WATER GOVERNANCE MAPPING REPORT: TEXTILE INDUSTRY WATER USE IN BANGLADESH

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Executive Summary

Led by the ready made garments (RMG) sector, the textile industry has become Bangladesh leading economic sector in the past few years. The market value of RMG exports at USD24.6 billion, contributing to 80.9% of the total exports earnings and around 14.2% of the GDP in 2014, with an annual growth rate of 12% between 2010-2014. The industry also provides employment for 4 million workers, out of which 80% are women. The growth trend is expected to continue with the ambitious export target of reaching USD 50 billion in 2021 and USD 66.25 billion by 2030.

As a water intensive sector, the growth and the sustainability of the RMG sector as well as its substantial contribution to Bangladesh economic and human development is highly dependent on how it manages its water risks. Textile industry in general has an enormous water footprint in terms of agricultural water consumption for cotton farming, high water use in textile manufacturing and water pollution. Therefore, this report aims to: a) assess the physical water risks pertaining to the textile industry in Bangladesh; b) Investigate water governance landscape and regulatory water risks in relation to textile water use; and c) provide recommendations for the capacity building in sustainable water management in the textile industry in Bangladesh.

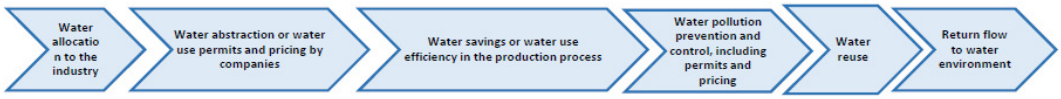
The capacities of the textile industry to manage its water risks are placed in the backdrop of the country's situations of water resources management. Despite high annual precipitation, droughts are recurring phenomenon with high economic losses. High water variability across seasons and regions provide very different regional water balance across the country varies widely. Its location in the floodplain renders more than 20% of the country flooded annually, especially during wet seasons. The exploitation of groundwater resources is reflected in the fluctuation of water table across seasons of up to 10 meters and it is worst in Dhaka. Both surface and groundwater quality in Bangladesh have been declining due to arsenic contamination, saltwater intrusion and land-based pollution activities. Inland surface water quality has dropped below the threshold of the Department of Environment in dry seasons and rendered their use unsuitable for domestic uses.

Key physical water risks that the textile industry should address are:

1) Increasing gap between the industry's water demand and water availability.
   Textile water demand will be increased by 270,3 % compared to 2014 creating water demand gap between 2.495 to 5.282 BCM per year. Higher future domestic and agricultural water demands that have a higher priority than industrial water, means that there is a higher risk of water shortage to the textile industry by 2030 and higher costs of water abstraction.

2) Increasing water quality risks.
   Out of 61% of textile units equipped with ETPs, only 29% were found to be compliant and around 11-51% of them are either poorly designed or operated. Textile wastewater discharge has brought about a declining quality of surface water bodies around the industrial clusters, such as Buriganga river, Shitalakshya river and Turag river. Water pollution will pose higher risks to the industry from more expensive alternative than groundwater resources and conflict risks from environmental impacts.

The mapping of water governance value chain pertaining to textile water use shows the key actors involved in each value chain, the responsibilities relevant to textile water use and the regulations that strengthen their mandates. The current water governance landscape has shifted toward more integrated water resource management under the leadership of the National Water Resources Council (NWRC), in which WARPO under the Ministry of Water Resources has an essential role in policy making and planning. Recent regulations incentives, and on-going initiatives have looked further into participatory water governance, strengthening of institutional capacities, providing incentives for cleaner technology, improving the efficiency of water utility operators, and restoration of river water quality



