DWASA Water Supply Master Plan for Dhaka City

EXECUTIVE SUMMARY

Background

This project has been undertaken by Dhaka Water Supply and Sewerage Authority (DWASA) to prepare the Water Supply Master Plan for Dhaka City. The project was awarded to the Joint Venture of Institute of Water Modelling (IWM) and DevConsultants Limited (DevCon). The goal of the project according to the ToR is to prepare a Master Plan, to indentify priority investment projects and to recommend an appropriate institutional framework.

Socio-Economic Situation of the Master Plan Area

The last national census was undertaken in 2011 and includes data on a number of socio-economic characteristics of Dhaka City. In order to obtain a more up-to-date assessment of the socio-economic situation, a sampling programme was implemented covering a range of issues. In total 907 households were surveyed in December 2012. The questionnaire covered different points of investigation, including basic information about households (education, occupation, income, *etc*), water supply status, attitudes and perceptions.

In the Master Plan survey, it was found that average family size was 4.9 and a typical building has about 7 families. The most common household income bracket was 10,001 to 20,000 Tk/month/HH bracket with 31% respondents. About 23% of respondents had household incomes less than or equal to 10,000 Tk/month/HH. Approximately 4% of respondents reported monthly household income in excess of 1 lac Tk/month/HH. The distribution of education levels of household heads were: illiterate (11%), Class 1-5 completion (12%), Class 6-10 completion (18%), SSC completion (10%), HSC completion (11%), university graduates (32%) and others (6%). The distribution of structure types surveyed were 42% paka (including 1-storied, 2-6 storied and high rise); 39% semi-paka and 19% kacha/jhupri (tin shed). The most common occupations of household heads were occupational worker/technician (24%) and others (26%). A significant proportion of household heads were retirees (13%). Also, a significant proportion of respondents stated that the household head occupation was in business (11%). 64% of respondents lived in their own homes. The most common house size was less than or equal to 600 sqft (32% of respondents). House sizes of 601-1,000 sqft and 1,001-1,500 sqft were also quite common (22% and 21%, respectively). House sizes of 1,501-2,000 sqft was also significant (11%).

Overall, there is good public support for DWASA as almost 80% of respondents stated that they would accept water supplied by DWASA through alternative means. Approximately 90% of households surveyed had a metered DWASA connection. About 30% of respondents stated that they receive insufficient water supply. The proportion of households facing water supply problems varied from 38% (in Nov to Apr period), to 25% (in May to Jun period) to 14% in (Jul to Oct period). Overall, 32% of respondents use suction pumps and 45% have underground storage reservoirs. About 56% of respondents stated at least one water quality problem.

Existing Water Services Situation

Water Sources

The existing water services heavily relies on groundwater with about 78% of water produced by DWASA currently sourced from aquifers. However, this needs to be further reduced to stop the continuous decline of the water table. Over the years, the number of DWASA deep tube-wells (DTW) has increased to nearly 633 across the city. The upper well casing length of DTWs is increasing to keep pace with the lowering static water table. Furthermore, due to disturbances in the aquifer and clogging of DTWs due to over extraction, the DTWs yields are decreasing resulting in short operational life of about two to three years. As a result, about 40 to 60 DTWs are replaced each year. The recurring maintenance and replacement costs add up to a significant number. In addition, synchronizing the operation of so many DTWs is a significant management challenge. On an average, at least 15 to 20 DTWs are out of operation on a daily basis due to mechanical and electrical failures. Considering the existing groundwater situation, DWASA is making a strategic effort to build more surface water treatment plants (SWTPs). Currently, there are 4 SWTPs in operation. Sonakanda SWTP is currently being rehabilitated and the new plant will have 12 MLD capacity. Godnail SWTP is currently producing 18 MLD but after renovation works it will have 45 MLD treatment capacity. Chandnighat SWTP has a capacity of 39 MLD after renovation works but produces 13 MLD on an average during dry seasons due to low water levels in Buriganga River. Even the treated water at the plant cannot meet the WHO and Bangladesh standards due to poor intake water quality. In fact, all four SWTPs suffer this problem from time to time. Of the existing 4 plants, Saidabad SWTP Phase-I plant is the largest and it has been operating since late 1990s, while Phase-II plant became operational in December 2012. Currently Saidabad SWTP Phase-I and Phase-II is providing 450 MLD. Due to the deteriorating raw water quality of Sitalakhya River, DWASA is also working on supplying water from the major rivers: Padma and Meghna.

Transmission Mains

The existing Saidabad Phase-I transmission main is operating at desired performance level without any major disruption. The additional 225 MLD water from Saidabad Phase-II SWTP unit is transmitted through the Phase-I mains and also through 9.6 km of new mains. Godnail and Sonakanda SWTP Transmission Main is currently undergoing rehabilitation (35 km) and 60 km new mains of diameter 150 mm to 800 mm are being constructed. New primary and secondary distribution mains for the proposed SWTPs will also be required.

