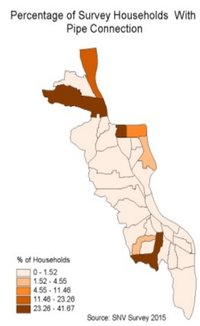
ERG-WASH Report # 4

Political Economy of Water Supply in Khulna City

Understanding the regime of rampant groundwater extraction



Submitted to
WaterAid Bangladesh

27 March 2016

Submitted by

Economic Research Group (ERG)
2nd Floor, House # 304, Road # 19/B, New DOHS, Mohakhali, Dhaka - 1206, Bangladesh
Phone: 880-2-9891783, 880-2-9889559, e-mail: info@ergonline.org
Fax 880-2-8810636, Web: http://www.ergonline.org

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Understanding the regime of rampant groundwater extraction

Prepared by

Sajjad Zohir
Md. Salauddin

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Sajjad Zohir is currently the Executive Director of Economic Research Group, and the Principal Investigator of the ERG study on WASH. He remains responsible for the main report, while a significant portion of the background information were prepared by Md. Salauddin, Assistant Professor, Khulna University. The paper was prepared in fulfillment of ERG's commitment to the WaterAid Bangladesh. For comments and suggestions, please contact the principal author at sajjadzohir@gmail.com or sajjad@ergonline.org.

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List of Acronyms

ADB	Asian Development Bank
BADC	Belgian Administration for Development Cooperation
BELA	Bangladesh Environmental Lawyers’ Association
DAP	Detailed Area Plan
DPH	Department of Public Health
DPHE	Department of Public Health Engineering
DTW	Deep Tube-well
DWASA	Dhaka Water Supply & Sewerage Authority
FAO	Food and Agriculture Organization
FOA	Foreign Operations Administration
HSD	Housing and Settlement Directorate
HYV	High Yielding Variety
ICA	The International Cooperation Administration
ILS	Institute of Livelihood Studies
IWFM	Institute of Water and Flood Management
JICA	Japan International Cooperation Agency
KCC	Khulna City Corporation
KDA	Khulna Development Authority
KMC	Khulna Municipal Corporation
KSS	Khulna Sewerage System
KWASA	Khulna Water Supply & Sewerage Authority
KWSP	Khulna Water Supply Project
KWW	Khulna Water Works
MAD	Mutually Agreed Destruction
MLD	Millions of Liters per Day
NGO	Non-governmental Organization
OPM	Online Project Management
PPA	Public Procurement Act
RO	Reverse Osmosis
SNV	SNV Netherlands Development Organisation
STW	Submersible Tube-well
UNICEF	United Nations International Children's Emergency Fund
UK	United Kingdom
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USA	United State of America
USAID	United States Agency for International Development
WASA	Water Supply & Sewerage Authority
WASH	Water Supply, Sanitation and Hygiene
WAB	WaterAid Bangladesh
WB	World Bank
WBCSD	World Business Council for Sustainable Development

Political Economy of Water Supply in Khulna City -
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1. Background and Rationale

After intense consultations with relevant people at WAB, drinking water in Khulna City Corporation (KCC) area was chosen as one of the two potential subjects for case studies[1]. A preliminary visit to Khulna City and consultations with several important stakeholders led us to identify a number of key concerns, which are deemed important subjects for separate research, on account of their relevance to WASH. These included the followings, which do not necessarily exhaust all concerns:

- Over-flow of sludge from septic tanks as well as from drains used for transporting human excreta from households to water-bodies[2].
- Current attempts by the SNV, an international NGO, to introduce Vacutug services for emptying septic tanks and to ensure safe disposal in the form of composts using 'constructed wasteland' technology. While progress has been made by involving KCC, there are hurdles to be crossed.[3]
- Severe shortage of safe and saline-free drinking water, tied with excessive extraction of groundwater leading to depletion of water table and saline intrusion at the lower tier. Household responses have reportedly been to invest on submersible pumps, and it has worsened the situation further.
- An earlier investment to procure drinking water for the city from DTWs in Phultala had to be abandoned due to litigation tabled by Bangladesh Environmental Lawyers' Association (BELA). With installation of pipes already made, there is renewed effort to bring in surface water from upstream on a seasonal basis, with a storage and treatment facilities along the way[4].
- The move towards surface water is now a reality. KWASA is currently implementing Khulna Water Supply Project (KWSP)[5], which, once completed in 2017, will procure surface water from Madhumati river in Mollarhat. It appears that neither DPHE nor

[1] The other is on fecal sludge management in Sakhipur. Several reasons for the choice of KCC water included: (i) it is a major concern in the coastal city, (ii) possible presence of diverse activities and actors allowing one to decipher patterns, (iii) added dimension of salinity in drinking water, and (iv) WAB is actively involved in the region, and therefore, study findings may be directly relevant for future programs.

[2] While the report was getting drafted (31 August 2015), parts of Khulna got inundated during high tides and the water level in Rupsha river reached 3.64 meter, which broke the previous record of 3.44 meter reached 16 years back! An exercise to update the (2011) DAP of drainage network will be undertaken soon. The drainage ironically remains in the domain of a separate agency, KCC. It is uncertain if new undertakings to reduce/eliminate water logging will be tied to the repair and rehabilitation work to follow installation of new water pipelines under the KWSP. A MoU was recently signed between KWASA and KCC on the latter task.

[3] Of several developments, the noteworthy are, pre-designated land at the outskirt of the city for treatment and disposal of fecal sludge, negotiation on places for transshipment is in progress, and digitized building footprints for informed planning of FSM is reported to have been developed.

[4] One KWASA official mentioned that salinity in Bhairab river water is not a year-round phenomenon in that region; and the water will be procured for about seven months can be treated economically before channeling those through the pipelines. We came to know from other sources that BELA's lawsuit against installation of DTWs had been overturn and 20 DTWs will extract groundwater from Phultala-Shiromoni region and supply to KCC area. The project was initiated by KCC since DPHE activities in the Khulna municipalities were handed over to them. Subsequently, KCC claims that these were handed over to KWASA, while the latter is yet to acknowledge.

[5] KWSP, with JICA and ADB supports, has made substantive progress with most components tendered out and several being implemented.

KWASA sees reasons to invest on rainwater harvesting in urban areas, and are optimist about KWSP's ability to satisfy demands. There are however others who do not hold such optimism, and believe that protection of Mayur river from unauthorized occupancy and re-excavating water bodies in and around the city are important for long-term securing of surface water, as well as for regular recharging of groundwater[6].

With on-going multi-dimensional activities and having made substantive progresses in some such activities, narrowing down on a single theme for political economy study was difficult. The literature survey that preceded the field surveys and continued beyond, suggested that Bangladesh's historical path of engagements in sourcing water for household use had been no different from the paths taken by most other countries in the world. While identifying the factors that induced (or, explain) the shared journey globally, all signs suggest of a significant turning point in the foreseeable future. There is no disagreement that there has been over-extraction of groundwater, while surface water has been neglected by indiscriminate dumping of industrial as well as household wastes (including untreated human excreta). Most people therefore recognize the urgency of returning to surface water to meet water needs for drinking and other purposes on a sustained basis. In case of Khulna, specifically Khulna city, increased water salinity and detection of intrusion of saline water into the aquifer, has raised the alarm. As mentioned earlier, large scale investment on infrastructure, to lift water from *Madhumati*, store and treat the water along the way, transport it to Khulna city and build pipelines in the city to allow new connections, is already under way. It provides an opportunity to look into a journey that led to the current state of dependence on groundwater, understand the various interests that may have led to the current state[7] as well as those currently tied to the *status quo*, and finally assess the roles that these stakeholders may play in promoting or obstructing the transition to a sustainable (surface water based) water supply regime in the KCC area.

2. Study Objectives, Methodology and Chapter outline

The central objective of the study is to understand the political, economic as well as technological factors that continue to perpetuate the current regime of groundwater-dependent water supply and use in KCC area. The purpose is to better appreciate the technological constraints within which such choices have been made, what obstructs switches to alternative modes where technological options are available, and recommend entry points for soft interventions, with a view to facilitate transition towards a surface water-based water supply regime in KCC area.[8]

Drawing upon secondary sources of information and upon consulting with relevant stakeholders, the study has the following specific objectives:

1. Review of the historical evolution towards groundwater-dependent water supply regime and of the political economic factors that may have led to the current situation;
2. Understand the current state of groundwater-dependent regime in KCC area, encompassing the various differentiated water products and agents/agencies currently involved in their production and distribution.

[6] Noteworthy among various initiatives are the studies undertaken with supports from Water Security in Peri-Urban South Asia Project, by the Environmental Science Department in Khulna University.

[7] Borrowing the jargon of experts on international relations and political science, one may term this as an inadvertent "Mutually Agreed Destruction" (MAD).

[8] At the inception stage, progresses made in implementation of KWSP were not known. Whether singular focus on it will lead to sustained supply of quality water to city dwellers remains a valid question.

3. For each of the major (to be discussed) supply chain, identify the groups (public or private agent/agencies) who have stakes and what those stakes are in terms of sharing total ‘economic rent’. The purpose of the exercise is to assess the coalitions for changes and how those may be incentivized, as well as to identify potential resistance to changes.

The methods involved the following:

1. At an analytical level, importance of resources and technological constraints within which various stakeholders operate, was recognized. Thus, observed reality is presumed to be an outcome of motivated actions given those constraints. Moreover, water is not considered as a homogenous utility service. Thus, the study identifies all manifestations of ‘differentiated (water) products’ that are currently observable in KCC area. Such identification is further concretized by account for all agents/agencies on both supply and demand sides, linking water source, method of extraction, supply mode, supply side management and end use by consumer types and purposes.
2. At an operational level, undertake interest-mapping (shares in economic rent) of stakeholders in the extraction, processing and delivery chain aimed at meeting water demand of urban households. The exercise thus compiled information to show relative shares of total water supply used (and wasted) under each of the above types, and attempts were made to trace the changes in those shares.
3. Undertake extensive literature review and analysis of data obtained from secondary sources to assess the historical changes and identify the broad parameters within which the state of water supply and uses in Khulna city is determined;
4. In an iterative process, engage in consultations and recasting the findings within an analytical framework.

A list of stakeholders interviewed and consulted is provided in annex 6. Some of the technical exercises are also relegated to annexes. The various issues are addressed in a number of sections, the first of which (Section 3) provides a historical overview of water supply in KCC and other urban areas in Bangladesh, while Section 4 takes a look into the global pathways for sourcing drinking water with a view to check if the local choices had at all been influenced by the global trends. Generally, both the sections address the followings: (i) trace the history of initial urban water supply system sourcing surface water; (ii) discuss factors leading to decline in the dependence on surface water, and increased dependence on ground water; and (iii) briefly introduce the current practices and why those are perceived unsustainable. The latter is corroborated with highlights of recent policy moves towards harnessing surface water. The exercise paves way for undertaking subsequent exercises on various interest groups that have emerged over the years of “practices” (institution and incentives, technology and rules & regulations), and which need to be understood in order to make the transition less troubled by frictions.

Subsequent sections presume that harnessing surface water is the desired route to take. The resistances against such moves are perceived from two ends; stakeholders having interest in the *status quo* with dependence on groundwater and therefore unwilling to change; and current interests around sources of surface water that are unwilling to give way for their uses in providing drinking water. We deal with both of these in separate sections; Section 5 looks into the water market to address the former and Section 6 looks into potential resistance one may expect against moves to procure surface water for drinking and other uses in KCC area. The discussion is concluded with several recommendations in Section 7.

3. Historical Overview of Water Supply in Khulna City

3.1 Early water supply in Khulna

Khulna was turned into an administrative unit, under the British Rule, as a police station in 1836. Five decades later, it was given the stature of a Municipal Corporation (on 12 December, 1884) under the Bengal Municipal Act 1884[9]. During the early years, Khulna Municipal Corporation (KMC) did not have any centrally managed water supply network; and people living in the area relied on few reserve tanks.[10] A decision at the Municipal General Meeting of 26 May 1896, to supply centrally managed water led to the formation of Khulna Water Works (KWW) in 1906. The emphasis was on surface water and KWW began to excavate and manage ponds and canals of the city. Over less than two decades that followed, there were six major reserved tanks, often named by their locations: Main Reserve, Post Office, Civil Court, Tutpara, Dak-Bangla, and the Bazar tanks. Another report suggests that there were 22 canals having the potential to provide additional surface water to the city. The first move to go beyond traditional ponds and tanks marked and protected for drinking water was made in 1921, when a water treatment plant (with a capacity of 9 lac liter per day) was established in the city's central (Municipality/Hadis) park[11]. Subsequently, the KWW gained momentum when two over-head tanks were constructed in 1929, with a total capacity of 70,000 gallons (Sardar, nd). Soon after, the department under the chairmanship of Mr. Mohendra Ghosh, introduced public tap (stand pipes) in the street corners and pipe networks to selected households. **The move signaled a significant change in the role of an authority, the Municipal, from that of a protector and overseer of (closed) surface water bodies, to one of service provider (supplier of piped water)**[12]. The search for safe drinking water in fear of epidemic and endemic cholera outbreaks had however commenced in the Bengal constituency since late 1920's, and by 1935 District Boards were authorized to dig tubewells, while the Department of Public Health (DPH) was responsible for supervision. The historical overview in DPHE (1963) mentions that there were 50,000 tubewells in the then East Pakistan during the Partition (1947), of which 38,000 were functional.

