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Dhaka Water Supply Sector Development Project
Dhaka, Bangladesh

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Summary

The Dhaka Water Supply Sector Development Project (DWSSDP) was implemented to salvage the water supply sector of Dhaka, Bangladesh. The Dhaka Water Supply and Sewerage Authority (DWASA) was saddled with so many challenges that prevented the growth of the water supply Sector. Dhaka was battling with poor quality water and depleting groundwater resources which served as the major water source for individuals and private water vendors. With a USD 212.7 million loan facility from the ADB, the DWSSDP was implemented. The project was divided into three main components. The over-arching objective of the project has been to contribute towards the achievement of a sustained economic development of the rapidly urbanized Metropolitan area. The first component of the project focused on water quality improvement and rehabilitation of project of the water supply networks. The second component also focused on institutional strengthening and capacity building of the staff of the water utility company of Dhaka in order to improve service delivery and operation optimization. Moreover, consultants were procured to support the project monitoring unit to effectively implement and monitor the project. The DWSSDP has since been implemented with minimum considerations on limiting project impact on environment, as well as inhabitants and or indigenous people. Majority of the project outputs have been achieved with few pending implementations.

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Acronyms and Abbreviations

ADB	Asian Development Bank
DMA	District metering areas
DS	Ductile Steel
DWASA	Dhaka Water Supply and Sewerage Authority
DWSSDP	Dhaka Water Supply Sector Development Project
EIRR	Economic Internal Rate of Return
FIRR	Financial Internal Rate of Return
NWR	Non- revenue Water Reduction
NPRS	National Poverty Reduction Strategy
SFR	Special Funds Resources
USD	United States Dollar
USDS	United States Department of State
PMU	Project Monitoring Unit

1 Introduction

Dhaka, the capital city of Bangladesh is located on the eastern bank of the Buriganga River. Dhaka is the most populous city in Bangladesh. It is also the center of the country's political, cultural, and economic life. Dhaka is the sixth-largest megacity in the world. It covers a total area of 306.38 square kilometres (ADB, 2011). The population of Dhaka is estimated to be over 18.0 million people inhabiting the Greater Dhaka Area, with about 8.5 million people in the city itself. Since the 1960's high urban migration, it has contributed to the steady population growth of Dhaka. Population growth is estimated at 2.5% per year. With these demographics, future projections clearly point to a significantly populated city by 2050 (ADB, 2007). As is the case with all mega cities, urban utilities such as water is key to the economic growth of the city of Dhaka.

Figure 1. Geographical Map of Dhaka, Bangladesh (USDS, 1985)

By 2006, the city of Dhaka had poor water supply and sanitation amenities. Access to good quality water was lacking in the city. Even the very few that had access to water supply had interrupted flows. With a very poor coverage, the rest of the city was left on their own to find and develop their own sources of water. Groundwater serves as the major source of water supply (about 80%) to the city of Dhaka. However, over exploitation of groundwater resources and unsustainable practices resulted in fast depletion of the resource. In addition, during groundwater exploitation, the quality conditions of the groundwater during abstraction, pumping and consumption is often compromised with contaminants that makes the water not potable for consumption. Notwithstanding, Dhaka city was proliferated with unregulated deep and shallow boreholes sunk into the underlying aquifer.

Unmanaged pumping and exploitation of groundwater resource are causing the groundwater table in the upper aquifers zones to drop at a fast rate (approximately 2-3 m per year), while drying up of wells were common. About 26% of the households in Dhaka are slum areas with very bad or no sanitary toilets. About 70% of the city was reported to be without sewerage system. The WHO estimations indicated that, Dhaka city and the rest of Bangladesh was at risk of water and sanitation related disease outbreaks due to the unhygienic conditions, water crisis and frequent flooding of the city (ADB, 2017).