Distribution System

The distribution network suffers from lack of proper planning, ageing fixtures, poor materials and poor workmanship. The system also suffers from illegal connections and pilferage. The District Metered Area (DMA) program plans to rehabilitate and replace the existing distribution network. DMA is designed to be a 24 hr pressurized system that will source water from local DTWs and SWTPs i.e. conjunctive usage. However, given the uncertainty associated with DTW supply due to mechanical and electrical failure of DTWs; the 24 hr continuous pressure condition in the network will be a challenging proposition to realize in a conjunctive usage scenario. DWASA should be mindful that unless and until the DTWs are sustainable and network is pressurized, previous practices of suction pump usage, illegal connections will reappear and plague the network. The risk of DMAs failing is being reduced by increasing SWTP supply to the distribution network.

Laboratory Facilities

Analyses of the existing situation at DWASA's two laboratories (at Asad Gate and at Saidabad SWTP) have identified some issues. Both labs require an inventory management system. Laboratory activities like water quality test, quality control, research, etc. should be performed efficiently with proper equipments. The entire premises of Asad Gate laboratory should be put to use for laboratory purpose only. It is recommended that simple Laboratory Information Management System (LIMS) software be used, whereby all data will be documented properly for present and future actions of good water management.

Non-revenue Water

The DMA initiative by DWASA will replace and rehabilitate the existing distribution network and aims at reducing NRW from 30% to 15%.As per its definition, the DMA will be extensively metered to monitor the network status. However, if leakage monitoring and control is not properly implemented, the 24 hr pressurized system may incur significant NRW through new leakages.

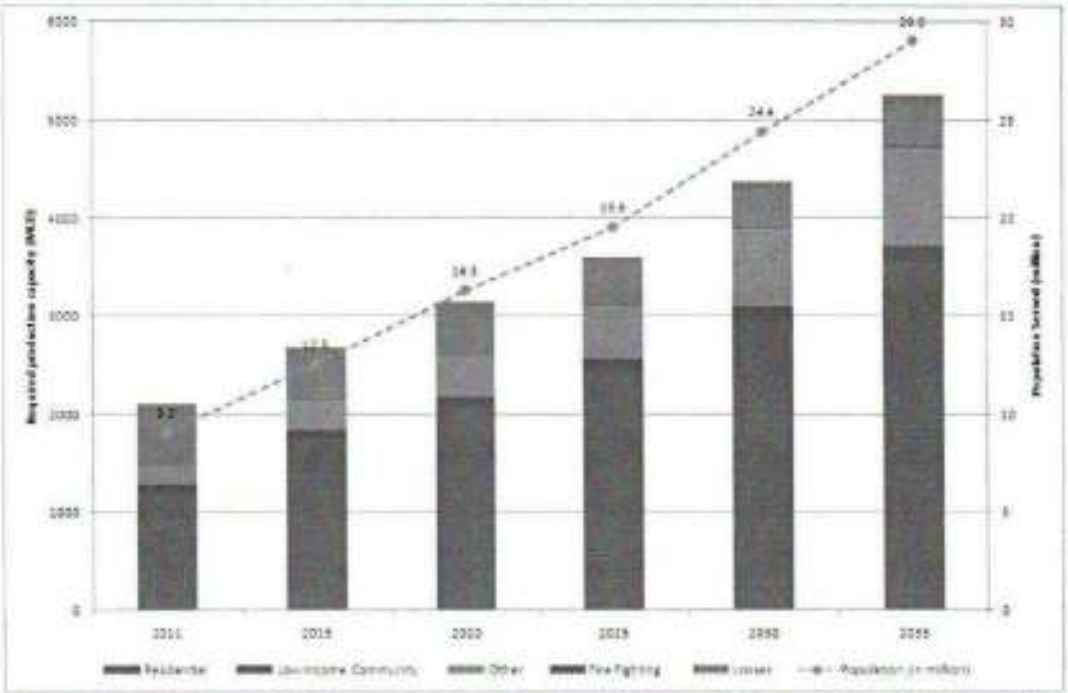
Institutional Analyses

The institutional analyses covered departmental setup; internal functions; links with external organizations; role of unions; regulatory framework; outsourcing; and other important considerations. DWASA was created by gazette Notification in 1963. Currently, it is an autonomous body according to DWASA Act 1996 with its own board and Managing Director (MD). DWASA organizational structure is vertical in nature. This is a common organizational culture of public establishments in Bangladesh. This creates communication difficulties.

DWASA is obviously understaffed with 29% vacancy of approved positions. Vacancies in Class III and Class IV grades causes overtime payments at double the hourly pay. Overtime payments constitute at least 29-34% of the total administrative expenses. Contractual hire or secondment to fill the permanent positions has also contributed to high administrative costs. Recruitment for most posts is conducted through public announcement. Promotion to chief positions or management posts other than the four top posts is generally handled through in-house promotion. Investment in training and development division is limited. Officers appointed to the post of Chief Training Officer (CTO) and lower posts should be encouraged and motivated with additional benefits. DWASA should invest in developing a comprehensive training and development program.