3.2 Initiation of DPHE and Water Supply

It is possible that the early moves towards groundwater for sourcing safe water and thereby reduce the incidence of cholera was rooted in our failure to protect the surface water designated for drinking[13]. The literature and reports available in the public domain does not mention of any in-country debate, even though gradual shift towards groundwater extraction continued during the post-Partition period. The pace was rather slow and interventions were

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[9] Incidentally, Khulna had the District administration functioning since 25 April 1882. It had then an area of 4630 sq. miles with a population of only 43,500 (Sardar, ?).

[10] Clay Tank, Tarer Pond, and Brick Field Tank are some of those early reserve tanks.

[11] It is alleged that the treatment involved boiling of water during the early years, and chlorination came into practice later.

[12] Till the early 1960's, Khulna city dwellers would wait to fill their pots for drinking water from two shots of supplies through stand pipes at pre-assigned times. A limited few got household connections by 1960, though many had under or over-ground reservoirs to separately store water for non-drinking purposes.

[13] Even as late as 1973-74, Hughes *et al* (1982) finds "In neighbourhoods with cholera infection, 44% of surface water sources were positive for *V. cholerae,* whereas only 2% of surface sources were positive in control neighbourhoods." The evidence is not against surface water, but reiterates the obvious – if a source of drinking water is contaminated (by *V. cholerae*), cholera infection is likely to be higher. It is however recognized that "the predominant route for cholera transmission is faecal-oral" (see UNICEF 2013).

at pilot levels till ICA[14] proposed to support installation of 12,000 tubewells per year during 1958 and 1959. More concerted effort towards groundwater extraction began with the formation of DPHE in 1960, later fueled by 'Green Revolution' during the later 1960s and beyond. By the end of 1962-63, the target of 1 tubewell for every 400 people is claimed to have been achieved; and DPHE set a new target of 1 per 200 persons in 1963. With political governance shaped under Basic Democracy, the USAID money for public works program under local governance with training via DPHE, raised the target to sinking 20,000 tubewells per year and re-sinking another 5000.

Similar to the rest of the country, the water supply system under KMC moved away from surface water and increasingly procured its water from ground water sources with the involvement of Department of Public Health Engineering (DPHE) since 1960-61. While KMC authority continued to supply water, the responsibility of finding new sources of water and tapping those within the net was vested with the DPHE under Municipal Administration Ordinance 1960. Thus, **effectively, the functions of procurement and distribution were separated which may have subsequently led to decline in accountability down the chain**.[15]

DPHE started to supply water by installing deep production tube wells and connected those to the network and extending distribution system in some new areas. Population pressure and limited surface water sources instigated government to further invest in ground water sources. In 1979-80, a survey, conducted on ground water with the technical support of the Netherlands government, led to installation of twelve deep tube-wells in 1980-81 to collect water with a capacity of 15 MLD. During the period of 1988-89, similar water related infrastructure development was initiated with the support of Bangladesh government, increasing the total water supply to 25 MLD by the year 1994. With further assistance from DPHE and Housing and Settlement Directorate (HSD), the capacity reached 32.5 MLD.

By 1998, there were about 49 pump houses and overhead tanks in the KCC area (USAID, 1999). According to Khulna Master Plan 2001, only 30 percent of total households in KCC area had access to piped water supply and remaining 64 percent were using hand tube wells (KDA, 2011). Over the next decade or so, only 11 production tubewells were added to increase the capacity of water supply (KDA). As a result, **installation of tubewells by private households became rampant even though it was prohibited by law**. In the case of Dhaka city, the indiscriminate drilling of pumps got further boost when property developers moved in to meet increasing demand for urban housing.

The growth in public water supply failed to keep pace with the growing population, and the capacity of production of deep tube wells started to deteriorate as well. In 2004-05 KCC took a project to install 20 production tube wells (in Phultala/Shiromoni area) and 20 km transmission line. This was stopped by a court injunction following BELA's litigation on

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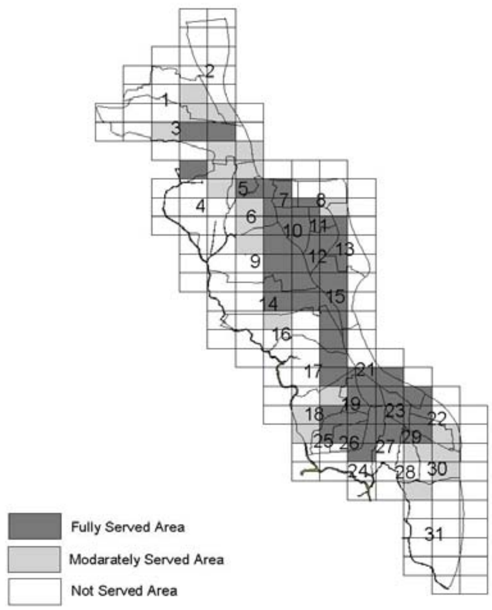
[14] The International Cooperation Administration (ICA) was established by the USA in 1955. The predecessor to this administration was the Foreign Operations Administration (FOA). Both organizations coordinated foreign assistance operations and conducted all non-military security programs for the United States. The administration was abolished by an Act of US Congress on September 4, 1961 and all functions were transferred to USAID (US Agency for International Development).

[15] Allocation of functions across institutions and provisioning of resources across those, within a set of vertically linked activities, has important implications for accountability. To our knowledge, this aspect had not received much attention in the past, and will be discussed further in later part of the report. One may also note that UNICEF was the sole distributor of HTWs till 1978-79, and irrigation equipments were later sold by BADC, BKB and BRDB.

ground of adverse environmental consequences.[16] Towards the end of the field consultation for this study, it was learned that KCC received a court decision in favor of them and 20 production tube wells have been installed in Phultala.[17]

Map 1: Piped water coverage, KCC Area



Source: Grid-level image in Alam et al, 2009 superimposed on ward-level .shp file

3.3 KWASA – the entrant in Khulna's water supply canvass

For almost half a century since 1960, it were the DPHE and one or the other brand of local government, which collaborated to do the sourcing of water for the city and supplied that water to households. However, the water distribution network in Khulna is rather old and with poor maintenance, the quality of tap-water degraded fast. The quality had also turned poor due to iron contamination in the shallow aquifer and increasing salinity of the ground water. A preliminary feasibility study was conducted; and strong voices were raised from local leaders to take up projects that will establish a surface water treatment plant. It is alleged that the government of Bangladesh, on insistence from segments of lending community, recognized the challenges involved and sought to establish the Khulna Water Supply and Sewerage authority (KWASA) to facilitate project implementation. KWASA is the third Water Supply and Sewerage Authority (WASA) in the country, following the Dhaka WASA and the Chittagong WASA, formed through a Statutory Regulation Order on 2 March

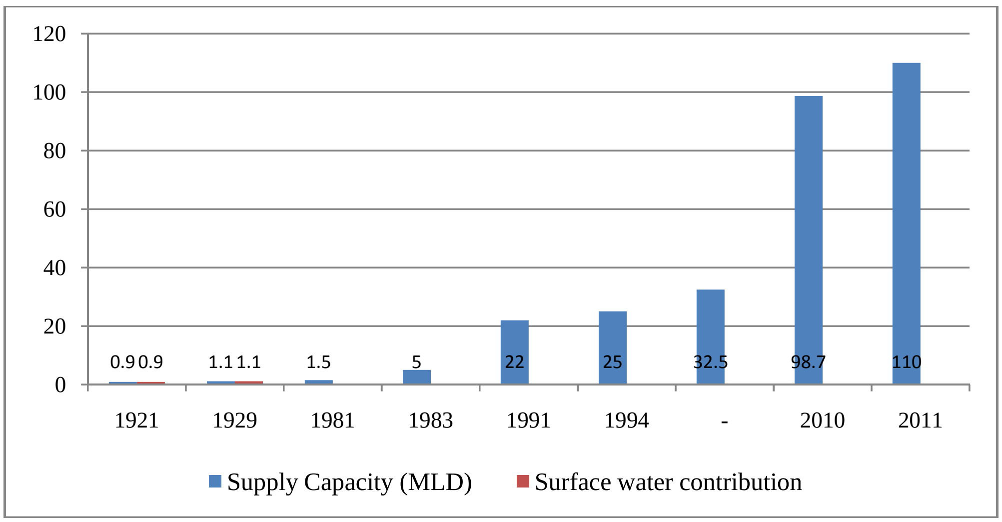
[16] Before the establishment of KWASA, Khulna City Corporation tried to install 40 deep tube well (in 152.4 meter depth) in Ward No. 1. The central government funded the project budgeted at BDT 47 million (USD 0.6 million) in order to add about 41 million liter water per day in the distribution system. However, the project was stopped in a court case in 2009 on the ground of inadequate EIA and protest from local people over fear of drying out pond and canals as about 0.2 million people's main income source is agriculture, plantation, poultry and pisciculture (BELA, 2009). It is claimed that all works related to drilling, storage and transportation (channel) had been completed. Various consultations lead us to believe that drilling had been done; and the civil engineering work on the reservoir and channel had been of extremely poor quality.

[17] When contacted, KWASA alleged that KCC was yet to hand over the tubewells, while KCC reported to have already handed the 20 wells to KWASA.

2008. It started its journey in October 2008, inheriting the human resource, physical assets and financial accounts of KCC's water works division (Tamaki, 2010)[18]. One may also note that the then Mayor of KCC (14.09.2008 till 09.05.2013) is the Chairman of Khulna WASA.

In spite of continued extraction of groundwater under the new water management regime[19], the water demand estimated at 240 million liters per day in 2011-12, far exceeded the supply of 114 million liters. One estimate reveals the household coverage under piped water to be only 30% in 2007-08 (Alam *et al*, 2009), which declined to 20.4% by 2012 (KDA, 2012). ADB (2013) provides yet a lower estimate, suggesting that 18% or less of KCC households have access to piped water.[20] In the context of this paper, it is more important to note that contribution of surface water to the city's piped water supply has been nil since 1981 (Graph 1). Only about 6 percent of city water supply came from surface sources before the turn of the century (USAID 1999).

Graph 1: Supply of Water in KCC Area



Note: '-' for year on the horizontal axis is during the turn of the century.
Source: KWASA, 2015

As noted at the beginning of this sub-section, KWASA's journey began by engaging in a ADB-JICA project (KWSP) worth USD 365 million project. The work of KWSP is already in progress to develop surface water sources, reservoirs, treatment plants and to extend piped

[18] It was suggested by some citizens with public images that the local political leader considered it an important prestige gain for the city and for his electorate, the lending agencies viewed it as an institutional reform for fast track project implementation, and the political power at the center found the delinking from local government (KCC) convenient for rent-extraction. Obviously control of KCC and the power around it were perceived to have been the beneficiary of the old arrangement; and it had to be one of the KCC Mayors (allegedly with interests in future contract assignments) whose participation had to be ensured.
[19] Since its establishment, KWASA installed 32 generators and 19 small generator-supported tubewells. As of 2011, KWASA had a total of 36 generator-supported tubewells, 50 small generator-supported tube-well, 10,000 deep and shallow tubewells, 240 kilometer pipe line providing connection to 16,660 households.
[20] The number game is obvious – with increasing population and stagnant service, percentage of households having access to that service will decline. It is however not clear if such figures under-estimate "access" by leaving out the households with no access to KWASA pipes, but with own tubewells and internal piped distribution. Recent SNV survey of 4367 households in Khulna city show that only 5.6% of them have piped water into dwellings, while 94.3% have piped water from tubewells and boreholes

network up to 600 km (ADB, 2011b). The project also has a component to excavate 22 canals and segments of Mayur river. In addition, while KWASA back-tracked from imposing restrictions on private ownership of STW/DTWs[21], it went ahead with the program of installing water meters and setting tariffs tied to meter readings. Some of the issues will be discussed further in later sections.

3.4 Summary: Highlights on trends in supply of water in KCC area

Chronology of events, including promulgation of new Acts, is presented in annex 1. Selected key elements and patterns from the historical journey of the city's populace are highlighted in this section.

Historically, few protected ponds and dugwells in each rural locality were the sources of drinking water; and these water bodies were barred from uses for bathing, washing clothes, cleaning dishes, etc. With increasing number of urban clusters recognized as separate administrative units, municipal administrations (or, any other form of government that preceded) were responsible to ensure safety of the water. The second important departure came when KMC engaged in supplying piped water to standpipes in street corners or to dwelling units, when several new responsibilities emerged. These were, procure water for adequate supply, ensure water quality (process and monitoring to ensure safety), installation & maintenance of the infrastructure, and meeting expenses that subsequently (in more recent times) involved imposing tariffs on consumers of water. All these called for greater professionalism and reduced control from local natural[22] authorities. For Khulna (KCC), the disjoint was severe, because the Partition of India (1947) compelled many local elites to leave the country on account of their religion.