The Dhaka Water Supply and Sewerage Authority (DWASA) established in 1963 was entrusted with the responsibility of construction, operation, development and maintenance of necessary water infrastructure (deep tube well) to meet the demands of industrial and commercial customers of Dhaka City among others. However, the authority has been unable to fully live its mandate due to extremely low capital investment in the water supply sector. DWASA was unable to generate adequate revenue at the time to solve the myriad of problems facing the water supply sector. To improve services, DWASA was faced with the challenge of controlling or at best, eliminating substandard connections and leakages in the distribution systems, improve metering, billing and collection, build adequate capacity to management its assets and human resource effectively. It was estimated that about half of the metered household consumers connected to DWASA water supplies had inaccurate and inaccessible meters. Further, surveys indicated that 90% of slum dwellers in DWASSA were illegally connected to the DWASA water supply. Physical losses were estimated to values above 50% of water supply, in addition to low-pressure of supplied water and frequently interrupted water supply system. With these challenges saddled to service delivery, DWASA was able to mobilize only 62% of expected revenues. Revenue losses resulted in the inability of DWASA to carry out rehabilitation, regular operation and maintenance, and expansion of existing water supply network. On institutional level, DWASA needed an improvement in management and accounting systems which were considered as inefficient and not transparent. Recruitment and staff management was reportedly highly politicized and with high turnover rates. DWASA had to grapple with high influence from labor unions with conflicted interest. These challenges made it difficult for DWASSA to implement effective human resource and management policies that would enable the organization to improve service delivery while maintaining financial viability.

The Dhaka Water Supply Sector Development Project (DWSSDP) was designed and implemented primarily with the aim to improve water supply system in Dhaka. Implementation of the project would make it possible for the city of Dakar to have access to reliable, sustainable, and climate-resilient potable water. Moreover, aspects of the project were to build institutional capacity towards delivering good service. In addition, the project would also improve the financial performance of the DWSSA. Essentially, the project would contribute towards a sustained economic growth and improved public health conditions of Dhaka Metropolitan Area. The project was also in line with the national poverty reduction strategy (NPRS) of Bangladesh, which stipulates the reduction of the number of people who do not have access to safe water. DWSSDP was jointly funded by the ADB and the Government of Bangladesh at a total sum of USD 212.7 million. Project details are highlighted in Table 1.

Table 1: Overview of the Dhaka Water Supply and Sewerage Authority (ADB, 2008)

Items		Description
Project name	:	Dhaka Water Supply Sector Improvement Project
Type	:	Water Supply, Sanitation and Waste Management
Donor name	:	i) Asian Development Bank ii) Government of Bangladesh
Project rationale and objectives	:	i) To contribute to the sustainable provision of urban water supply services particularly in Dhaka city, by rehabilitating and strengthening the water supply system based on long term policy and investment road map. ii) To build the capacity of DWASA for it to be able to competently manage the water supply systems for approximately 12.3 million people in Dhaka city.
Total project fund	:	USD 212.7 million (ADB Funding: USD 150.0 million) (Counterpart funding by the Bangladesh Government: USD 62.7 million)
Project duration		November 2008- June 2016 (Originally June 2014)

2 Technical and Technological Brief

The DWSSDP had three main components which aimed at rehabilitating and strengthening the water supply system of Dhaka, by adopting long term policy reforms and investment plans that would promote sustainable urban water supply services operation in Dhaka. DWASSDP outputs were categorized into three main components. Project component A, which was oriented towards achieving an improved water distribution system and quality control in DWASA. It involved the rehabilitation and performance improvement of water distribution networks within DWASA's service areas in order to reduce network losses. In addition, physical works involved the restoration to a full 24-hour pressurized water supply that included the implementation of water quality assurance and control measures. To this end, four zones namely; zones 3, 4, 5 and 6 were selected for rehabilitation and system optimization works under the project. With plans to increase the water transmission capacity of the selected zones that must meet future demands, it was necessary for DWASA to rehabilitate those zones and reduce all leakages in the network ahead of time. Further, physical losses were mainly from these zones, thus, it was much needful to reduce these leakages and restore maximum transmission. Water quality improvement and monitoring would be achieved under component A through rehabilitation of disinfection/chlorination facilities and installation of water quality monitoring facilities which would also include equipping the laboratory to sufficiently ensure adequate monitoring of water quality in the system.

Figure 2 Water quality equipment under the DWASDP Dhaka (ADB, 2017)

Component B of the DWASDP on the other hand, involved capacity building and institutional strengthening. The project aimed towards building the capacity of DWASA to be able to effectively provide a financially viable and self-sustaining urban water supply services. Under component B, the project would establish sound financial management, efficient billing, revenue collection, and customer record systems. These activities were to be carried out by rehabilitating and upgrading of training facilities, training DWASA staffs to provide maximized operational performance as well as carrying out demand control awareness campaigns for consumers. The scope of component B also included consultancy support for detailed planning and design of activities, contract structuring, tendering, execution and management, construction supervision; and the preparation of demand control and public awareness campaigns (ADB, 2007). Component C involved the engagement of external consultants to assist the project monitoring unit during project implementation, monitoring, and supervision. Further, consultants would conduct feasibility studies and prepare tender documents for future procurement and location of water treatment plant.