Demand Assessment and Required Production Capacity

Water demand for the future has been estimated for domestic, low income community, fire fighting and other uses. The main basis of estimating the demand is population projection for the time under consideration. Figure 1 gives an overview of demand projection for various uses. The total production capacity, however, considers physical losses (leakage) from the transmission and distribution pipelines and appurtenances. The demand scenario presented considers implementation of an effective demand management strategy. The strategy consists of introduction of a 3-tier increasing block tariff (IBT) structure as soon as possible and an advocacy of the adoption of water efficient gadgets.



DWASA Service Coverage (sq km)	401	401	496	496	617	617
Year	2011	2015	2020	2025	2030	2035
Demand (MLD)						
Residential	1,186	1,737	2,055	2,429	2,954	3,546
Low Income Community	98	102	114	125	154	174
Other	192	294	434	562	777	1,004
Fire Fighting	0	11	13	14	16	17
Total demand (MLD)	1,476	2,144	2,616	3,130	3,901	4,741
Losses	632	536	536	468	482	527
Total required production capacity (MLD)	2,108	2,680	3,152	3,598	4,383	5,268

Figure 1: Water Demand and Required Production Capacity for Dhaka Master Plan Area

It has been planned that DWASA will expand its service area from the present 401 sqkm to 617 sqkm in 2035, covering its entire jurisdiction and some additional areas. As a result of increase in domestic, industrial, commercial and other uses in the expanded service area of DWASA, the total demand will rise from 1,476 MLD in 2011 to 4,741 MLD in 2035. If we consider that leakage from the system will be reduced from the present level of 30% to 10% of the total supply in 2035, the total required production capacity will increase from the 2,108 MLD in 2011 to 5,268 MLD in 2035. This is an increase of 2.5 times. However, during the same period, population increase will be 3.2 times and service area increase will be 1.5 times.

For the period 2035 to 2060, the likely scenario is that there will be approximately 50% growth in demand. As a result, an additional 2,650 MLD production capacity will be required by 2060. It is expected that in future reviews and updates of the Water Supply Master Plan the long-term demand will be considered in more detail in light of the development of Dhaka City.

Resource Assessment

There are around 650 DTWs withdrawing water from the upper and lower aquifers of Dhaka city. Every year the groundwater level is depleting at a rate of 2-3m in the upper dupitila aquifer. Therefore, water supply from the groundwater aquifers is not sustainable in the long-term. Identification and utilization of alternative groundwater sources is very important to meet the water demand of Dhaka City. A project is being carried out by DWASA which will bring 300 MLD of groundwater in two phases from a well field in Savar and Singair Upazilla.

The most critical period of the year is March in terms of water availability and water quality for the surface water sources. Therefore assessment of water availability was made based on historical simulated data from March. It was found that withdrawal for water supply from the peripheral rivers would not result in any major change in water depth. But the water quality is progressively declining due to increase in pollution load from various domestic and industrial sources. The situation would further deteriorate if no pollution control measures are implemented. Therefore, the peripheral rivers of Dhaka city are considered vulnerable as water supply sources .

Water availability analysis in the major rivers of the country show that they have significant flow available. The water quality of these rivers is also acceptable. The feasibility studies of the Gandharbapur SWTP and Saidabad Phase-III found abstraction of 2,525 MLD water is viable from Meghna River. The feasibility studies of Jashaldia SWTP found abstraction of 900 MLD is viable from Padma River. These sources have been found to be technically and economically feasible in the long-term for Dhaka City. Additional analysis has been done for resource assessment periods 2035 to 2060. It is recommended that the Padma River should be utilized as a long-term source. Protection from pollution is required if peripheral rivers are to be considered for future supply.