Key actors	WARPO under MoWR	Water Utilities under MoLG	Ministry of Textiles and Jute Ministry of Industries	Ministry of Textiles and Jute Water Utilities under MoLG Dept. of Environment (DoE)	Dept. of Environment (DoE)
Roles and responsi-bilities	**Water Resources Planning Organisation (WARPO), under Ministry of Water Resources (MoWR)** • High level water resource planning and management through National Water Management Plan. • Planning the location of new industries based on water availability and effluent discharge requirements.	**Water utilities under MoLG** • Three types of water utilities under MoLG: Water Supply and Sewerage Authorities (WASAs), city corporations and pourashavas. • Role: planning, construction, operations and maintenance of water supply and sewerage services, including issuing licences for sinking deep tube-wells and charges for industrial water use. ***Other actors:*** **The Prime Minister's Office through Bangladesh Investment Development Authority (BIDA) and the Bangladesh Export Processing Zones (BEPZA)** • Approval of foreign, joint-venture and local projects. • Facilitate utility connections including water. • Water supply and sewerage services within Export Processing Zones (EPZs). **ECNWRC** • Extraction of water, construction that may potentially change the direction of flow of water in a natural water body.	**Ministry of Textiles and Jute** • The National Institute of Textile Engineering & Research (NITER) aims to enhance the overall productivity, quality of products and raise efficiency of textile sector • Monitoring of the textile sector from 2014. **Ministry of Industries** • Developing new policies and strategies for promotion, expansion and sustainable development of Industries. ***Other actors:*** **Bangladesh Garment Manufacturers and Exporters Association (BGMEA)** • Promote workplace safety and compliance by regular monitoring of its member's compliance and organising training on social and environmental standards. **Bangladesh Knitwear Manufacturers and Exporters Association (BKMEA), Bangladesh Chambers of Commerce and Industry (FBCCI)** • Monitoring of site water use reduction.	**Ministry of Textile and Jute** • Approval of registration of textile wet processing units given the installation of effluent treatment plant (ETP). • Monitoring existing ETP capacities in the textile sector from 2014. **Water Utilities under MoLG** • Setting charges for sewerage and wastewater treatment services. **DoE, under Ministry of Environment and Forest (MoEF)** • Monitoring operations of the activities affecting environmental quality and enforce the standards of environmental conservation, including monitoring of ETPs. ***Other actors:*** **BEPZA** • Water supply and sewerage services within Export Processing Zones (EPZs). **BGMEA** • Promote workplace safety and compliance by regular monitoring of its member's compliance and organising training on social and environmental standards. • Requiring industry to have ETP after 2010 to be its member	**Dept. of Environment (DoE), under Ministry of Environment and Forest (MoEF)** • Monitor operations of the activities affecting environmental quality (water, air, land pollution etc.) and enforce the standards of environmental conservation, including monitoring of ETPs.
Laws, regulations, policies	**WARPO, MoWR** • Water Act, 2013 • Water Resources Planning Act, 1992.	**MoLG:** WASA Act, 1996; Local Government Acts 2008; **BIDA:** BIDA Act 2016 **BEPZA:** Authority Act, 1980 **ECNWRC:** Water Act, 2013	**Ministry of Textiles and Jute:** Textile Industry Act 2015 **Ministry of Industries:** Industrial Policy	**DoE:** Environmental Conservancy Act 1995, Environmental Conservation Rules 1997 **Ministry of Textiles and Jute:** Textile Industry Act 2015 **Ministry of Industries:** Industrial Policy	**DoE:** Environmental Conservancy Act 1995, Environmental Conservation Rules 1997.

Water Governance Value Chain Pertaining to Textile Industry Water Use in Bangladesh

The capacities of current water governance landscape in Bangladesh to address the physical water risks of textile industry are limited by: 1) the problem of non-align incentives of textile water use, in which very little incentives exist in practice for the industry to have rational use of water and treat their effluent appropriately; 2) overlapping and ambiguity of responsibilities coupled with resource constraints weaken monitoring and enforcement capacities of both efficient water use and compliance to effluent standards; and 3) lack of involvement of industrial line ministries with considerable influence in the area of water governance renders the current governance landscape has less relevance and capacities in addressing textile industry's physical water risks.

This report recommends the following areas to improve the country's capacities in managing textile industry's water risks:

1) Align existing incentives and provide more targeted incentives toward cleaner textile industry, i.e.: improve the levels of industrial water abstraction and sewerage charges to meet their intended objectives; green incentives to target medium and smaller enterprises with higher barrier in adopting cleaner technology; explore other positive incentives that reward the industry's to be more water smart and innovative; process efficiency than end-of-pipe technology will be more effective; better alignment between environmental and industrial incentives, such as tax rebate for greener technologies and tax exemption for import of cleaner technologies.