3 Financial brief

The DWSSDP was funded with at a total project cost of USD 212.7 million including taxes and duties of USD 16.1 million. About 70.5% (USD 150 million) of the total project cost was funded with loan facility from the Special Funds Resources (SFR) of the Asian Development Bank (ADB). The Government of Bangladesh however, counterpart funded the rest 29.5% of the total cost (USD 62.7 million) of the project. The counter fund includes cost elements covering land acquisition, renumeration of counterpart staff, office accommodation, taxes and duties, resettlement cost, part of the civil works, and other miscellaneous costs (ADB, 2007). The repayment period for the loan facility by the government of Bangladesh was fixed within 32 years, a grace period of 8 years, and an interest charge of 1.0% per annum during the grace period and 1.5% per annum thereafter.

Further, agreement was reached to relend loan proceeds to DWASA under repayment term period of 20 years which includes a 5-year grace period and an annual interest rate of 5%. Also, the Government of Bangladesh would bear all foreign exchange risks which was costed at USD 35.4 million. Cost allocations to the project components are shown in Table 2.

Table 2 Dhaka water supply sector project investment plan (ADB, 2007)

Item		Amount (USD million)
A	Base Cost	
	Part a: Distribution system and quality improvement	160.4
	Part b: capacity building and institutional strengthening	8.3
	Part c: Project management and implementation support	17.1
	Subtotal (A)	**185.8**
B	Contingencies	23.2
C	Financing charges during implementation	3.7
	Total	**212.7**

4 Project Features

4.1 Technical and technological features

The key technical and technological features of the DWSSDP would be realized in three main components as mentioned earlier. Under component A, the project would remove illegal connections that are mostly in the slums and also regularize unregistered connections. Physical works under the component A includes the rehabilitation works on primary and secondary distribution networks which involved the replacement, installation and lining of pipes where necessary. Moreover, short bends and connections that reduces transmission efficiency in the network would be eliminated while tertiary distribution networks and house connections would be made. Further, additional supply lines would be installed in slum areas within Dhaka city. Twenty-four over-head reservoirs would be rehabilitated while 14 new ones would be built. District metering areas (DMA's) would be created by installing flow valves and water meters in households to track and measure water supply and consumption within the supply networks. Trenchless technologies would be used for the network rehabilitation works on 3,500 km distribution water lines and rehabilitating or replacement of 150,000 service connections. Significantly, 300 disinfection units with water quality monitoring and analysis capacity would be installed at all water sources. Hydraulic works would include:

(i) installation of 56 km of plastic lining inside existing pipes of 100-450 mm diameter to repair leaks and seal off illegal connections,

(ii) installation of 17 km of new Ductile Steel (DS) pipes of 100-300 mm diameter to replace blocked or leaking existing pipes

The project would also build capacity and strengthen the urban water supply services sector of Dhaka. These objectives were to be achieved through carrying out financial management improvement trainings and capacity building and demand control, and public awareness.

Substantially, the project would also assist DWASA to build strategic business plans using financial models and also to undertake tariff reforms as well as ensure sustainable debt management. In addition, the project would assist DWASA in achieving a result oriented budget mechanisms and also the development of efficient and accurate double-entry accounting system and auditing procedures where transparent accounting systems would be established. The project also required the compulsory publication of annual reports. Consultancy for financial and capacity building of DWASA would be pursued under this component in order to ensure that, appropriate and financially sustainable tariff structure would be set up to achieve efficient cost recovery on investment. Private contractors would be engaged on pilot basis to manage rehabilitated pipelines in project zones during the contract period. Moreover, arrangements for knowledge sharing and technical assistance would be solicited from other water utilities (e.g. Public Utility Board Singapore or Phnom Penh Water Supply Authority) within the south east Asia region to help DWASA develop a sound managerial, technical, and financial capabilities in order to remain viable in offering urban water supply services.