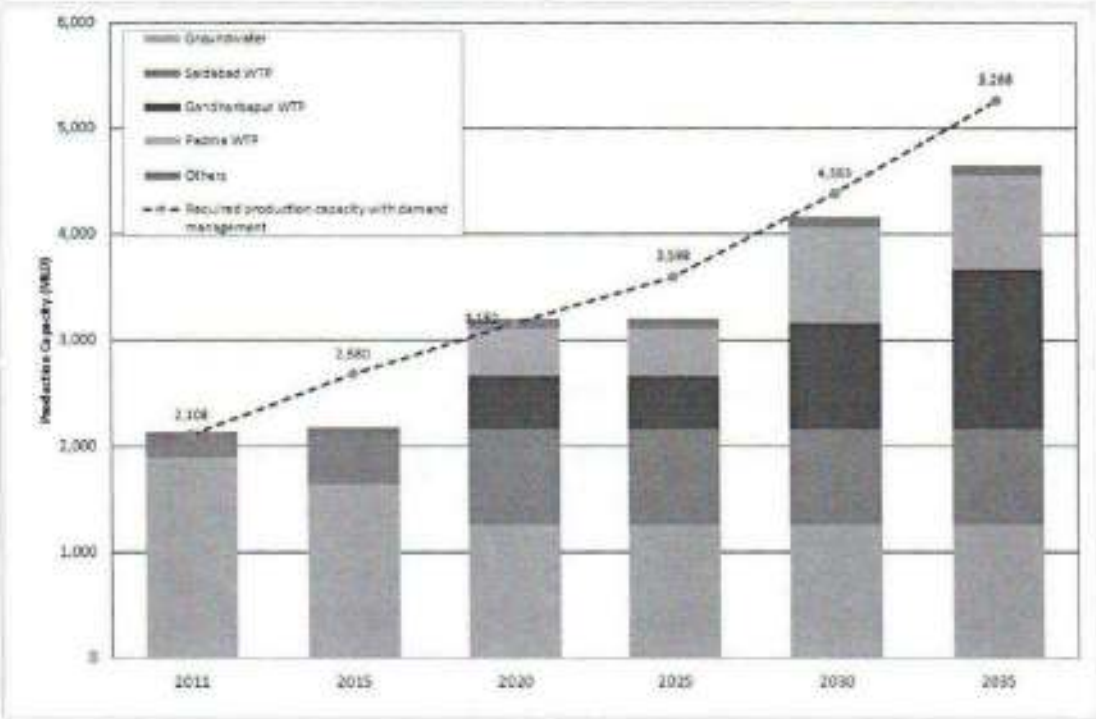
Strategy for Water Supply Master Plan

A set of guiding principles were discussed with stakeholders to get their feedback. The strategic priorities included several items. For institutional framework it is proposed that the capacity of the organization be increased in order to manage future requirements of DWASA. Strategy regarding planning focuses on improving coordination between stakeholders, efficient management of assets and human resources. Strategy for infrastructure development proposes reduction of groundwater use; protection of water supply sources; ensure pressurized water supply distribution and identification of future urban expansion areas. In addition to improving overall efficiency of O&M, the strategy proposes steps to reduce non-revenue water and power consumption. Implementing the recommended strategy for efficient water utilization and promotion of water use conservation is important for demand management in Dhaka City. To increase the revenue needs, revenue opportunities need to be expanded and collection efforts need to be improved.

Future Sources of Supply

Assessment of demand shows that the required production capacity by the year 2035 the total demand is expected to rise to 5,268 MLD in the 617 sqkm of DWASA jurisdiction area. To meet the demand, options for DWASA are limited to harnessing the water resources of Meghna and Padma rivers. Resource assessment study (IWM, 2006) showed that sufficient water of adequate quality is available in these two rivers. The two feasibility studies conducted for the Padma (Jashaldia) and Meghna (Gandharbapur) WTP also shows that these two plants are technically, socially and

economically viable. Preliminary assessment made in the feasibility study of Saidabad WTP Phase III shows that, Meghna River could also be a source for the three phases of the Saidabad WTP planned to produce 900 MLD in total. Therefore, total supply from the Padma and Meghna could be planned for 900 MLD and 2,400 MLD respectively by the year 2035. Figure 2 shows different levels of deficit through the planning horizon up to 2035, except for the year 2020.



Year	2011	2015	2020	2025	2030	2035
Required Production (MLD)	**2,108**	**2,680**	**3,152**	**3,598**	**4,383**	**5,268**
From GW sources (MLD)	1,900	1,640	1,260	1,260	1,260	1,260
Godnail, Sonakanda & Chandnighat	10	96	96	96	96	96
Saidabad I	225	225	225	225	225	225
Saidabad II		225	225	225	225	225
Saidabad III			450	450	450	450
Gandharbapur I			500	500	500	500
Gandharbapur II					500	500
Padma (Jashaldia) I			450	450	450	450
Padma (Jashaldia) II					450	450
Gandharbapur III						500
From SW sources (MLD)	**235**	**546**	**1,946**	**1,946**	**2,896**	**3,396**
Total Production (SW + GW) (MLD)	**2,135**	**2,186**	**3,206**	**3,206**	**4,156**	**4,656**
Surplus or Deficit (MLD)	**27**	**-494**	**54**	**-392**	**-227**	**-612**

Figure 2: Future Sources of Supply for Short-term and Medium-term Plan

The allowable limit of groundwater abstraction from the upper dupitila aquifer is around 1,640 MLD, which also includes Singair and Tetuljhara-Bhakurta groundwater well fields. The lower dupitila

aquifer is considered not dependable. Therefore, DWASA will have to rely only on the groundwater resource of upper dupitila aquifer only. It is recommended that around 75% of the resource in the upper dupitila aquifer is harnessed for water supply to Dhaka Master Plan Area. Rest of the extractable groundwater resource should be reserved for any future uncertainties, which might arise due to increase of demand or delay in commissioning of large bulk surface water supply sources. Around 96 MLD will be available by rehabilitation and expansion of the Chandighat WW, Godnail WTP and Sonakanda WTP.