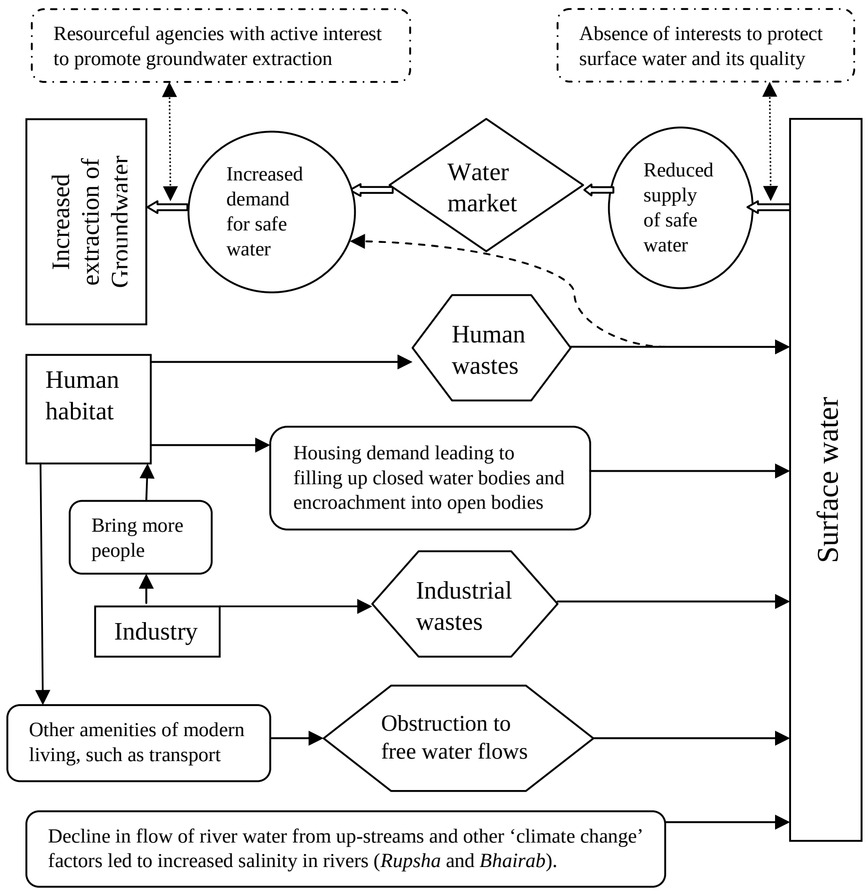
In the absence of year-specific data, it is guessed that by 1960, pipe water, meant for drinking, was sourced by pumping groundwater only. Within a logical schema depicted in Chart 1, one may note that the city grew due to several impetus at different time periods -- extension of railway from Jessore to Khulna; influx of refugees due to Partition of India; and industrialization during the 1960s. The growth in city population surpassed all past records after the Independence, primarily due to rural to urban migration. Factories with high negative externalities, such as, newsprint, as well as those in the upstream are alleged to have polluted river water, aggravated by declines in discharges from up-streams.

The water in most parts of Khulna city is brackish (DPHE) and USAID (1999) found only about 6 % of city water supply to have come from surface sources. Share of the latter, used for animal bathing and washing utensil, may have further declined. In addition, problems of salinity remain in both surface and groundwater. The worst outcome of the process has been intrusion of salinity into aquifer, reduced pace of regenerating aquifer leading to significant (and persistent) lowering of water tables[23], and private responses in the form of excess investment on pumps (moving to high-powered and submersible pumps), to get a share of the limited supply of groundwater. Public responses, reflecting intents and actions of the government, representative public bodies, and the external lending and development

[21] KWASA had issued a circular setting a fee of Tk. 10,000 for every installation of tubewells under private initiatives/ownership. With KCC opposing such move, the circular was reportedly withdrawn.
[22] Reference is being made to local landlords, business houses and educated elites; who are viewed separately from a local administration representing a national or a colonial government.
[23] The lowest water level data of the major rivers during the dry season also show a declining trend (BBS, 1985, 1992, 1998).

practitioners, get reflected in projects undertaken by various government agencies and other organizations. The decline in water status in KCC area appears irreversible, although there are signs of important changes to come in near future. All these are further discussed in Section 5.

Chart 1: Schema of inter-related factors leading to increased ground water extraction



Source: Own construct.

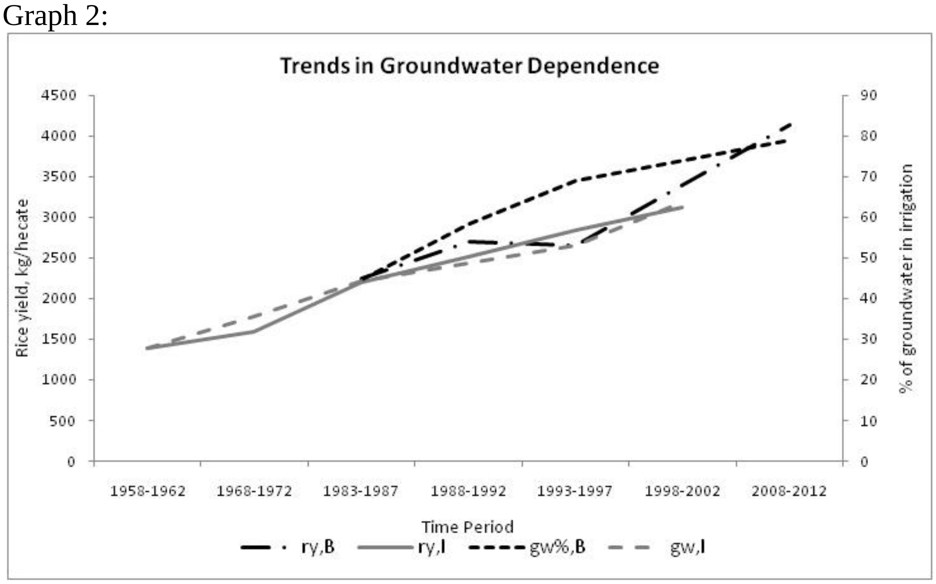
4. Changes of water sources and water management: From Surface to ground water

This section outlines the trends in our relative dependence on alternative water sources; in Bangladesh as well as in other countries in the world. The purpose is to assess if Bangladesh's experience differed from rest of the world in any significant way, and what plausible factors may underlie the common experience.

4.1 Changes in Water source: National

Almost 93% of the streams from the Ganges-Brahmaputra-Meghna river system discharge huge amount of surface water through Bangladesh (Khan, 1993). However, population growth, commercial and industrial expansion and the resulting pollution of urban watershed have severely affected the country's potable water sources (Minnatullah and Orsola). Since late 1950's, dependence on groundwater increased persistently in the then East Pakistan; and the process gained pace with the formation of DPHE, whose activities were externally financed in significant proportion. Around the same time, USAID supports to the agriculture sector, and subsequent expansion of HYV-irrigation-fertilizer technology during the Green Revolution, increased the demand for irrigation water by manifolds. By 1980, around one-third of irrigated area depended on groundwater and surface water was no more the source of drinking water in Khulna as well as other major cities in Bangladesh. Major policy changes promoting groundwater extraction, in order to foster crop-sector growth, came during the 1980's.[24] BADC sale of low-lift pumps and tubewells to private parties (individuals, informal groups and KSS), backed by special credit arrangement for purchasers, were pursued during 1980-85. The subsidy on DTW rental was close to 100% at one point in time, while the sales were made at less than one-fourth of government procurement cost. However, there was hardly any subsidy to STW during mid-eighties. Thus, withdrawal of restrictions, on import of engines and pumps by private sector in 1987 and of standardization restrictions (limiting makes and models) in 1988, paved way for rapid expansion in groundwater extraction. Over a period of 15 years (1981-96), share of modern irrigation increased from 63% in 1981 to 85% in 1996; while share of groundwater increased from 35% to 77%. If one assumes the water intakes per unit of land to remain constant, this implies that extraction of groundwater for irrigation increased by almost 5 times, while use of surface water had declined in absolute amount by almost 5%. The dependence on groundwater continued, even though the pace of increase has now been constrained by the options provided by nature. Graph 2 below compares the trends in groundwater dependence for irrigation and rice yield in Bangladesh and India. In both countries, average rice yield is highly correlated with share of groundwater irrigation. The former captures switch to high-yielding varieties and expansion of rice cultivation during dry season, which are facilitated by groundwater irrigation. The pace of increase in groundwater extraction in Bangladesh (shown in the Figure with darker lines) was significantly higher than India since the late 1980's. As discussed earlier, the policies had important roles to play in such increases.

Graph 2:



Note: ry = rice yield; gw% = % of irrigation water sourced from groundwater; B = Bangladesh; I = India.
Source: Own compilation from FAO statistics.

[24] For detail discussion, see Zohir (2001).

The dependence on surface water for drinking purpose had increased at a faster pace than that of irrigation or all-purpose water use. Information on it is sketchy and the figures are difficult to be assessed. If one asks the municipality or the WASA authorities, significant presence of surface water in their supply systems is reported. For example, KWASA repeatedly asserted that river water was brought into the tanks from *Bhairab* River, was treated and added to the piped supply system. Our independent query suggests that such practices have not existed for quite a number of years! DWASA (2000) claimed that their surface water treatment plants produced about 40 million liters per day. More recently, in response to claims of smelly water in the pipelines, the DWASA suggested that huge amount of chemicals had to be used to treat surface water, and over doses may have made the water toxic. Experts' opinions on share of surface water in DWASA's total water supply range widely from 13% to 31%.[25] In contrast, it would be safe to accept claims on significant dependence on surface water by Chittagong WASA. The literature search revealed that the focus of past efforts on data collection had been on households and their accessibility to "safe" drinking water, identified by associating the concept of "safe" with the source of water. For urban population, such sources included "piped water" and many others. It is therefore difficult to get any robust estimate from existing surveys. Recent reports however suggest that 97 % of people in Bangladesh have turned to underground sources for water over the past 20-30 years.[26] OPM (2015) makes more definitive claim that 79% of total water supply at the national level comes from ground water. Pessimism with regards to surface water continues, even when mega projects are being designed and implemented in Khulna as well as in Dhaka, to bring treated river water to the cities. The reasons for such pessimism were summarized in a recent WB report (WB 2014) in the following words:

"Surface water issues in Bangladesh can … be summarized as follows: (i) varying water availability during different seasons as well as its irregular occurrence; (ii) an intricate network of alluvial rivers carrying a huge annual discharge and sediment load, which is also unstable in nature causing embankment erosion; (iii) withdrawal in upstream areas, which has a serious effect on socioeconomic growth, the environment and ecology, and threatens fish habitations; (iv) inland navigation blockages; (v) increased water demand for domestic use; and (vi) an increase in salinity in the coastal belt."

4.2 Pattern of changes in water sources in other countries

Limited historical evidence suggest that the move towards groundwater extraction was initiated during the British Rule in India and was subsequently promoted by UNICEF since 1950's, on grounds of procuring safe drinking water. The latter received research backup from iccdr,b, which earned fame on account of its cholera research in Matlab, Comilla. USAID, a more important player, helped in institutionalizing agriculture research system and supporting the transformation of DPH to DPHE.[27] Much later during the 1980's, several multilateral lending agencies, including the World Bank, aggressively promoted irrigation

[25] See, Daily Ittefaq, 26 th February, 2015 and http://www.bracu.ac.bd/news/visit-saidabad-water-treatment-plant-26-november-2013. Informal queries suggest that Saidabad treatment plant has a capacity of 250 MLD, and hardly 40 MLD is generated. Compared to a total supply/use of approximately 2000 MLD, that would be 2% only.

[26] Ahmed, Firoze. "Water Supply situation analysis", conference paper, retrieved from: http://users.physics.harvard.edu/~wilson/arsenic/conferences/Feroze_Ahmed/Sec_2.htm.

[27] It is acknowledged in the literature that the intermingling of military engineering core with the civilian (technicians) spread the skill of drilling amongst civilians, thus providing the subsequent move towards expanded drilling for groundwater extraction.

with subsidies on tubewells and cheap credit. An obvious question arises, was this unique for Bangladesh? Or was Bangladesh's journey towards excessive dependence on groundwater merely an extension of a global trend, driven by factors beyond national boundaries? A comprehensive answer to the question requires independent studies with exclusive focus on those questions. Rest of the section only presents summary findings to allure the idea of such relations.

The case of India has already been introduced in Graph 2. Giordano and Villholth (2007) mentioned a paradigm shift from surface to ground water since 1960 in India and other parts of south Asia. While Bangladesh, a lower riparian country, continued to fight for autonomy, eventually leading to independence in 1971, emerging economies like India began to emphasize on artificial recharging of ground water since 1990s. China has always relied on harnessing surface water and in spite of alleged institutional failures in large-scale water management projects, share of groundwater increased to only 31% in 2006 from a mere 18% in 1985 (see FAO statistics).