2) Clarification of responsibilities and streamlining of water governance structure for greater capacities and effectiveness, i.e.: clearer differentiation of responsibilities among WARPO, Department of Environment, and industrial line ministries (Ministry of Industry/MoI and Directorate of Textile/DoT); greater delegation of some responsibilities from national institution to local government institutions.

3) Broader stakeholder engagement in building the capacity of textile industry toward sustainability should be anchored to the existing National Water Resources Council (NWRC), i.e.: involving industrial actors either line ministries or industry's association within the National Water Resources Council (NWRC); the synergy between Bangladesh Water Act 2013 and the 7th Development Plan should be reflected in the mandate for industrial line ministries (MoI, DoT, and Bangladesh Investment Development Authority/BIDA) in improving the industry's capacity toward sustainable textile industry; better data sharing between conventional water-related line ministries and industrial line ministries to improve ministerial coordination.

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Chapter 1 Introduction

1.1. Background

As one of the most populous nations in the world with 162.9 million people in 2016, Bangladesh is a dynamic South Asian economy that has demonstrated nearly 6% of economic growth and human development progress simultaneously over the past decade. Along with economic growth, poverty level was reduced by almost a third while life expectancy, literacy rate and per capita food intake was increased.[1]

Bangladesh strong growth is driven by the clothing or ready-made garment (RMG) sector that accounts for a sixth (16%) of the economy and provides employment for 4 million workers, out of which 80% are women. The RMG sector is also the backbone of export revenues, contributing to nearly 90% of total Bangladesh exports.[2] The latest figure shows that Bangladesh has a market share of 5.1% of the USD435 billion global export market values in 2015, making it the world's second largest garment exporter.[3] RMG sector's export share shows an increasing trend of from 53% in 1995 to 87% in 2011[4] and the trend is expected to continue.

As a water intensive sector, the growth and the sustainability of the RMG sector as well as its substantial contribution to Bangladesh economic and human development is highly dependent on how it manages its water risks. Textile industry in general has an enormous water footprint in terms of agricultural water consumption for cotton farming, high water use in textile manufacturing and water pollution.

Water risks of the textile industry will add pressure to Bangladesh current challenges in addressing regular flooding and inundation issues during monsoon season and water shortages and drought issues during the dry season. Eventhough industrial water use makes up a small part of Bangladesh water demand, growing textile water demand will intensify competing water uses with domestic and agricultural water use, driven by population growth and dietary changes. The expected growth of the RMG sector will exacerbate current gap between water supply and demand and declining water quality.

The immense challenges of sustainable water management in Bangladesh require a sound water governance as the systems that make decision over water allocation (who gets what water, when and how), who has the right to water and water-related services and how to balance competing uses and well as to manage the trade-offs arising from those decisions. In this light, the report looks at existing water governance landscape related to textile water use in Bangladesh and how well they are in addressing the industry's water risks.

1.2. Objective

This report aims to:

a) Assess physical water risks pertaining to the textile industry in Bangladesh.
b) Investigate water governance landscape and governance related (regulatory) water risks in relation to the textile industry in Bangladesh.

c) Provide recommendations for the capacity building in sustainable water management in the textile industry in Bangladesh.