For the period 2035 to 2060, the possible cost effective sources of water could be the Lakhya and Buriganga Rivers (if their conditions improve). However, the Padma River is also a reliable source. It is expected that in future reviews and updates of the Water Supply Master Plan the identified supply sources will be considered in more detail. Though identifying projects this far into the future is difficult, it helps in the identification of potential land purchases, right of way and integration with other sectoral plans.

Sectorization

One of the key components of the water supply strategy is dividing the service area into sectors based on main sources of supply and connected primary mains. Each sector will have a dedicated and independent major source and primary main to transmit treated water to localities within the sector. The criteria that were used to delineate a sector are as follows:

a) The maximum contiguous area where the incident demand can be adequately served by production capacity of the source.
b) The area up to which the primary main can provide water to secondary mains, distribution systems at a minimum 1 bar pressure (based on preliminary hydraulic modeling).
c) Existing and proposed DMA boundaries.

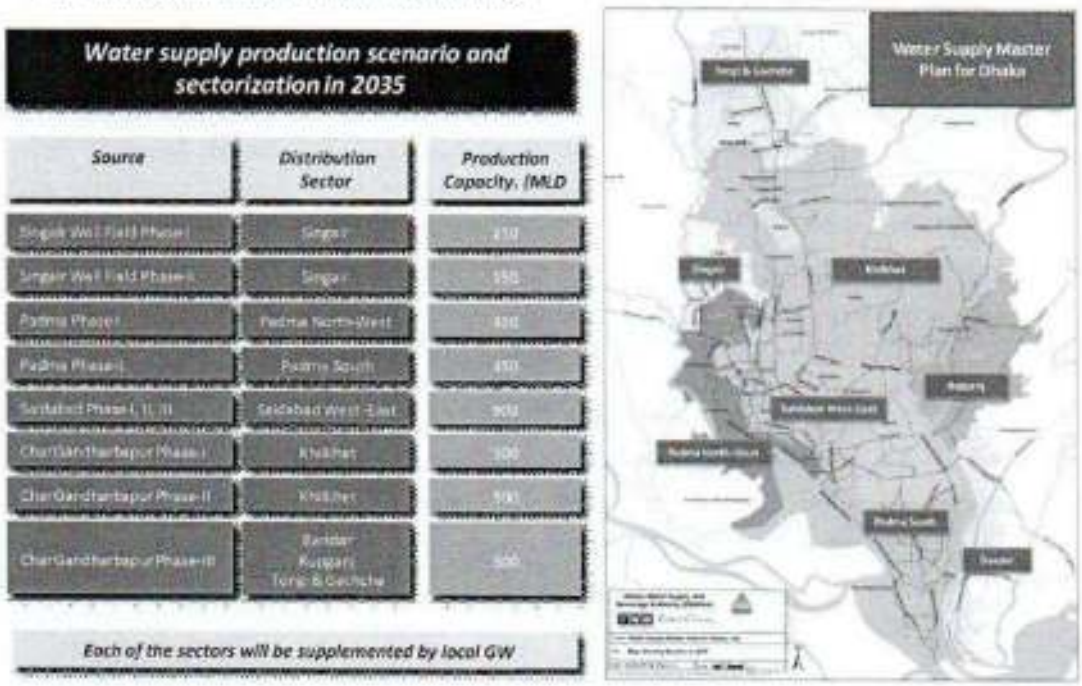


Figure 3: DWASA Sectorization of Service Area by 2035

Based on the available major sources of supply, the ongoing and proposed projects in near future, the entire DWASA service area is divided into eight sectors. Figure 3 describes them in elaborate detail.

Future Transmission and Distribution

The surface water distribution system is based on water from the 650 DTWs of the City. Only major source of supply is the Saidabad SWTP. As result, the distribution system lacks larger pipes to transmit water from one part of the City to another. As new plants will be constructed to meet the future demand, primary distribution lines will be required to transmit the water from the different sources. Each sector has a plant which will be built in phases. The primary transmission main will have to be built in each sector to transmit the water from the plants. Secondary and tertiary distribution lines will be required to distribute water to the customer end. DWASA has taken up DWSSDP project which is establishing DMAs for the distribution system. DMA is essential to ensure a minimum amount of NRW and minimize the loss of precious water through system leakage. In each sector, DMAs will be established to transmit water from the primary distribution. The current network is not designed to implement DMAs, so gradually the current system has to be changed in to DMAs. Using hydraulic models, the primary distribution lines have been designed according to the supply requirements in different parts of the sector to the DMAs. The primary and DMA distribution line that will be required in each sector in addition to the construction of treatment plants is shown in Table 1. Khilkhet sector will require the highest length of primary transmission as the SWTP is located in Char Gandharbapur, some distance from the City and it also supplies distant areas in different directions.