Historical paths followed by the more developed countries reveal several characteristics; relatively high dependence on surface water and the phase of unabated increase in groundwater extraction has been thwarted by both a switch to surface water and via attaining a higher efficiency level in total water use. Although USA is in the top three positions for ground water extraction, relative share compared to surface water is much less. Since 1950, the share of surface water remained steady at around three-fourth of the total withdrawal (see Graph 2). UK was historically dependent on surface water for domestic use and protection of sources of surface water was ensured by establishing property rights.[28] However, in the late nineteenth and early twentieth century, large volumes of groundwater were pumped from aquifers in major cities, resulting in considerable fall in groundwater levels. More recently, patterns of groundwater use in cities have changed. Industrial activity has declined and many private boreholes have turned dysfunctional since preference switched to public water supplies. A further factor was the decline in the quality of groundwater in city areas, because of surface contamination and in some cases saline intrusion from the sea or tidal rivers.

The developed countries were quick to realize the urgency of greening the surface water bodies and the need to curtail unnecessary water use through policies (price policy included) and by promoting technologies for water treatment and reuse of waste water. Household water recycling system is very much common in Australia and USA. UK still has a low rate of implementing but from 2016 all buildings are to be constructed in accordance with guidelines on water use. According to the highest level of the code, the internal per person daily water use has to be less than 80 liters as suggested by Codes for Sustainable Homes (Environmental Agency, 2011).

To conclude this part, there are several important dimensions in water use patterns which deserve attention and reveal a number of differences across developed and less-developed countries.. First, more than 80% of water use in developing countries is accounted for by agriculture[29], compared to only 30% in developed industrialized countries (UNESCO 2003). Second, share of ground water in total water use kept increasing in developing countries, while it stabilized in developed countries (see Figure A2.3 on USA). Third, of the total

[28] The New River Company was given the right during early 17th century, which was taken over by the Metropolitan Water Board in 1904, and subsequently became part of Thames Water in 1973 (Waterhistory, 2007).
[29] In cases of Bangladesh and India, the share of agriculture exceeds 90%.

groundwater extracted, a very high percentage is accounted for agriculture in less-developed countries. While domestic uses may solely depend on groundwater, its share is only around 10% in Bangladesh and India, around 20% to 25% in USA and China, and 60% in Thailand. Finally, share of groundwater in total domestic use of water varies and no unique meaning can possibly be attached to the observed outcomes; 85% for India and around 97% for Bangladesh. It is estimated that 75 percent of domestic water in Thailand is obtained from groundwater sources (Sethaputra et. al, 2000).

4.3 Summary: Factors behind switch to groundwater

A number of factors may have pushed Bangladesh to the current state of excessive dependence on groundwater extraction. We summarize those below, prior to addressing the issues of change in the subsequent sections (5 and 6).

1. A primary reason is believed to be the population pressure which (i) raised demand for water (ii) with excess supply of human wastes dumped into limited closed and open water-bodies, deteriorated the quality of surface water, and (iii) with increased demand for land for housing, reduced the size of such water-bodies.
2. The fecal-oral connectivity is long recognized to have prevailed in the swampy lands of deltaic Bangladesh, and is considered the root cause of cholera epidemics. Perceiving groundwater for drinking as a solution, pre-Partition target of 1 tubewell per 400 persons was reset at 1 per 200 persons in 1960. The search for safe drinking water from groundwater sources was further boosted during 1970's and 1980's when the Bangladesh government and a few development oriented organizations tried to stop the problem of diarrheal diseases that were once fatal and caused severe malnutrition.[30] Deployment of tube wells during the period has been linked to several positive public health outcomes, including reductions in the outbreaks of waterborne disease, epidemics and reductions in infant mortality rates (Leidner, 2012).
3. Another advocacy issue touched upon gender related concerns, which argued that installation of tube well significantly reduced the workload of women and allow them to save time for fetching water.
4. Demand for groundwater increased manifolds due to the expanded adoption of seed-fertilizer-irrigation technology under the guise of Green Revolution, which was suitable during dry seasons when surface water was not widely available.
5. Eradicating cholera and diarrheal diseases, and the urge to increase food (rice) production provided sufficient grounds for designing new lending products by external partners. Bangladesh's experience lends support to the argument that the set of policies which led to improvements in social sector, had simultaneously caused insurmountable damage to its ecology and water balance in particular. The unregulated use of tube well in rural areas was clearly driven by a strong push from international lending/aid organizations to tie in lending with adoption of groundwater extraction technology (Leidner, 2012).
6. The alternative in the form of surface water shrank due to industrial pollution of river water, initially because of early industrialization during the 1960's, and more rapidly since the 1980's with growth of tannery industries and washing & dyeing associated with textile and RMG sectors. This effectively raised the cost of processing surface water for drinking as well as for healthy irrigation.

[30] These organizations concluded that the epicenter of the disease was sewage contamination of the surface water, and so they started digging thousands of wells to get to the groundwater (Sengupta *et al* 2012).

Given the development dynamics involving food, industry and the social sectors, it is difficult to associate any one motive that has strategic influence in shaping the increasing ecological imbalance. In the course of undertaking literature search and field research, we raised two other issues for consultation. The first dealt with possible role of pump (and other machineries) manufacturers and traders and the second question sought possible relations between extraction of groundwater and private cost associated with mining or drilling of resources from underground. On the first, the evidences are implicit in external lending to projects that were tied to sale or use of tube wells. Literature on aid conditionality was not found to have dealt with such micro-issues, and a closer scrutiny was beyond the scope of the present study. A group of environmental engineers having expertise in the respective fields were consulted on the second question, all of whom mentioned that such a question had not been posed earlier. However, they generally agreed that having an aquifer dried out is likely to reduce the cost of resource extraction, part of which is on account of unobstructed fuller extraction.

Finally, without delving explicitly into 'institutions'[31], it is important to take note of two additional issues. First, water sector management in Bangladesh confined most efforts to embankments and irrigation, having the least concern with safe drinking water and maintenance of water bodies for other purposes (aesthetic as well as for transportation). Since no property right was established for protection, use and supply of surface water, there were no voices to engage in social contracts and define institutions to promote the cause. We have seen temporary property rights established through leasing out river segments for the purpose of fishing, which have often hindered natural flows making the water unsuitable for human use. There is no instance of institutionalizing guardians of surface water, as was the case for ponds and tanks till 1950's.

The last statement leads us to the second issue, which is the role of organizations that are presumed to exist independent of our wishes and the people who run those organizations. As noted earlier, KWASA backed by several lending agencies, is currently implementing KWSP. It is alleged that the new organization was set up, curbing the power out of KCC, to facilitate implementation of KWSP, a mega infrastructure project funded by ADB and JICA. It is therefore expected that the people at the helm of that organization do not find any reason to address rainwater harvesting in urban areas, nor do they find any rationale in investing on technologies to recycle water. Many of the technocrats we met asserted that rainwater harvesting is for rural areas only; an obvious answer in a country where opinions are shaped by availability of project-specific resources. The business plan also reduced to the tariff rates suggested in technical reports prepared by consultants of lending agencies; a symptom associated with non-ownership of an agenda. More focused discussion in the following two sections will highlight some of those issues.

5. Water supply in Khulna city: understanding interests in favor of *status quo*

5.1 Understanding the status quo -- an emerging market with differentiated products

Coining the term 'market' takes one aback, especially if it comes from economists. People often tend to associate neo-liberalism and all the inhuman fallouts of ill-regulated markets whenever a question is posed within a framework of markets. Moreover, one is too tuned to accept rights to water and government's responsibility, to honor that right and general

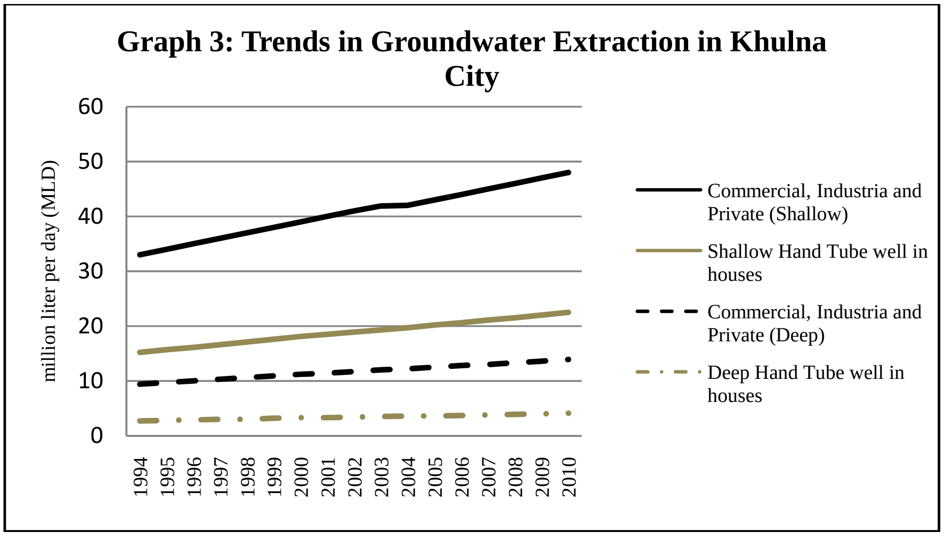
[31] An insightful discussion on institution and organization is made in Hodgson (2006).

antipathy against treating water as a 'marketable' item. It is however important to recognize that water is no more a free good, that is, it requires resources to make water available in usable form. Even when it is made available at zero prices by an agency in government or outside, as long as the opportunity cost is positive and consumers are willing to pay for receiving water, a market-based analytical framework can provide much insight into agencies engaged on the supply side. With that presumption, this section identifies the actors on both sides of transactions in water in Khulna, and interests involved in various segments of those transactions (market). Findings on water supply and uses are reported in different ways. Some refer to how water is procured, and others refer to how it is delivered to or accessed by households.[32] In addition, there are difficulties of comparing water for drinking and water used for other purposes. Such findings are summarized at first before reconstructing the canvass with important actors and how they are related. The latter will allow one to locate the groups that have an interest to maintain status quo and those keen on bringing about changes.

Ground water is the sole source of water supply in Khulna city. Graph 3, borrowed from ADB (2011), shows one particular categorization of groundwater abstraction, which reached a total of 98.7 MLD in 2010. Alam *et al* 2009 had shown that piped water coverage was 30% but excessive increase in city population led to decline in coverage to 20.4% (KDA, 2012). ADB (2013) estimation was even lower at only 18%.

Water happens to be both a good and a service. While qualities are attributes of goods and different types of water are available, there may be variations in nature of services for the same good. A survey of KCC consumers who have access to pipe water, revealed that only two-third of them considered the water drinkable. And only one-fourth of the latter explicitly mentioned of salinity as the reason for non-drinkability. On the service dimension, almost a third mentioned that the water supply was not adequate. On an average, households connected to the piped network enjoy only intermittent water supply (5.3 hours per day), and 74% of households find the supplied quantity insufficient. While KWASA's pipe water is also sourced from production tube wells, poor quality, irregularity and inadequacy forced private households to opt for ground water extraction on their own. The poor households with no connection rely on shared public taps and a study found substantial time loss on accounts of fetching such water (ADB, 2009).

[32] Hossain (2011) categorizes major drinking sources as tap water (10%), tap water in front of the house (0.30%), government tap pipe (3%), shallow tube-well less than 500 feet depth (13.70%), deep tube-well greater than 500 feet depth (72.80%), pond (0.20%), and bottled water (0.01%). The categories are rather confusing.



Source: ADB, 2011

Table 1: Source of Water (% of households)

Sources of Water	Drinking water	All purpose water (domestic)		
	ADB 2009	Consumer survey 2009	ADB 2011a	KDA 2012
Piped water supply	0.2	19.4	24.0	20.4
(Of which, Non-Revenue pipe)			(6.0)	
Private/Own tubewell	38.4	31.9	44.0	51.0
Public/Community tubewell	59.1			28.2
Hand pump tubewells		39.5	30.1	
Hydrants/public taps		0.2	1.0	
Water Vendors/bottled water	1.1	0.7		
Pond/well		6.9	2.0	0.3
Others	1.2	1.4		0.1
Total	100	100	100	100

Note: Approximately 6% of all households, that is, one-fourth of those availing piped water supply, were found to be under non-revenue category (ADB 2011a).
Sources: Mentioned in column heads.

Chart 2 summarizes the flow of drinking water to end consumers via different agencies. The focus is confined to drinking water only, all of which are currently sourced from aquifers using tube well pumps. At the ground level, four major operators are identified; KWASA with numerous private individuals (households), approximately 17 private firms supplying filtered/boiled water in 20 liter jars and distributors of bottled water (250 ml to 5 liter) of national level companies. In most cases of the latter, water is bottled outside Khulna and the local water supply firms process water available from groundwater sources, normally private deep tube wells in rented or own premise. Private initiative to extract groundwater with own pumps came as a desperate attempt for self preservation as a result of failure of the public sector. Currently, more than half the population is estimated to be procuring drinking water through self-dug tube wells (Table 1). The private suppliers of water are secondary players and account for an insignificant portion of the population in KCC area while the major actor remains KWASA, which also happens to provide the link between the micro setting with the meso and macro-level actors.

The study team had consulted all four groups, as well as those identified on the right hand side of Chart 2. The following subsection details on the actors and their likely roles in either perpetuating/protecting the status quo or in actively promoting changes away from groundwater extraction.