1.3. Methodology and Focus

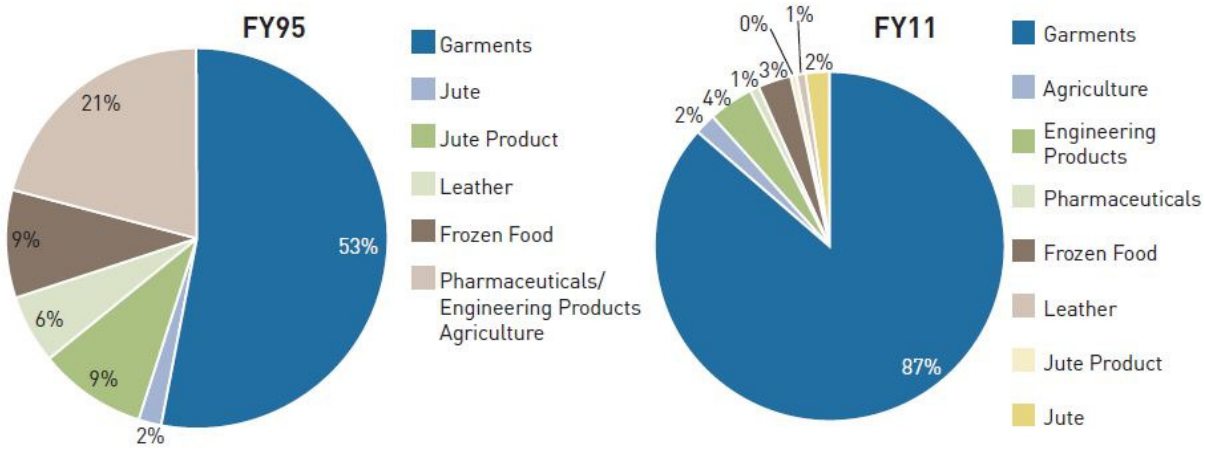
The information, analysis and recommendation in this report are built on comprehensive desk research and data review of international and local sources. The report uses the term 'textile' sector in general to refer to both the textile and clothing industry. Since the textile sector in Bangladesh is dominated by the ready-made garment (RMG), this report will also focus the discussion on the RMG sector.

Chapter 2 Textile Industry in Bangladesh

2.1. Economic importance of Bangladesh textile industry

2.1.1 Textile Sector as the Driver of Economic Growth

Textile industry has been a crucial sector to the Bangladesh economy and its important role as a driver of economic growth has also been increasing rapidly over the last 30 years. The crucial role of the garment sector is unique among low income countries in terms of the high share of manufactured goods in Bangladesh total exports, i.e. 90% compared to around 20% in other countries with similar level of development, as the following figure indicates.



Source: Export Promotion Bureau in World Bank 2014.

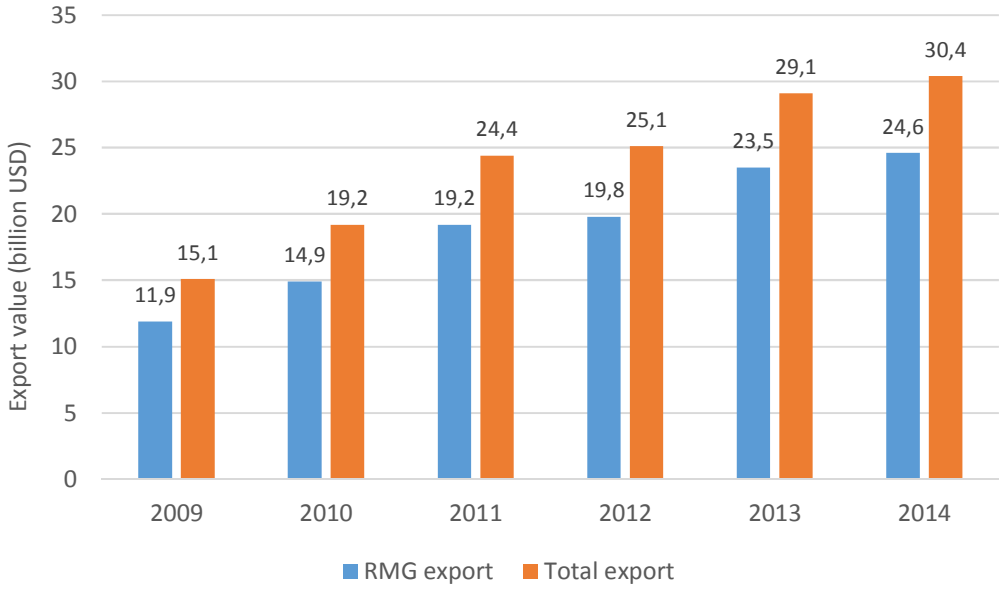
Figure 1 Share of Bangladesh Merchandise Exports to Total Exports