Table 1: Primary and DMA Distribution for Sectors up to 2035

Year	Primary Distribution (km)	DMA Distribution (km)	Sector Name
2020	41.54	606	Padma North-West
2030	57.42	384	Padma South
2020	98.35	685	Khilkhet
2030	81.44	293	
2035	18.59	60	
2015	46.22	824	Saidabad East-West
2020	57.53	381	
2015	52.86	354	Singair
2025	41.00	82	
2035	21.29	37	Rupganj
2035	23.66	113	Bandar
2035	31.13	96	Tongi & Gachcha

Action Plan

The action plan for works and services of the Master Plan are outlined below.

Action Plan and Targeted Dates for Works

Sl. No.	Activity	Time Frame	Costs (million USD)	Remarks
1	DTW performance Assessment and future recommendations for sectors	2014 - 2025	0.6	Availability of surface water source need to ensured
2	Construction of intake for Godnail WTP	Ongoing	5	Timely completion, successful operation and improvement in intake water quality are important
3	Renovation of Sonakanda WTP & primary and secondary mains	Ongoing	20	Timely completion, successful operation and improvement in intake water quality are important
4	Implementation of Singair Well Field Phase-I & primary and secondary mains; expansion of distribution network	2013-2017	105.1	Funding arrangements have to be ensured
5	Shifting of intake for Chandnighat WTP from Buriganga to Dhaleshwari	2015-2017	10.4	Water quality of Buriganga river is very low. Therefore, intake of Chadnighat needs to shift to Dhaleshwari river to operate WTP at full capacity
6	Implementation of Padma WTP I & primary and secondary mains; expansion of distribution network	2015-2018	554	Finance has been ensured for SWTP and DMA (part);Funding arrangements have to be ensured for primary & secondary mains and DMA (remaining)
7	Implementation of Saidabad WTP III & primary and secondary mains; expansion of distribution network	2016-2018	652	Finance has been ensured for SWTP and DMA (part); Funding arrangements have to be ensured for primary & secondary mains and DMA (remaining)
8	Implementation of Gandharbapur WTP I & primary and secondary mains; expansion of distribution network & establish DMA	2016-2019	729	Finance has been ensured for SWTP and DMA (part); Funding arrangements have to be ensured for primary & secondary mains and DMA (remaining)

Sl. No.	Activity	Time Frame	Costs (million USD)	Remarks
9	Implementation of Singair Well Field Phase-II & primary and secondary mains; expansion of distribution network	2023-2025	75.9	Funding arrangements have to be ensured
10	Implementation of Gandharbapur WTP II & primary and secondary mains; expansion of distribution network	2027-2030	719	Funding arrangements have to be ensured
11	Implementation of Padma WTP II & primary and secondary mains; expansion of distribution network	2027-2030	533	Funding arrangements have to be ensured
12	Implementation of Gandharbapur WTP III & primary and secondary mains; expansion of distribution network	2032-2035	720	Funding arrangements have to be ensured
13	Implementation of DMA in Dhaka City phase 2	2016-2020	300	Funding arrangements have to be ensured
14	Replacement, rehabilitation and optimization of production tube wells	2016-2020	150	Funding arrangements have to be ensured

Action Plan and Targeted Dates for Services

Sl. No.	Activity	Time Frame	Costs (million USD)	Remarks
1	Implementation of revised tariff structure	2014-2016	0.63	Political challenge exists, public awareness has to be raised.
2	Organizational structure for future operation of DWASA		0.75	Organizational restructuring is needed. If private sector is involved then regulatory reform is also required.
3	Institutional reform & regulatory framework for private sector participation	2014-2016	1.25	Have to be in line with DWASA mandate. Sufficient policies to enable partnerships have to be ensured. Regulatory framework is under preparation at Govt. level.

Sl. No.	Activity	Time Frame	Costs (million USD)	Remarks
4	Policy & regulatory reforms	2014-2016	0.63	Have to be in line with national policies and regulations. DWASA jurisdiction should be increased in relation with the DMDP boundary and planning & policy should be reformed accordingly.
5	Human resource development and training programmes	2015-2035	5	Human resources development programme should be prepared in line with restructuring of the organization. Local & international training and higher study programmes should be undertaken to improve capacity of the DWASA staffs
6	Development of Enterprise Resource Planning (ERP) System	2014-2017	2	Updating of GIS system. Development Asset management system.
7	Implementation of performance monitoring system (KPI)	Continuous process	-	Adequate organizational setup and accountability are required to ensure proper monitoring
8	DMA operation	Continuous process	-	Capacity building, organizational setup and resources required for DMA operations
9	Ground water monitoring and recharge	Continuous process	-	Ground water should continuous monitored.
10	Strategy for protection of the raw water sources and establishment of pollution control zone	2015-2016	0.75	Enforcement of government regulations and awareness will be required
11	Study for development of drinking water sources by rain water harvesting	2015-2017	0.5	Govt. policy and regulation will be required for implementation.
12	Improvement of Communication system	Continuous process		Internal & external communication must be improved for the improvement of DWASA performance
13	Water for Urban Poor	2014-2017	0.5	Co-ordination with NGOs will be required.
14	Strengthening of the Water Quality Lab	2014-2017	1.5	Capacity building of staff, equipment, budget and Laboratory Information Management System (LIMS) software will be required.