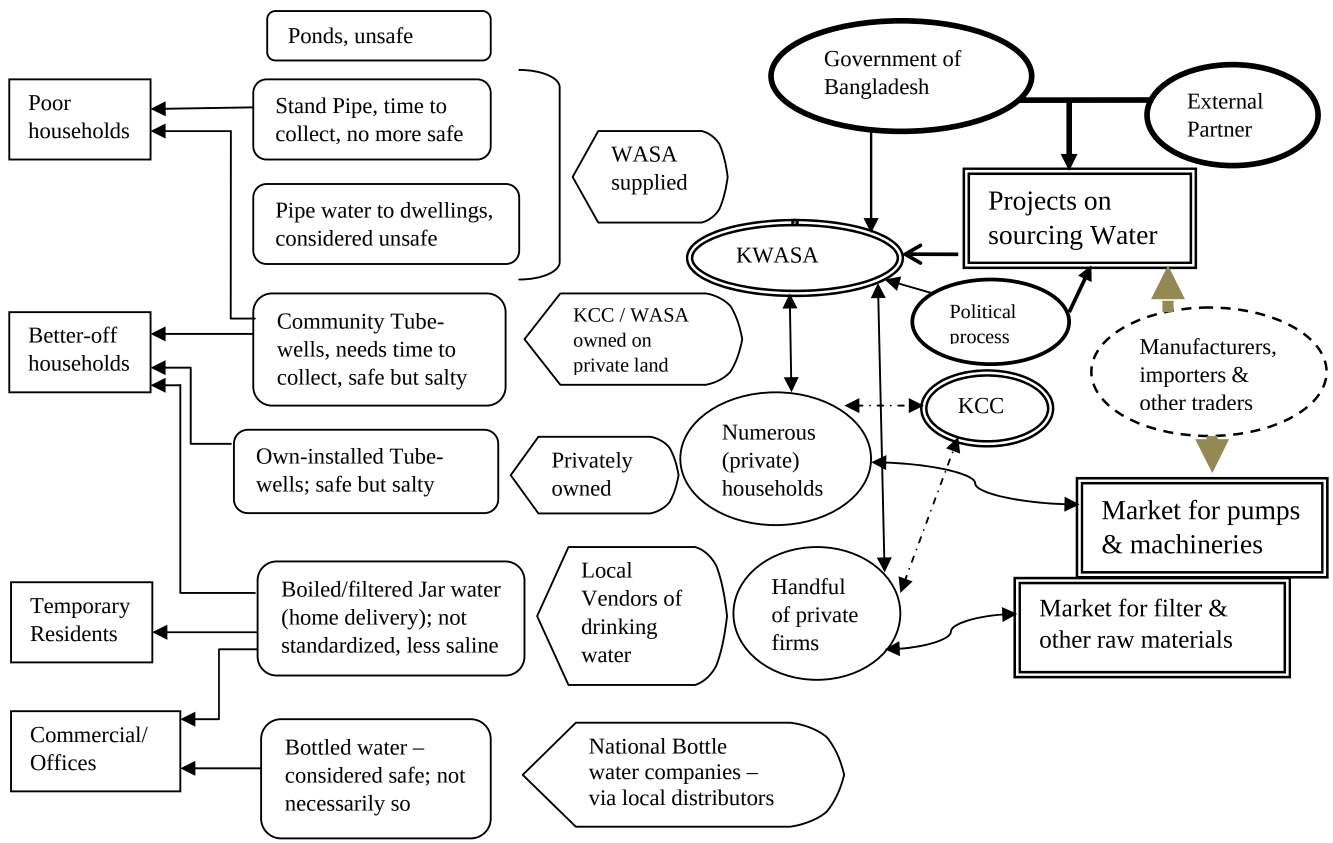
5.2 Stakeholders' interests and perspectives: findings from consultations

Since recent surveys find no significant presence of drinking pond (and other) water, one may list six different types of water that are currently available for drinking purposes in KCC area. These are stand pipe (KWASA), pipe water in dwellings (KWASA), community tube wells (whose *de jure* ownership lies with KWASA, but *de facto* ownership may lie with the private owner of the compound where the tube well is installed), privately dug tube wells, vendors of water in large jars, and bottled water. If the opportunity cost of one's time is zero, then the stand pipes are the least cost source of drinking water which however, is alleged to include additional pollutants on accounts of depleting water distribution infrastructure. Similarly, zero cost provisions (from user perspective) are available through community tube wells, which are normally located in neighborhoods with better-off residents. Leaving aside those groups, we address the others below.

5.2.1 Households with many sources

We all tend to minimize risk by spreading it on a wider portfolio. The same principle applies to city residents who have the means to ensure regular supply of quality water, the ultimate necessity for living. For the generation of around 50 years old or below, getting a water connection is a mandatory ritual that goes with each and every new building on the landscape. When the supply dwindled, each was digging deep for the reserve tank, negotiating a better connection point, investing on a mindless game of outbidding other neighbors by installing a high-powered pump to force the water-flow towards one's direction. Those who had the right social and/or political contacts influenced the KCC/DPHE installation of community tube wells inside their compounds. When efforts (and financial cost) to access pipe water failed to be a fruitful investment both on adequacy and safety concerns, many began to dig their own tube wells. The latter was encouraged by policy relaxations of sites during the late 1980's and of standardization and imports during early 1990's, though those were meant for irrigation.

Chart 2: Segmented Market of Drinking Water and Interests around Groundwater Extraction



Source: Own construct.

When interviewed, almost all were unhappy with the situation. In spite of the cost, depleting water table was commonly recognized[33]. It was also reported that many moved into submersible pumps to fight for the water at lower levels in aquifers; a second round of mad competition as a result of failure in collective (public) actions. In addition, with the introduction of meter system, with meters placed at points of lifting water vertically to overhead tanks and not at the point where WASA's pipe water enters the dwellings, the tariff had allegedly gone up manifolds.[34] People at large are prey of markets and public inactions and they are keen on seeing a regular supply of safe water. Most also realize that this ought to come from surface water. There is however a lack of appreciation for the importance of rainwater harvesting, partly because of non-availability/non-awareness of appropriate technology.

5.2.2 Private Firms supplying Drinking Water

Currently there are 17 firms operating in Khulna city, all of who claim to be using RO for processing underground water.[35] The key researchers interviewed several of the entrepreneurs who come from diverse backgrounds in terms of education and home districts (list included in annex 6). The operations are generally carried out at regular residence or rented premise where water from DTWs is accessible. An average plant, dictated by the RO capacity, currently produces 3,500 liters per day[36]. Even though Jonayed Osmo's market research assumes a requirement of 2 liter per day per person, we found an average consumption of 7 jars (of 20 liters) per month, for a family of 5 members (including domestic help). Based on the number of firms currently active, and a city population of 15 lakh people, it is estimated that a maximum of 5% households can be covered. However, more than half of production is reported to be delivered to offices and social events (such as, wedding and other parties). Thus, roughly 2% of the city population is likely to be availing jar water.

Based on the consultations carried out, several observations may be made:

1. Main source remains the groundwater, and the selling point is primarily the removal of salinity from water. Normally, water from a depth of around 800 – 950 ft is considered saline-wise safe (i.e., less than 5% saline), and a knowledgeable entrepreneur will choose DTWs that extract water from that level. The industry also keeps adapting to new

[33] This was independently verified.

[34] It is a classic case of rent extraction which can only be justified on grounds of deterring groundwater extraction and by diverting the revenue for the alternative. One may also note that the actual payment is double that of the water bill on account of sewerage and wastewater disposal.

[35] Reverse Osmosis (RO) is a technology that is used to remove a large majority of contaminants from water by pushing the water under pressure through a semi-permeable membrane. It is capable of removing up to 99%+ of the dissolved salts (ions), particles, colloids, organics, bacteria and pyrogens from the feed water. An RO system should not however be relied upon to remove 100% of bacteria and viruses. Reverse Osmosis is very effective in treating brackish, surface and ground water for both large and small flows applications. Some examples of industries that use RO water include pharmaceutical, boiler feed water, food and beverage, metal finishing and semiconductor manufacturing. (Source: http://puretecwater.com/what-is-reverse-osmosis.html#what-contaminants-does-reverse-osmosis-remove)

[36] If the processes are honestly followed, generation of bottled water involves pre-filtration, RO, UV charging and bottling. A firm may have one or more plants, and every firm directly coordinates deliveries to home and to places of gatherings.

techniques of chemical treatments and less costly filtering before RO process with membranes. The latter is the costliest part and longer durability with required performance reduces cost of producing drinkable water.

2. A 20 liter jar costs Tk. 50, thus requiring a family of five to pay less than Tk. 400 per month for drinking water. While the amount is negligible for a middle-income family, the suppliers feel that lack of awareness is the main reason for insufficient market response. The President of the Association, Mr. Iftekhar Ali, would like to see more people made aware of the poor quality of water in the Khulna region and the probable health hazards of drinking such water. Given the size of the market, and the low willingness to pay among potential customers, individual entrepreneurs are unwilling to invest on the awareness campaign. Moreover, it is a part-time business for most entrepreneurs because of the limited time it demands and the limited income it fetches.
3. Attempts were made to assess the importance of importers and sellers of equipments and membranes. It is understood that there are multiple brands and suppliers. During the early years of the industry, costly membranes imported from the USA and Taiwan were used. The choices have widened, and cheaper ones are now available from South Korea and China. While there is a growing market, the supply-side players were not found to be sufficiently powerful to influence local policy. On the contrary, they are pleading with the Mayor to waive (or reduce) the newly imposed municipality tax.[37]

5.2.3 Pumps and Machinery manufacturers and traders

With groundwater extraction, for irrigation as well as for procuring safe drinking water, the market for pumps and other irrigation accessories have expanded as well. For the purpose of drinking water and water for urban use, there are two distinct markets, project-based procurements done by respective government agencies, and the private owners of tube wells who sought the route in response to failure of public agencies. Several dealers of pumps, doing business for decades, mentioned of existing entente between project engineers (and management) and the suppliers.[38] While a detailed search was not possible, suggestions were made that there is bias in the brand choices under government projects which procured pump machines. For example, several pump dealers in Khulna market reported that KSB, a German technology produced in India, had been a most frequently sought brand under government procurements. The second segment in the market is a small part of the nation-wide market of irrigation pumps used for tube wells. Traditionally, this market had been dominated by few brands such as Pedrollo, mostly from Italian and Japanese origins. While there has been substantive penetration in the market by few foreign manufacturers, enormous increase in demand created space for the inclusion of no-name Chinese pumps, Chinese machineries converted to local brands (Gazi and RFL), and brand names from China and few other countries. A classic example is that of Pedrollo which started off with a single distributor during early 1980’s and expanded the net of dealership since mid-1990’s[39] till recently (in 2010) opened its own showroom in Khulna city aiming at providing one-stop solution to its clients.

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[37] See SRO No. 44 Rule/2015, notified on 23 February 2015, Bangladesh Gazette, published on 2 March 2015.

[38] Instances were also cited where project officials were allured to mention 2 HP machines where only 1.5 HP was necessary.

[39] Pedrolla’s expansion in Khulna city came in 2005 by bringing sanitary outlets under the fold.

The historical overview revealed possible association between external borrowing tied to cheap credit for irrigation equipments, and the latter facilitated groundwater extraction. Such association cannot be shown to hold in the present context. On the contrary, markets clearly matured, prices reduced, submersible pumps have been introduced (since 2008) and had addressed (through differentiated products) subtle needs that surfaced in a regime where consumers have no alternative to groundwater extraction. Thus, given the macro environment (options on water sources), historically determined politics of resource allocation across surface and groundwater was no more an issue. It however remains relevant in the choice of pumps/machines under government-run projects.

5.3 Brief detour to local politics and how they fit in the water canvass

The politics of multiple organizations with functional responsibilities in inter-related activities yet lack coordination is discussed in Annex 3. In this sub-section, we touch upon local political influences that may (or may not) have bearings on decisions in the water sector.

Bangladesh's party politics at local levels, be those in upazilas or districts and divisional towns/cities, is dominated by people who are occupationally engaged in the business of "contractors". In the recently concluded election of 26 councilors in the two Dhaka city corporations, 17 are contractors. Another 9 have not registered themselves as contractors but their business is supplying construction materials, commodities and services to various government and private offices"[40]. The same if not more, applies to electorates at municipal and upazila levels. The linkage between political authority (either as Mayor or as a powerful party leader), authority over WASA (as a Chairman) and the role of a Contractor who may potentially benefit from procurements by WASA projects or some other government projects, is all too evident in case of Khulna city. The alliance across these functions is driven by the urge to have new projects with fresh finance, and it so happens that such projects in Khulna will be more in surface water than in groundwater extraction. One may therefore expect local political leaders with interests tied to contractor-jobs in new projects, to be enthusiastic about projects with large components of civil works.[41]

6. Access to Surface water for Khulna city: politics for and against

6.1 Introduction: options for surface water

In terms of availability, withdrawals and stress status of surface water, Bangladesh is perceived to be comparatively in a safe position. About 10 liters of water per person is said to be renewed every year in natural process, which is quite high and the stress on fresh water is projected by some to be minimal in 2025 (Revenga, 2000 and WBCSD, 2006). However, the situation may alter under certain adverse scenario, if the planning on water system fails to account for those scenarios. Salinity in south-western coast of Bangladesh is rising, water tables are noticeably

[40] Source: Prothom Alo (English), May 7, 2015.
[41] An example is the land filling work in Rampal for the proposed power plant. The government of Bangladesh recently moved towards changing procurement procedures with a view to brining in efficiency and timely completion. See, coverage in Dhaka Tribune, 7 September, 2015.

declining and people have to deal with unbearable troughs during dry seasons.[42] Of the broad options available for coming out of the situation, three were highlighted, (i) bringing saline-free and otherwise safe surface water from a distance, (ii) retain/harvest rainwater at household or collective level, and (iii) develop Mayur river as a reservoir of surface water. In the earlier parts of this report, mentions were made of KWASA's formation and the likelihood of it being linked to the undertaking of a mega project called KWSP which is under implementation to bring water from *Madhumati* river in Mollarhat. It had also been noted that local political leaders, with cross-cutting interests in contract jobs under project procurements, had full supports for such mega schemes. Due to absence of resources for rent-sharing under household-level rainwater harvesting schemes, the latter are less attractive to these leaders as well as to the technocrats in the government agencies. While the issues linked with lending programs will be discussed in the concluding section, we pursue with an exclusive focus on *Mayur* river.