The sector was first established in 1960s to produce export goods that targeted the European markets. A decade later there were only nine export companies that expanded to South Korean markets.[5] Currently there are around 3500-5000 garments factories in Bangladesh[6] that are predominantly cutting and sewing units, providing employment to four million workers, in which 80% of whom are women. Most of these factories were locally owned, estimated at 95% in 2004.[7]

The market value of ready made garments (RMG) exports was recorded at USD24.6 billion in 2014 growing significantly from merely USD 5.1 billion in 1990[3], contributing to 80.9% of the total exports earnings[6] and around 14.2% of the GDP in 2014. Figure 2 illustrates the increasing share of RMG sector to the country's total exports, which has contributed to Bangladesh resilience against the backdrop of a volatile global economy. The sector's market value has an annual growth rate of 12% and its contribution at the global RMG export markets grew 13% annually between 2010-2014.

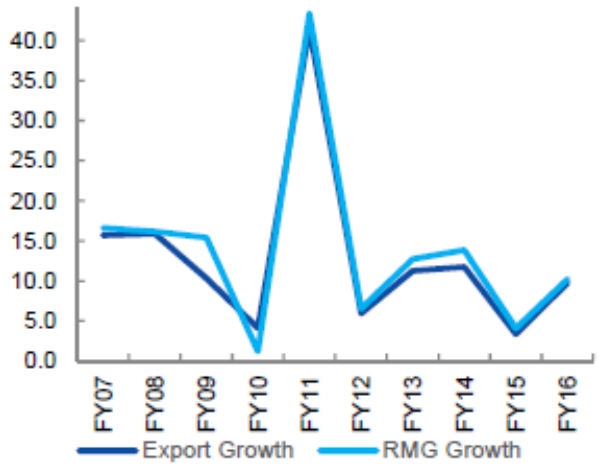
The latest figure confirms the trend of RMG sector leading the rebound of export growth in 2016 following a disappointing export performance in 2015. Recorded growth of RMS sector is 10.2%, much higher than non-RMG sector at 7.8%. Nevertheless, the contribution of exports relative to GDP

has declined from 18% in 2012 to 15.1% in 2016, which is not a favourable trend for an export-driven economy like Bangladesh, as shown in Figure 3.[8]



Source: Export Promotion Bureau.

Figure 2 Share of RMG export to Bangladesh Total Exports

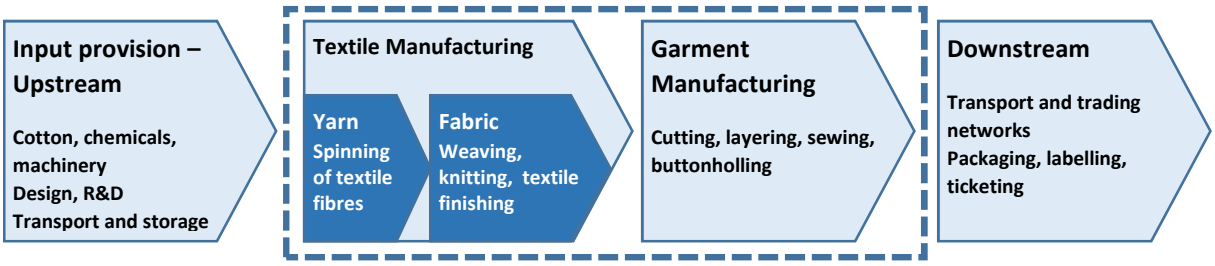


Source: Export Promotion Bureau in World Bank, 2016.

Figure 3 Year-on-year growth in Percentage of RMG sector and Bangladesh Total Exports

2.1.2. Characteristics of Bangladesh Textile Sector

In general, the textile and clothing value chain can be presented as follows. The focus in Bangladesh is at the central part of the value chain, i.e. textile and garment manufacturing, and it is very export oriented. For instance, only about 2% of the cotton is produced in the country.[9]



Source: modified from UNCTAD (2012).