Sl. No.	Activity	Time Frame	Costs (million USD)	Remarks
15	Pilot study to develop a good monitoring programme using SCADA	2016-2017	2	Establishment of DMA
16	Water Safety Plan for DWASA	2016-2017	0.5	Govt. policy will encourage adoption within DWASA
17	Update Water Supply Master Plan	2022-2024	2	The Master Plan to be updated based on BBS survey and DWASA consumer survey in 2021
18	Establishment of groundwater monitoring system	2015-2017	0.5	Required for optimizing groundwater abstraction according to the Water Supply Master Plan

Financial Assessment

Table 2 presents investments that will be required in the future years for water supply by DWASA. Some of these investments are already in progress as a part of ongoing development. As of 2014 DWSSDP, Singair Well Field and Padma SWTP projects are on implementation stage, Gandharbapur SWTP which is in DPP stage and Saidabad Ph-III is in feasibility stage. Investment plans are already in advanced stage for these projects. The amount of all the major investments are calculated in present value and the total amount required up to 2035 is *325 billion BDT or 4.17 billion USD*. Investment requirement envisaged for projects in 2025 and onwards can be updated through a revisit of the Master Plan in 2022-24.

Table 2: Year-wise Capital Investment Requirement in Million BDT

Year	2015	2020	2025	2030	2035
Saidabad I & II DMA Distribution	6,760				
Singair I WF & Primary Dist	5,300				
Singair I DMA Distribution	2,906				
Saidabad III SWTP		43,408			
Saidabad III Primary Dist		3,892			
Saidabad III DMA Distribution		3,126			
Gandharbapur I SWTP		41,367			
Gandharbapur I Primary Dist		9,909			
Gandharbapur I DMA Distribution		5,614			
Gandharbapur II SWTP				42,400	
Gandharbapur II Primary Dist				11,253	
Gandharbapur II DMA Distribution				2,401	
Padma NW SWTP		33,390			
Padma NW Primary Distribution		4,828			

Year	2015	2020	2025	2030	2035
Padma NW DMA Distribution		4,971			
Singair II Wellfield			4,160		
Singair II Primary Dist			1,368		
Singair II DMA Distribution			344		
Padma South SWTP				33,390	
Padma South Primary Distribution				5,037	
Padma South DMA Distribution				3,146	
Gandharbapur III SWTP					42,400
Gandharbapur III Primary Dist					11,253
Gandharbapur III DMA Distribution					2,513
Total Cost	14,967	150,505	5,694	97,627	56,166

Proposed Tariffs

About 35% of respondents in the Master Plan survey expressed willingness to pay higher than the 2012-3 tariff (6.99 Tk/kL) if 24hrs drinking water supply can be ensured. The main reasons for agreeing to pay included: reliability of supply (65%), no complications (41%), clean water (36%), reasonable price (21%). Main reasons for not agreeing to pay higher price included: price is too high (78%), government's duty (27%) and DWASA will not be able to ensure reliable supply (12%). 56% of respondents stated that the water bill should be 2% or less of household income. 70% of respondents stated that it should be less than 5%.

During the analysis of tariff two pricing structures were considered: flat rate and 3-slab increasing block tariff structure. In the financial analysis block tariff structure was assessed and the main factors considered were:

- Start year of IBT strategy – is 2015
- Change in the tariff rate on annual basis

The recommended IBT structure is shown in Figure 4. The first slab's price is the current 7.34 Tk/KL which will be incremented by 5% in 2015. Thus the basic flat rate expected in 2015 is 8.09 Tk/KL. The third slab's price is three times the first slab's price and is also the expected starting water tariff for commercial and industrial users in 2015 (based on annual 5% increases as per DWASA rule). Based on the expected population proportion falling into each slab, the weighted average price will be 12.94 Tk/KL. However, the slab prices in the IBT should increase over time to take into account of inflation.

Table 3 presents the annual increase rate required for different interest rates on loan. It was found that for an interest on loans of 2% the required annual tariff increase rate has to be 6% per year, and for an interest of 5% the required tariff increase rate is 7.5% per year. Based on these findings, it can be recommended that the current interest rate of 5% by GoB needs to be lowered in order to keep the tariff rate within an acceptable range of the consumers.