During the first month of undertaking this study, we were repeatedly told of resistance to any attempt to bring the river under a water reservoir scheme. Mentions were also made of a Ward Commissioner murdered, only because of his public stand against illegal occupants on the banks of *Mayur* river. A field study was therefore designed separately to assess the kind of resistance one would expect against any move to make use of the *Mayur* river for enhancing the public supply of water to Khulna city. The design and findings of the study are presented in 6.3, following a brief summary on current status of water available in *Mayur* river in sub-section 6.2.

6.2 Risk of surface water sources[43]

Mayur has been a subject of query from the academics in environmental science at Khulna University, where several studies were undertaken in collaboration with IWFM-BUET and Institute of Livelihood Studies (ILS). This sub-section draws upon some of the works done and focuses on geo-morphological characteristics of *Mayur* water.

The potential sources of water security in KCC are the groundwater aquifers, the city wetlands such as the ponds and lakes, and the river *Mayur*. The geochemical analysis of these waters indicate that the water type represents both rock weathering (particularly carbonate weathering) and salinization (seawater intrusion) as governing mechanism. The groundwater represents unstable geochemical behavior and is not maintaining the standard for inorganic constituents as prescribed by WHO and Bangladesh. Thus, these waters are not suitable as potential source of potable water. A current estimate shows that there are at least 55 ponds and small lakes in KCC. However, most of the pond and lake water samples are within the standards of reference to inorganic constituents but also indicate signature of anthropogenic contaminants. However these ponds and lakes could get rid of such anthropogenic contaminants by renovation and maintenance and monitoring. The inorganic constituents of the *Mayur* winter samples do not obey the prescribed quality standards as prescribed by WHO and Bangladesh. However, the inorganic constituents of monsoon water of *Mayur* do not exceed the desirable limit as

[42] Apparently, the JICA funded surface reservoir project in Khulna did not consider the possible increase of salinity in groundwater of that locality (ADB, 2011b).
[43] This sub-section draws upon discussion made in a paper of Professor Dilip K Dutta, shared with ERG researchers.

prescribed by WHO and Bangladesh[44], even though those indicate signature of anthropogenic contamination.

The volume of water required by the KCC population for potable purposes is around 240 million litres *per* day (MLD) (accounting for a population of 15 million that is 16 litres *per* person *per* day). KWASA supplies around 30 MLD through pipe-line and 90 MLD through tube-wells installed by KCC. The rest of the requirements are met by privately owned tube-wells. The fact is, the current supply is exclusively depended on groundwater. However our estimate indicates that the *Mayur* is holding quite a sizable amount of water, of which at least 20% (amount) could be a potential supplement to KCC potable water requirement. However, to utilize *Mayur* water, proper management plan to deter the untreated effluents from entering the *Mayur* was deemed necessary. In addition, proper regulatory measure is required for keeping the *Mayur* as a freshwater reservoir.

6.3 Study on Current Interests around Mayur River

As discussed, the chemical composition of *Mayur* River has become unusable (Khan, 2011). During the dry season, the water quality exceeds the recommended limits, leaving mostly unsuitable for any use (Kumar *et al* 2011). There are 22 drainage canals in the KCC area which directly discharge wastewater into the *Mayur* River. KDA performed an inventory on 49 canals where the report reveals that most of them are filled up or encroached for the purpose of fishing (KDA, 2014)[45]. Under the prevailing situation, it can be understood that the surface water base dependency on *Mayur* River and canals of the city will not be possible to implement without working on drainage, proper channel, drainage system and strict planning intervention to protect water bodies. The concept of open water reservoir at a large scale is still unfamiliar in Bangladesh and requires commitment from the community as well as from the authority. As mentioned, changing the current structure of *de facto* ownership of parts of the water bodies and banks, is perceived almost impossible, which encouraged us to search for the sources of power that may give formidable resistance. Therefore, a central question posed was, what are the various interests that may obstruct/oppose an initiative to ensure use of the *Mayur* River (and *Pabla Beel*) for retention of safe water, to be supplied to KCC area? It also meant to identify ways to address the concerns of the affected parties and implement the first objective.

6.3.1 Survey design and Tasks undertaken

The most recent google map of the area (2015) covering the total length of *Mayur* river was downloaded and 37 segments were identified that covered approximately 85% of the length of *Mayur* river. Of those, 30 segments were chosen for administering a segment-level questionnaire. These 30 accounted for 69% of the total length of the river and the segment-level questionnaire had a checklist to identify presence (or absence) of certain activities during rainy and dry (winter) seasons. The information allowed a cluster analysis with five clusters, where ANOVA technique was used to ensure clear distinction between the clusters. Subsequently, 6

[44] One measure to assess quality of water is the Total Dissolved Solids (TDS), which refers to “any minerals, salts, metals, cations or anions dissolved in water”. TDS comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides and sulfates) and some small amounts of organic matter.
[45] Official documents rarely acknowledge illegal occupation for human habitats!

segments were selected covering 4 out of 5 clusters, and the selected segments together accounted for 14% of the total length of the river. The fifth cluster was left out since large slums cover the area and the vote dynamics associated with it is widely known. All the plots adjacent to the river in these segments, visible in the Google map and subsequently identified during the field survey were included in the second survey. The findings presented in Annex 4 are either percentages of segments (for the first survey), or correspond to the plots (for the second survey). Maps A4.1 and A4.2 show the location of the segments.

6.3.2 Survey Findings

Three observations applied to more than three-fourth of the segments (see Table A4.1), people from neighborhood dumping solid wastes (93%), land-filling for homestead (77%) and filling land with solid waste (73 to 77%) Hanging latrine was also quite common. In one-third of the segments, at two ends of the river, fish cultivation of two different kinds were found to be common. Though present, less visible were hanging shops, floating vegetable cultivation, industrial or hospital waste disposal, and land filling for business. Table A4.2 on cluster-specific information reveal the locations where some activities are more prominent than in others.

Plot-level information on activities and space use are summarized in Tables A4.3 and A4.4, where homestead is considered as well. In 76.6% of the surveyed plots, single use is observed. Of the latter, two-third (49% of all plots) is used exclusively for homestead. It is noteworthy that more than a quarter of the plots are used for economic activities with no homestead on the plots and a single economic activity is carried out in presence of residents in 15% of the plots. Of the various economic activities, fish and vegetable cultivations along with nursery, dominate. Among others, cattle-farming is found in 8.6% of the plots.

Without delving into details of plot size, investment and employment are summarized for single use plots in Table A4.4 which aggregate resources that are estimated to be tied to the plots adjacent to the Mayur river, are presented below in Table 2. No independent assessment could be done on the legal ownership of the land, but given respondents' revelations it appears that most of the land belongs to the government. Thus, other than the human displacement factor, the financial cost appears insignificant compared to the expected benefits.

Table 2: Estimated Resources tied to banks of *Mayur* River

Description of items	Estimates
Land, in acres	733
Fixed Investment on structures, million Taka	196
Number of persons employed round the year	1293
Number of persons employed on a seasonal basis	2414
Part-time employment, number of person-days per year	11000

Note: Aggregate figures obtained from the survey of plots in 6 segments, considered to account for 14% of total length of the river, were blown up to 100%.
Source: Own estimate.

In the second survey, we probed into economic, social and political linkages of the occupants and users of the plots on the banks of *Mayur* river. Direct questions were also posed to know their reaction to a government move to excavate the river and make it a reservoir for water to be supplied to the city. The questions were open-ended and were followed up by long consultations. Only the highlights of our observations are outlined below. It is important to note that we had purposively left out a cluster dominated by slums.

1. There did not appear to be any noteworthy concentrations of people coming from a particular district or upazila outside Khulna, although there were many outsiders.
2. Significant presence of absentee landlords, *de facto* or *de jure*. In many places, help, protection and advice of the ward commissioners and local political leaders were reportedly sought. However, since the cases of new settlements are insignificant, the old settlers have common agenda and can unite on their own to protect.
3. While hands have changed and legal papers may be available with occupants or plot-owners, there is a consensus on the need to protect the water body. Majority believed that there will not be much resistance if suitable alternative accommodation was provided by the government.
4. The major resistance is foreseen in segments 1 to 6 in our map, covering two legs of the *Mayur* river on the south, where shrimp cultivation was found to be practiced. Historically, the owners of the *Ghers* (fish farms) had direct patronage from political leaders in power and instability increases as and when there are changes in power. Our field enumerators were threatened in some parts when the second survey came to the notice of some local powerful players.

By drawing upon numerous interviews of local residents, it is understood that people from different professions, most of whom are based in Khulna, have stakes in the public land on or near the banks of the *Mayur* river. There is a silent voice that may affect election outcomes at local (ward) levels but is perceived to have little or no significance for national assembly or Mayorial elections. Moreover, many of these occupants, legal or not, are willing to make way for better use of the water body if alternative arrangements can be made for their residence. Thus, asset-wise, viable options may be sought with little or no resistance. However, in terms of current flow of incomes, major resistance is expected from the shrimp/fish cultivators in the segments mentioned above. Given the high social benefits perceived and given an assumption of little or no flow of rents from such occupancy to the actors in the central government, realizing a change for better is feasible.

7. Summary and Recommendations

Instead of summarizing the long narrative, selected observations are made to capture the political economy of water extraction in Bangladesh. The story of Khulna is unlikely to be unique, same stories of land encroachment or industrial waste disposal are expected to be observed elsewhere in the country, particularly in Dhaka, Chittagong and the divisional cities. No attempt could however be made to gather similar information on other cities which could enable us to make some generalized conclusion.

1. Till markets took over there had been supply side drivers to promote groundwater extraction
2. While not elaborated in fuller details, biases in the inflows of external resources and a project-based development approach left the surface water unattended. Thus, other interests, unloading of human wastes, industrial wastes and encroachment into public water bodies, came to play a bigger role in shaping the fate of (surface) water bodies. All those, made groundwater extraction relatively more desirable on account of safe water.
3. In the policy domain, water has been considered a resource only in the context of irrigation. Part of the reason lies in the lucrative nature of mega project with respect to rent-sharing prospects. There are also reasons to believe that policies had systematically facilitated the opening up of market for pumps and machineries, which biased our views towards water markets. Even if one avoids any argument based on rights, there had clearly been a policy failure to understand the linkages between large scale investments on surface water that define the state of groundwater, as well as the limits to markets linked to groundwater extraction. Kureshi *et al* (2015) rightly notes the need for balancing aquifer recharge and discharge and revisiting groundwater governance policies.
4. With groundwater extraction reaching a limit in Khulna, search for viable options was being driven by factors that are tied to interests of multiple actors. There is clearly a congruence of interests among technocrats keen on controlling resourceful projects, people keen on getting quick solutions, a government keen on availing foreign loans with high aid component, local political leaders eyeing for contracts on civil works, lending agencies keen on cost-efficient disbursement. For some reasons, Mayur river project failed to draw the attention until very recently when the WB approved the excavating and beautification project on Mayur river worth TK 1000 crore, along the line of the Hatirjheel model. While consulting with different stakeholders (KCC, KDA, BWDB), JICA and ADB reported that many of the organizations' heads, including the then KCC Mayor, gave their opinion in favor of using Mayur river as a reservoir. Unfortunately, the detail Assessment study done later did not consider Mayur river.[46]
5. The alleged resistance by illegal occupants is argued to be ill-founded. The latter suggest that such allegations often arise because there is not sufficient urge to bring the change.[47]

[46] See, appendix-C of the stakeholder meeting report. Some of the attendees of the meeting and another project done by SaciWater gave emphasised on Mayur river for retaining drainage water. See also, http://www.adb.org/sites/default/files/project-document/63110/42469-01-ban-tacr.pdf and http://greenwatchbd.com/save-mayur-river-for-water-security-of-khulna-city/

[47] One may note that the WB project on Mayur was signed with KCC, and not with KWASA. It gives two messages that remain to be unveiled, (i) the project is not viewed within the larger context of managing drinking water, and (ii) choice of KCC as the implementing agency may run into difficulty with the removal of the Mayor.