Figure 4 Textile and Clothing Value Chain in Bangladesh

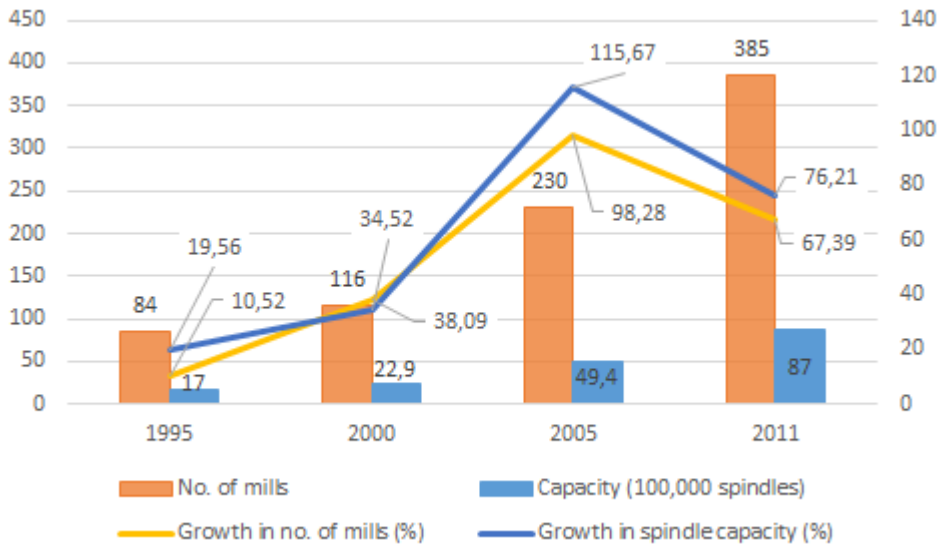
The RMG value chain is increasingly expanding its domestic back linkages into textile production. Overall, the sector is moving toward higher value textile production processes including and of wet processing units was envisaged to grow significantly over the next few years.[10]

Despite the extension of the RMG value chain and the various types of garments are manufactured in Bangladesh, all RMG products are classified into two broad categories: woven products and knitted products. Woven products include shirts, pants and trousers; while knitted product includes t-shirts, polo shirts, undergarments, socks, stockings and sweaters. Woven products still dominate the export earnings of the country, although there is an increasing share of knitted products, which currently contributed 40% of export earnings.[5]

In recent years, traditional textile sector targeting domestic market has emerged to link to the export-orientated knitwear and woven garments sectors as part of a fuller value chain above (Figure 4). The current supply from domestic textile sector to woven garments is 34-40% and there is much potential to expand supply capacities. According to Bangladesh Textile Mills Association (BTMA), over €4 billion has been invested in textile mills has underpinned the growth of textile manufacturing in terms of units and capacities (Figure 5). As a result yarn production has increased by four times and clothing production by three times over the period of 1995-2010.[11]

The growth of Bangladesh RMG sector cannot be separated from the context of two crises in the apparel global value chain that have re-shaped the whole sector. There are two main crises that affect the industry in different directions[12] :

a. The World Trade Organisation (WTO) phase-out of the quota system for textile and clothing in 2005 that enabled the access for many poor and small export-oriented economies to the textile markets of industrialised countries.
b. The global economic crisis in 2009 that has lowered the demand for apparel exports and led to massive unemployment across the industry's supply chain.



Source: Bangladesh Cotton and Products Annual 2011 and BTMA Directors Report 2011.

Figure 5 Growth in Primary Textile Sector in Bangladesh

Bangladesh is one of the countries that have gained from the WTO quota phase-out together with India, Vietnam and Indonesia, albeit not as strong as China as the big winner. This first crisis has also accelerated the rationalisation of the supply chain, encouraged industry consolidation and motivated major retailers and brands to work with fewer, larger and more capable suppliers around the world. On the other hand, the recession impact tend to hurt the weaker manufacturers in large developing economies from the supply chain consolidation. However, Bangladesh RMG sector has shown to be less affected by the second crisis as demonstrated by its resilient sectoral growth.