Figure 3 Trenchless horizontal directional drilling technology (ADB, 2017)

Project management unit would be supported by design and management consultants who would help DWASA to improve operational performance by identifying and delivering on key performance indicators to increase supply coverage, establish appropriate service and consumption levels, and ensuring. Training would be carried out for all staffs of zonal offices under the project towards operation performance optimization and improving customer services. These would also involve in-service training of workers and the development of training manuals for staff including plumbers, technicians and pump operators. To this end, the DWASA training center situated at Lalmatia would be rehabilitated while tools in the facility would be upgraded. Public awareness campaigns would be targeted towards dissemination of information to consumers about the need for tariff reforms, sustainable water consumption, and also the impending disruption in water supply during project implementation. Public education on meter reading check and customer complaint procedure and redress mechanisms would be carried out. The public awareness campaigns would be a coordinated effort carried out through non-governmental organizations (NGOs), print media, radio and television

stations, cinemas and field. Technical support to project monitoring unit for implementation, monitoring and supervision would also be procured under the project. DWASA would procure consultancy services for project management and monitoring, detailed design and planning of activities, construction, supervision, contract structuring and tendering, execution and management, preparation of demand control and public awareness campaign.

4.2 Economic and financial features

Economic analysis of the project was done by calculating the economic internal rate of return (EIRR) on the acquired project loan from the ADB as well as the cost implications of the policy actions associated with the project. Essentially, the calculated EIRR of 16.7% was noted to be more than the opportunity cost of capital which was estimated at 12% per annum. The robustness of the EIRR was tested with a sensitivity analysis against the following variables: (i) a 20% increase in capital costs, (ii) 20% underachievement in water quality improvement, (iii) 20% underachievement in water pressure increase. Results reported showed that the EIRR for the project loan was robust and thus, the project was viable under most conditions**.** The financial viability of the project was calculated based on the project loan. The financial internal rate of return (FIRR) was used to assess the financial viability of the project, using real terms constant of 2006 prices. The nominal cost estimates and projections were adjusted to include the possible estimated effects of foreign and domestic inflation impacts as well as impacts due to currency fluctuations. The "with and without" project scenario was used to evaluate the incremental costs and benefits of the project based on the financial position of executing agencies of the DWSSDP. The FIRR calculated on an after-tax basis, was 3.99%. The reported weighted average cost of capital, also calculated on an after-tax basis was 2.33%. The comparisons of both indicators points favorably to the financial viability of the project. However, further sensitivity and risk analyses reveled that the FIRR is sensitive to delays in each item of the implementation of financial improvement action plan (ADB, 2007).

4.3 Social and environmental features

The DWSSDP project was designed with special considerations on reducing environmental and social impacts right from the project preparation stage through to implementation and closure. The loan agreement by the ADB was subject to the environmental and social safeguards stipulated in the initial project proposal. Initial environmental safeguard reports indicated that, the benefits of the project to the environment outweighs the impacts. Available water supply at high pressure and of good quality would effectively contribute towards water security and sound public health. It would also contribute towards good quality of life of the project beneficiaries. Good sanitation and hygiene would reduce diseases associated with poor sanitation in the city while contributing to the increased productivity of the city of Dhaka. This is mainly because, time spent on water withdrawal may be rechanneled towards productive activities. Moreover, cost savings would be made on healthcare associated with diseases borne from poor access to good quality water and hygiene.

Environmental impact mitigation measures detailed in the project environmental safeguard documents would limit the impact of works such as pipe laying, rehabilitation of training facilities and building of overhead reservoirs. Trench-less technology was adopted in order to avoid

excavation where possible. Minimum land claims for pipe laying would be achieved by underlaying pipes beneath and between roads and where possible new facilities situated on government owned lands. Also, as part of environmental safeguard measures, the project prohibits the use of fibrous cement sheets (asbestos cement). Environmental regulations regarding waste disposal at construction sites involved covering up of sand and all construction debris that might generate dust were strictly planned for and monitored. Safe disposal of soils and minimal disruption of traffic were strongly encouraged in the environmental monitoring plan documents. Construction for the program as a whole would affect most parts of the city, where pipes of the existing water supply network (which are mainly buried beneath roads) would be repaired or replaced, and house connections would be repaired and provided with new meters.

