in Dhaka. *Water Resources Development,* 22(2), 291ï 311.

Hossain, S. 2006. Social characteristics of a megacity: a case of Dhaka City, Bangladesh. TASA Conference 2006, University of Western Australia and Murdoch University. pp.1-9.

Islam M. M., Chou, F. N. F., Kabir, M. R. and Liaw, C.H. 2010. Rainwater: A Potential Alternative Source for Scarce Safe Drinking and Arsenic Contaminated Water in Bangladesh. *Water Resource Management,* pp. 3987ï 4008.

Jinnah, A.I.S. 2007. Rights of Water Connections for Urban Slum Dwellers in Bangladesh: A study on DSKôs experience in three slums of Mirpur, Dhaka. Advancing Sustainable Environmental Health (ASEH). Water Aid, Bangladesh. pp.1-8.

Khan, H.R and Siddique, Q.I. 2000. Urban Water Management Problems in DevelopingCountries with Particular Reference to Bangladesh. *Water Resources Development*, 16(1),21ï 33.

Khatun, A. and Amin, M. R. 2011. Greywater reuse: a sustainable solution for water crisis in Dhaka, Bangladesh. 4th Annual Paper Meet and 1st Civil Engineering Congress, Dhaka. Noor, Amin, Bhuiyan, Chowdhury and Kakoli (eds). pp. 427-434.

Kothari, C. R. 2004. Research Methodology: Methods & Techniques. 2nd edition. New Age International (P) Ltd. New Delhi, India.

Massoud, A., Al-Abady, A., Jurdi, M. and Nuwayhid, I. 2010. The Challenges of Sustainable Access to Safe Drinking Water in Rural Areas of Developing Countries: Case of Zawtar El-Charkieh, Southern Lebanon. International perspectives. *Journal of Environmental Health,*pp. 24-30.

Moinuddin, G. 2010. Metropolitan Government and Improvement Potentials of Urban Basic Services Governance in Dhaka city, Bangladesh: Rhetoric or Reality? *Theoretical and Empirical Researches in Urban Management,*5(14),59-81.

Oppenheim, A.N. 2000. Questionnaire design, interviewing and attitude measurement. Continuum. London and New York.

Rahman, G. and Mallik, B. 2003. Analysis of disparity in water and sanitation services: A comparative study of Dhaka, Chittagong, Khulna, and Rajshahi cities in Bangladesh. Water and Sanitation for Cities. Dhaka: BIP and CUS.

Rana, M.M.P. 2010. Urbanization and sustainability: challenges and strategies for sustainable urban development in Bangladesh. *Environ Dev Sustain.* pp. 237ï 256.

World Bank 2000. Entering the 21st Century, World Development Report 1999-2000, New York, Oxford University Press (published for the World Bank).

Zahur, A.B.M.S. 2010. Overcoming Water Crisis. *The Daily Star*.[Available online at]:http://www.thedailystar.net/newDesign/news-details.php?nid=135589.