Finally, several suggestions are made for agencies like the WaterAid Bangladesh who deal with soft changes such as dealing with communities, awareness and mobilizations. Three broad areas which need urgent attention are being overlooked under regimes of mega projects. These are, (i) bringing in efficiency in water use through awareness as well as by acting as intermediary between regulatory agencies and water-users[48]; (ii) work towards popularizing the idea of open surface water reservoir for drinking purpose, and organize communities towards realizing the very first such attempt in Bangladesh and (iii) since rain water harvesting in urban areas is looked down upon by established agencies within the government, WAB may take initiatives on the appropriate technology and institutional arrangements to make inroads.

[48] The more recently introduced water act of 2013 makes it mandatory for any individual to obtain a license/permit for large-scale withdrawal of groundwater by individuals and organizations beyond domestic use. However, enforcing laws, installing licensing and permit systems, and the establishment of tradable property rights have so far proven largely ineffective. Important lessons on what does not work in improving groundwater governance could be learned from the management experiences of nearby countries such as India, Pakistan, and China, where permit and licensing systems also failed to yield desirable results. (Kureshi et al 2015).

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Annex 1: Water Related Laws in Bangladesh

In Bangladesh the following legislations are there with regard to drinking water and water bodies:

The Canal Act 1864 also known as Bengal Act V of 1864, was used to manage the Rivers and Canals.
The Embankment and Drainage Act 1952 was enacted to consolidate the laws related to embankment and drainage. It allows for the provision of construction, maintenance, management, removal and control of embankments.
The Water Resource Planning Act 1992 was passed to ensure water resource planning.
The Bangladesh Environmental Conservation Act passed in 1995 and the accompanying Environment Conservation Rules in 1997 are arguably the most important legislative documents for industrial water pollution. Environmental Court Act 2000, was also passed to control environmental pollution.
Bangladesh Water Development Board Act 2000 was passed to ensure the total management of the open water resource sector and this act nullified the function of the Bangladesh Water and Power Development Boards Order, 1972 (P. O. No. 59 of 1972).
In the same year, The City Development and Conservation of Natural Wetland Act 2000 was passed to protect the playground, open place, park and natural water bodies in the city area. With this act, the natural water bodies including the river, lake or any water bodies became recognized in the master plan.
Recently, the Water Act 2013 has been passed which is based on the National Water and Sanitation Policy 1998,designed for integrated development, management, extraction, distribution, usage, protection and conservation of water resources in Bangladesh. The formation of the high-powered National Water Resources Council with the Prime Minister as the head implies the importance the government is paying to the management of this precious resource. The Act recognizes the significance for managing all forms of water resources in the context of natural flow of surface water and recharge of groundwater. The Act provides the legal framework for development, management, extraction, distribution, usage, protection, and conservation of water resources. Moreover, considering the prospects of rainwater harvesting, it was given much importance. Nevertheless, the Act falls short in making a commitment by the government to ensure the quality of water for various beneficial uses. The maximum amount of surface water or groundwater that can be withdrawn by individuals or organizations is not mentioned in the Act as well.
Moreover, the government (Paurashava) Act 2009 and Local government (City Corporation) act, 2009 also has the provision of maintaining and searching of water sources while supply adequate water to its residents.

The following table illustrates the chronological changes in water supply system in Khulna city and relevant rules and regulations:

Table 1.1: Chronological changes of water supply in Khulna City

Events	Date	Organization	Comments
Khulna city started as a police station	1836		
The Canal Act	1864		
Promoted to Paurashava	Bengal Municipal Act 1884		No established water supply system for first 25 years – maintenance of *Clay*, *Tarer* and Brick Field tanks/ponds
Municipal General Meeting	1896		Intention expressed
Establishment of water works	1906		From six major tanks 1) Main Reserve, 2) Post Office, 3) Civil Court, 4) Tutpara, 5) Dak-Bangla, 6) Bazar.
Water Works installed a water treatment plant	1921		Treated 9 lakh liter a day
Constructed two over-head tank with the capacity of 20,000 gallon and 50,000 gallon	1929	Water Works	Roadside Water tap (stand pipe) installed
The Embankment and Drainage Act	1952		
Responsibilities handed over to DPHE and HSD	1960		Started installing deep tube well and extend distribution system to new areas
Bangladesh government started sourcing groundwater in a full fledged manner.		BOB	This was done to avoid pathogen contaminated surface water.
survey has been conducted on ground water by the technical support of Netherlands government	1979-80		
twelve deep tube-well were installed	1980-81		Capacity was 150 lakh liter per day
	1983		Demand 15 million, supply 5 million
Formation of Khulna City Corporation	1984		Responsibilities shifted to KCC
water supply related infrastructure development has been initiated by the support of Bangladesh government	1988-89		Capacity went to 2.5 crore liter per day
	1991	KCC	Supply 6 million, 34% of demand
The Water Resource Planning	1992		

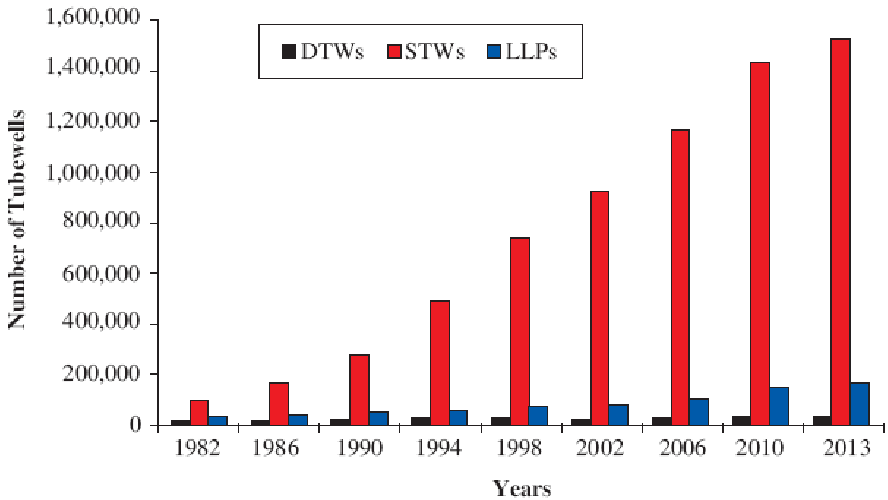
Events	Date	Organization	Comments
Act			
The Bangladesh Environmental Conservation Act	1995		
Environment Conservation Rules	1997		
Environmental Court Act	2000		
Bangladesh Water Development Board Act	2000		total management of the open water resourse sector replacing Bangladesh Water and Power Development Boards Order, 1972 (P. O. No. 59 of 1972).
The City Development and Conservation of Natural Wetland Act	2000		To protect the playground, open place, park and natural water bodies in the city area. Natural water bodies including the river, lake or any other water bodies have been recognized in the master plan.
National Policy for Arsenic Mitigation.	2004		This policy emphasized on alternative safe water supply, particularly preferred surface water over groundwater for drinking water supply
Establishment of KWASA	2008		
Established 32 generator supported tube-well and 19 small generator supported tube-well		KWASA	
	2011		By 2011, KWASA had 36 generator supported tube-well, 50 small generator supported tube-well, 10 thousand deep and shallow tube-well with 1.5” diameter, 240 kilometer pipe line, connection to 16660 household with ½-2” diameter
	2011-12		Demand was 240 million liter but the supply was 114 million liter per day
Dhaka City Building Rules	2011		Rainwater harvesting and groundwater recharge have been made mandatory for buildings having

Events	**Date**	**Organization**	**Comments**
			roof area more than 200 square meter
Water Act	2013		The act is based on the National Water Policy, and designed for integrated development, management, extraction, distribution, usage, protection and conservation of water resources in Bangladesh. Rainwater harvesting has been made compulsory.

Source: Own compilation.

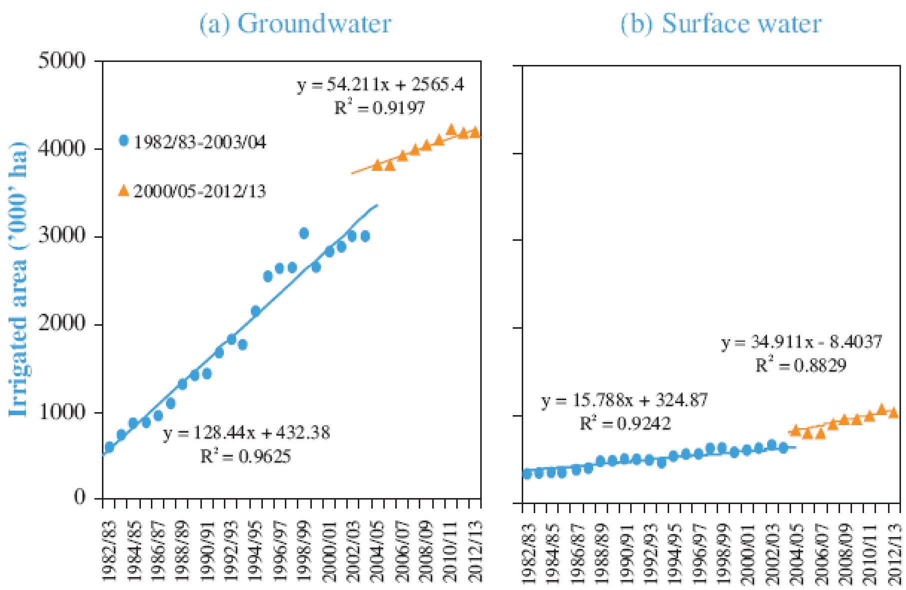
Annex 2: Statistical Graphs and Tables

Figure A2.1: Historical development of different types of pumps in Bangladesh



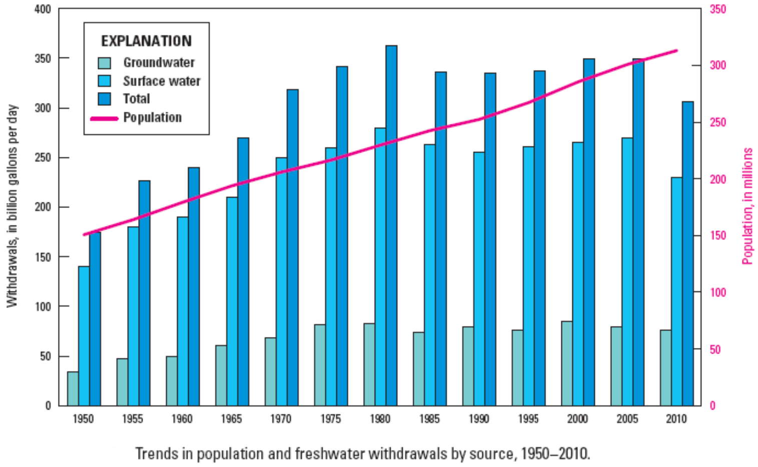
Source: Figure 4 in Kureshi et al (2015), compiled from BADC (2013).

Figure A2.2: Area irrigated with (a) surface water and (b) groundwater in Bangladesh



Source: Figure 5, Kureshi et al (2015), compiled from BADC (2013).

Figure A2.3: Trends in Shares of Surface and Groundwater in the USA



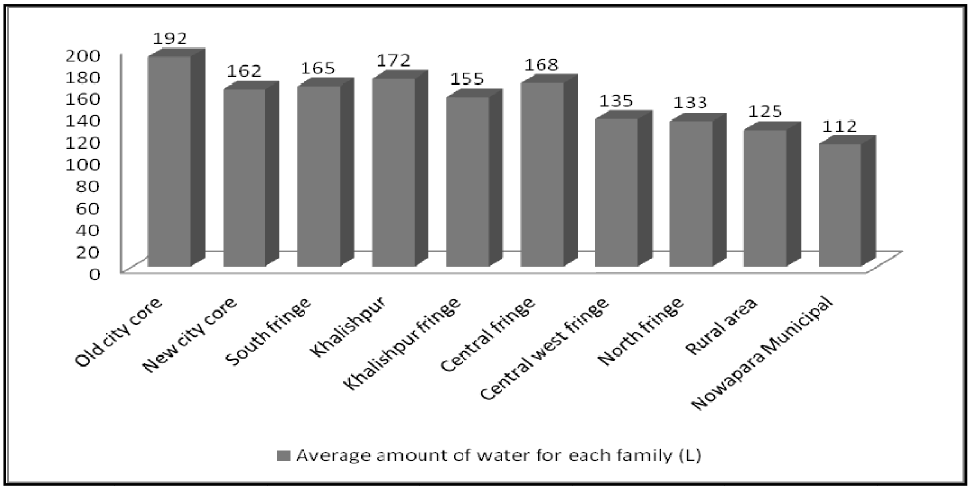
Source: USGS, 2015

Table A2.1: Cross-Country Comparison on Water Consumption and Groundwater Use

Country	Population	Per capita water withdrawals (liter)	Per capita consumption of water (Liter) for domestic use	% GW for Domestic use
USA	321,362,789	1,550	575	23
China	1,361,512,535	414.6	86	20
India	1,251,695,584	644.1	135	9
Bangladesh	168,957,745	224.2	46	13
Thailand	67,741,401	855.6	99.5	60