Table 3: Impact of Changes in the Annual Increase in Price of Water

	Tariff Growth 6%, Interest on Loan 2%			Tariff Growth 7.5%, Interest on Loan 5%		
Project	FIRR	NPV (mBDT)	FBCR	FIRR	NPV (mBDT)	FBCR
Padma Ph-I	3.80%	2,030	1.03	3.55%	359	1.00
Singair Ph-I	6.31%	2,924	1.31	6.02%	2,747	1.24
Gandharbapur Ph-I	3.43%	(629)	0.99	3.11%	(3,640)	0.96
Saidabad Ph-III	3.77%	2,001	1.03	3.59%	698	1.01
All		6,326	1.03		164	1.01

Note: Discount rate for financial analysis is 3.5%, Cost growth 3%, NRW 15%

It can be recommended from the financial analysis that the tariff may be raised every year by 6% for all users. Figure 4 shows the weighted average tariff proposed for the future. This increase is an important strategy to ensure the feasibility of the projects that will be undertaken by DWASA. This also implies that as long as the rate of inflation is above 6%, the real price of water is in fact reducing over time from that of the initial year of 2015.

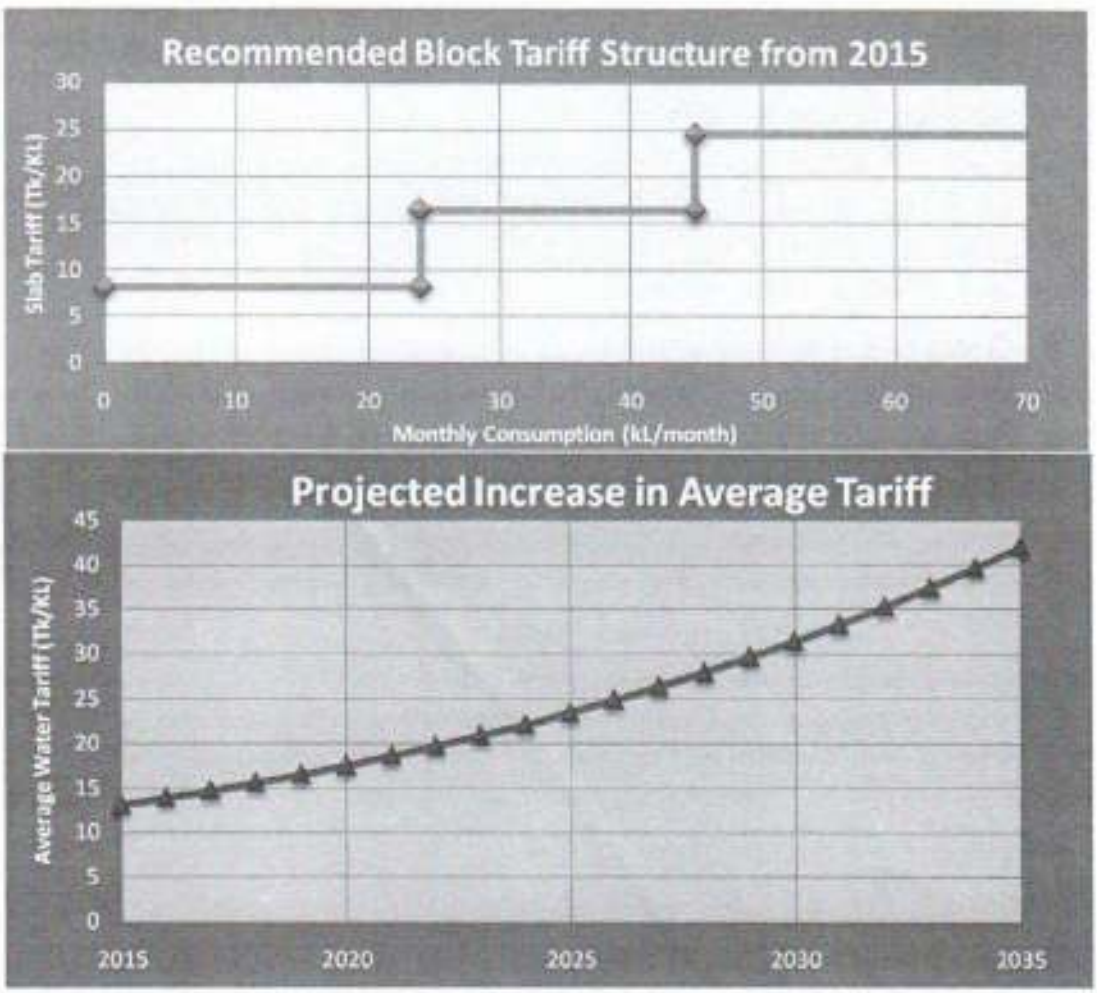


Figure 4: Recommended Tariff Structure and Increases in Average Tariff in Future Years