An assessment of the social and public health impacts of the project noted that, the project would have minimal impact on the indigenous people. In the event of any likely impact, resettlement plans have been designed to address such instances. However, the implementation of the project components would not require any such land acquisition. Other social safeguards policies stipulated in the project documents sought to increase awareness among communities regarding the project activities and the concomitant benefits. Also, increased community support and cooperation was garnered from the society which enhanced the ease of project implementation. Timely renumeration of hired labor as well as unfair handling of labor during physical works were also avoided. Mid annual review reports indicated that, to reduce the likely water stress that might be introduced during project implementation, alternative water supply was provided to low income community dwellers affected by the project. In addition, possible damages caused by contractors to properties of people were promptly repaired by respective contractors and compensations made where possible.

5 Project Benefits

The implementation of the DWSSDP would produce significant benefits to the inhabitants of Dhaka Metropolitan Area. The over-arching impact of the DWSSDP is the benefits contributing towards a sustained economic growth and public health improvements in Dhaka Metropolitan area. First, the project would generate significant public health benefits to the inhabitants of Dhaka. The project would also contribute to the alleviation of water related health problems which may be induced by water scarcity. Water availability in adequate quantities and of good quality is crucial for the economic and social development of rapidly urbanizing cities. The livelihood strategies of inhabitants would be positively influenced because resources and time savings during water collection, transportation and purification would be channeled towards other productive ventures. The fast depleting groundwater resources of the city can induce possible problems associated with groundwater sustainability and geotechnical support provided by the ground to the urbanized infrastructure of the city. In the same vein, unsustainable exploitation of groundwater resources would increase chances of resource depletion in a short period. Demand control and public awareness programs would foster a good and sustainable water services provision and utilization by consumers. Another major benefit of the DWSSDP is the provision of metering programs that would improve billing and collection by DWASA. Moreover, reduction in leakages in the supply and distribution networks would reduce revenue losses incurred by DWASA. By this, DWASA would be

able to improve their financial performance and remain viable. Capacity building and institutional strengthening of DWASA would improve the management capacities of DWASA to effectively manage urban water supply business. Further, technical support provided by consultants to the project monitoring unit (PMU) would build capacities of the implementation and management of similar donor funded projects of such scopes.

6 Implementation status of the project

The DWSSDP has since undergone various implementation phases and has been noted to contribute significantly to the project goals. Under project component A, most of the physical works under the DWSSDP has been completed by June 2016. Project documents indicated that, about 47 district metering areas involving about 2,456 km of water distribution networks within the Dhaka Metropolitan Area have been rehabilitated and water quality supply subsequently improved. In addition, new water supply connections for 106,662 numbers of households were installed. Civil works under the project has been duly awarded and agreements made with contractors to ensure losses were reduced within the limited liability periods. Consumers within the metered service areas have been reported to be receiving 24-hour potable water supply with good pressure. Also, water quality monitoring systems are under implementation. Under the DWSSDP, 46 deep tube wells have been constructed, 18 deep tube wells constructed, and 200 chlorination units installed. Pump operators in various pumping units were trained and supplied with water quality test kits. Social inclusion components of the project that would connect about 1,000 slum house to the water supply has not been completed yet. In all, about 70,000 dwellers in slums such as Korali and Sattala are benefiting from the slum oriented initiative under the DWSSDP. Community Based Organizations (CBO) were formed to support and facilitate the smooth operations of the entire process. Reports indicated that billing and regular payment of bills by new connections to the water supply system are going on smoothly without defaults.

Component B of the DWSSDP involved capacity building and institutional strengthening. Training facilities belonging to DWASA has been refurbished and various training modules were done for management, operation, and development system offices staff. Zonal level project orientation programs were conducted with training sections covering gender inclusiveness. About 126 training programs have been conducted for about 2,244 staff, who were trained in various capacity building programs. In addition, workshops and refresher trainings were held for 660 pump operators in water quality monitoring, reporting and test kit usage. Awareness on non-revenue water reduction through discouragement of illegal connections, water conservation and economic use of water, and hygienic use of water were conducted by NGO's. Automated billing systems were installed by DWASA. This has improved the effort towards achieving a maximum and efficient billing and collection. Due to the improvements brought about by the DWSSDP, future water treatment plant financing was approved by the ADB. The construction of the future water treatment plant has been included in another ADB-financed project; Dhaka Environmentally Sustainable Water Supply Project which was approved in 2013. International consulting firms were procured a Design and Management Consultants who helped the manage the project in terms of preparation of detailed designs, works and technical supervision and assurance.

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