Source: FAO and ESCAP, 2007; Margat, 2013

Figure A2.4: Average Water Consumption (litre/day) in various parts of Khulna City



Source: Alam et, al. 2009

Map A2.1

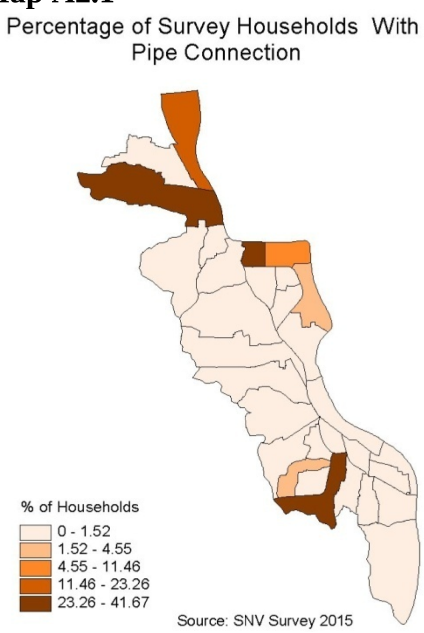


Table A2.2: A decade of change: depleting public space

Number or length of	2001 Master Plan	2010 WASA
Overhead water tanks	5	0
Production tubewells	60	109
Deep tubewell	1850	1736
Shallow tubewell	3800	5526
Distribution pipeline (km)	262	227

Source: Salauddin

Table A2.3: Irrigated area as % of gross cropped area doubled during 1981-96
(% of area irrigated under STW and DTW)

Fiscal Year	STW	DTW	Total groundwater source
1981	9.63	25.34	34.97
1982	16.44	26.30	42.74
1983	20.09	27.43	47.52
1984	21.22	30.24	51.46
1985	21.12	31.03	52.15
1986	35.07	24.05	59.12
1987	33.23	24.71	57.94
1988	47.51	23.65	71.16
1989	43.67	24.38	68.05
1990	49.04	20.11	69.15
1991	46.71	25.42	72.13
1992	49.10	24.90	74.00
1993	50.86	23.02	73.88
1994	52.21	23.41	75.62
1995	53.81	23.29	77.10
1996	54.69	22.50	77.19

Annex 3: Activities of KWASA, KCC and KDA and politics of water supply[49]

Swyngedouw (1999), quoted in Heynen, Kaika and Swyngedouw (2006) argued that natural and ecological conditions operate together with social process. The latter noted that urban conditions are made and remade though the political economic process. Thus, political processes involved in Khulna city water sector are worth a review. Political ecology studies on water sectors reveal that shortage of water supply or crisis in sewer cannot only be considered as technical malfunction, but rather a result of collective metabolisms (Southerland, 2002; Marvin and Medd, 2006). Smith and Ruiters (2006; p. 192) argued that weak and underdeveloped administrative mechanism led to conflict over access to municipal resources in global south. In Athens, Kaika (2006) showed how a natural event created political transformations that led to adopting multi-million projects and consensus building, in the water sector.

The first Master Plan for Khulna city was prepared in 1961 and emphasized installation and continuous expansion of piped network (KDA, 2001). However, the city water supply system was developed based on discretely located hand pumps. Piped system was not expanded, rather coverage of piped network shirked. Until 2008, KCC was the responsible organization for providing water services. Elected members were concerned about their political agendas and tried to convince people by providing services on a short time basis. Activities of City Corporation is highly influenced by central politics and politician's development of thinking was shaped by their tenures. In the political system of Bangladesh, tendency exists in political parties to overthrow plans and programs taken by previous authority. Therefore, both the central and local government had been unwilling to take long-term sustainable measures.

Apart from the regular maintenance, all the development projects are planned and implemented under the guidance and funding from central government. These dependencies propelled City Corporation to take immediate measures to solve water crisis with the help from NGOs. Development projects however, were selected and determined by political agenda.

After the establishment of KWASA in 2008, a multi-million dollar project was undertaken for supplying water from surface sources along with the ground water. As less coordinated organizations are present with relatively weak administration, the sustainability of water supply would be more challenging. The responsibilities of KCC, KDA and KWASA are conflicting within the same jurisdiction. KDA prepares city plans and approves building plans. It also provides housing through creation of new residential areas. KWASA supplies water, prepares plans and collects water charges. On the other hand, KCC collects revenues and provides municipal services. Construction and maintenance of drainage is also under the jurisdiction of KCC.

As these three organizations prepare and implement their plans separately, co-ordination and congruence is hard to achieve. KDA might have a plan to create a new residential area in a place where KWASA does not have any proposal. On the other hand, it is unclear how KWASA would expand the water supply services to places where the buildings do not have KDA approval. According to the World Bank, the institutional framework for urban planning administration and finance in Bangladesh provides a difficult environment within which urban development must

[49] This annex was prepared by Md. Salauddin.

take place. Present law assigns many functions related to planning and service delivery to more than one-agency. In practice, many functions are hardly performed at all and co-ordination for municipal administrations, slum upgrading, water supply, sanitation, drainage and environmental control" (KDA 2001). There is not much seasonal variation in activities, other than greater presence of fishery and floating garden during the rainy season.

Annex 4: Sample design and summary findings from Mayur river study

Map A4.1: Mayur River and the Segments Surveyed

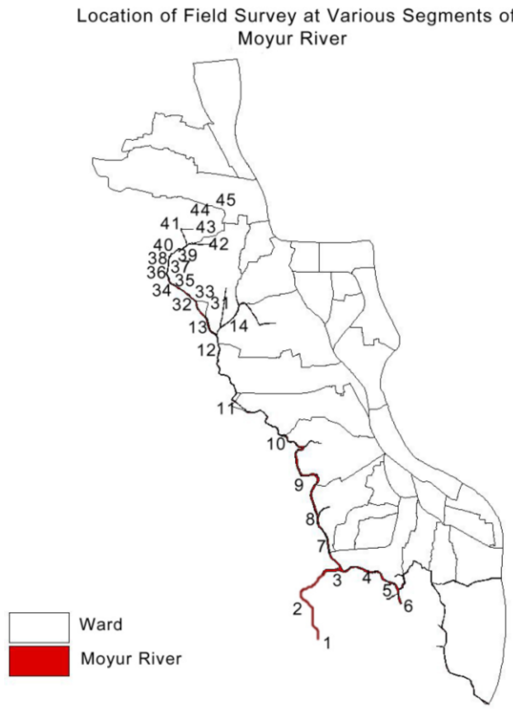


Table A4.1: Activities on the banks of Mayur River

(% of River segments surveyed)

Activity Name	Dry	Rainy
Fish cultivation	36.67	43.33
Hanging Latrine	66.67	70.00
Hanging Shop	16.67	16.67
Hanging House	36.67	36.67
Floating vegetable	20.00	30.00
KCC sewerage line	43.33	43.33
household waste, neighborhood	93.33	93.33
Industrial or hospital waste	13.33	13.33
Land-filling for homestead	76.67	76.67
Land-filling for vegetable/nursery	36.67	36.67
Land-filling with solid waste	76.67	73.33
Land-filling for business	16.67	16.67

Note: There were 30 segments where first survey was administered.

Table A4.2: Presence of different activities in surveyed segments, Cluster characteristics

Activities	Clusters				
	1	2	3	4	5
Fish cultivation	yes	no	no	yes	no
Hanging Latrine	no	no	yes	yes	yes
Hanging Shop	no	no	no	no	yes
Hanging House	no	no	yes	no	yes
Floating vegetable	no	no	no	yes	no
KCC sewerage line	no	no	yes	no	yes
household waste, neighborhood	yes	yes	yes	yes	yes
Industrial or hospital waste	no	no	no	no	yes
Land-filling for homestead	yes	no	yes	yes	yes
Land-filling for vegetable/nursery	no	no	no	yes	no
Land-filling with solid waste	no	no	yes	yes	yes
Land-filling for business	no	no	no	no	no
Presence of Slums	no	no	part slums	no	Slums
First sample (map numbers)	1, 2, 3, 44	4, 5, 7, 8, 9, 10, 12, (37)	6, 13, 14, 33, (36), 39, 40, 41, (42)	(36), (37), 38, (42), 43, 45, 46	11, 31, 32, 34, 35
Final sample (maps)	3	8	13, 39, 41	45	

Note: 30 segments were covered by an initial survey (first sample), which accounted for 69% of total river length. 6 of those segments, accounting for approx 14% of total river length were covered by the final plot-level survey.

Table A4.3: Distribution of Activity Mixed among all survey plots/respondents
(% of all plots surveyed in 6 segments)

		Single	Fishery	Nursery	Vegetable	Poultry	Cattle Firm	Tea stall	Factory
Homestead		48.73	3.05	3.05	2.03	0.51	8.63		
	Fish			0.51	1.02				0.51
	Vegetable						1.52	0.51	
	Poultry						0.51		
Fishery		6.60			0.51				
Nursery		3.05			1.02				
Vegetable		8.63							
Cattle Firm		0.51							
Grocery		1.02							
Garage		1.02							
Factory		5.58							
Mosque		1.02							
Madrasa		0.51							

Notes: Light blue shades = single activity; pink shades = double activities; grey = triple activities.
Source: Own survey.

Table A4.4
Summary statistics on current investment and employments in survey plots
(Average per plot used for single purpose)

Single activity	The size of Land (decimal)	Fixed Investment (Taka)	Number of Persons working always	Number of persons working seasonally	Part-time worker, working days per year
Homestead	37.50	1,96,500	n.ap.	n.ap.	n.ap.
Fishery	63.60	74,750	1.25	8.55	15.30
Nursery	77.25	22,000	.40	.60	31.20
Vegetable Cultivation	137.90	3,410	.50	2.95	8.25
Cattle Firm	5.00	10,000	1.00	1.00	25.00
Grocery	2.00	82,500	.50	.50	182.50
Garage	2.50	50,000	n.av.	n.av.	n.av.
Factory	6.45	2,727	n.av.	n.av.	n.av.
Mosque	5.50	12,00,000	n.av.	n.av.	n.av.
Madrassa	5.00	n.av.	n.av.	n.av.	n.av.

Note: n.av. = not available; n.ap. = not applicable. Investment is the reported value of non-recoverable expenses in the forms of buildings and other structures to carry out the activity.

Annex 5: Segments on Mayur River considered as sampling units


M1


M2


M3


M4


M5


M6


M7


M8


M9


M10


M11


M12


M13

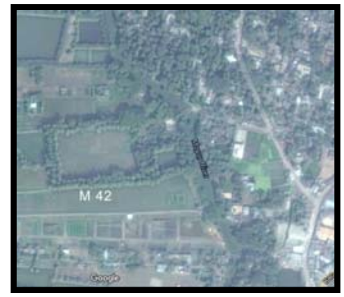

M14


M15

-

 M16	 M17	 M18
 M19	 M20	 M21
 M31	 M32	 M33
 M34	 M35	 M36
 M37	 M38	 M39

-

 M40	 M41	 M42
 M43	 M44	 M45
 M46		

Administered the first survey only   Administered both surveys

Annex 6: List of Persons consulted

1. Ashraful Alam Nannu, Linkers Drinking Water
2. Alhaj Liakat Ali, Editor Daily Purbanchal
3. Abir-ul Jabbar, Chief Planning Officer, KCC
4. Begum Ferdousi Ali, Manging Editor, Daily Purbanchal
5. Dilip Kumar Dutta, Professor, Environmental Science Department, Khulna University
6. Elma Morshed, ADB
7. Faraque Ahmed, Project Coordinator, Rupantar
8. F.M. Ismail Hossain, Head Estimator, DPHE, Khulna
9. Kazi Abdul Noor, Additional Secretary, Project Director, Policy Support Unit
10. Maruf, Assistant Engineer of KWASA
11. Md. Abdallah, (P. Engineer) MD, KWASA
12. Md. Kamaluddin Ahmed, (Engineer), DMD KWASA
13. Md. Mosaddeque Hanif, Rain Water
14. Md. Iftekhar Ali, Jonaid Osmo Water Industries
15. Md. Mijibor Rahman, Ex. Engineer and Chief Planning Officer (on duty) KDA
16. Md. Shahidul Islam, Adviser, Governance, SNV Netharlands
17. Md. Sahidul Islam, Engineering Advisor, FSM Program, SNV Netharlands
18. Mizanur Rahman, Member of Parliament, Khulna constituency
19. Mohidev Jubo Sanaj KollyaN Samity (MJSKS)-Md Rejakul Haider Khokon, ED
20. Moniruzzaman Moni, Khulna Mayor (Recently Removed)
21. Nobolok- Kazi Wahid Uz Zaman, ED
22. Nobolok- Kazi Rajeeb Iqbal, Deputy Chief Executive
23. Professor Dr. M. Firoze Ahmed, Vice Chancellor, Stamford University, Bangladesh.
24. Professor Mujibur Rahman, BUET
25. Rafiqul Islam, ED, Rupantor
26. Rajeeb Munankami Khulna Head, SNV Netharlands
27. S.M. Wahidul Islam, Superintendent Engineer, DPHE KHULNA