There are a number of factors that underpin the strong growth of Bangladesh RMG sector:

1. Competitive price based on low labour wage and energy costs.
   A study finds that US and European apparel companies mentioned price attractiveness as the main reason for sourcing from Bangladesh. The chief purchasing officers (CPO) and suppliers of these companies expect that in the near future labour costs will increase by 30% due to regulation on minimum wage. Nevertheless, the stakeholders perceive that wage development will be in line with those in other countries for Bangladesh to remain competitive in terms of labour costs. [13]
   Bangladesh firms are also willing to maintain competitive price by having a low profit margin while investing in new technology to improve high-productivity and maintaining good long term relationships with buyers.
2. Industry's capacity.
   The large number of factories in Bangladesh RMG sector is a competitive advantage compared to other similar RMG exporting countries, such as Indonesia (2450 factories), Vietnam (2000 factories) and Cambodia (260 factories). Other markets with similarly high capacities, such as India and Pakistan, have structural workforce factors that prevent full utilization of their capacities.

3. Suppliers' capability.
   Bangladesh suppliers are well known for their good quality products and abilities to meet large order sizes for the value and lower mid-market. However, the suppliers have also begun to expand into more value-added services. The services offered by suppliers to main export markets entail quality lab (39%), design (36%), yarn or fabric production (21%), and ticketing (10%).

4. Improvements in terminal handling and customs
   The process has been shortened from 12-13 days to within 3 days.

5. Assurance of market access by international agreements and granted preferences.
   Most prominent agreements are Multi-Fiber Arrangement, the Generalized System of Preference (GSP), and the EU's Everything but Arms initiative (EBA).

6. Supporting industrial policies.
   Apart from the above advantages, Bangladesh also support sectoral development through a number of policies, such as the creation of special economic or export processing zones, incentives for the use of local inputs, duty reduction for input and machine imports, and income tax reduction.

Despite its strength, the industry still faces some challenges that hamper its long-term growth, such as:

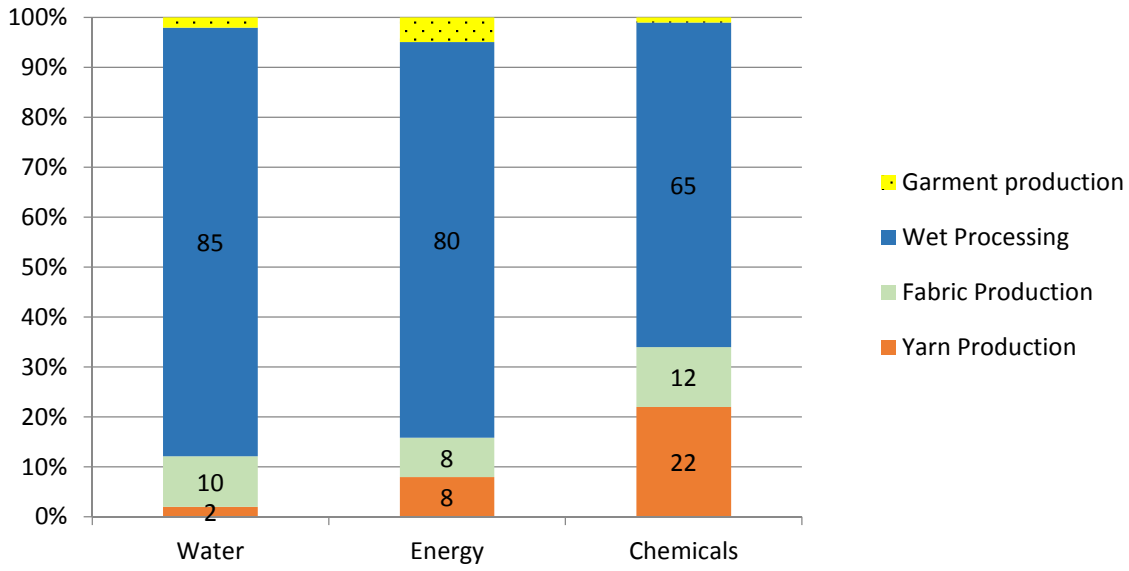
1. Good infrastructure in utilities, road network, and port facilities.
   This is the key issue that affects garment lead time and thus how buyers made their decision on product type. More reliable transport infrastructure will allow for much shorter lead time. However, completion of transport infrastructure often lags long behind schedule and this has raised some doubts weather the issue could be resolved in near future.
   Likewise, poor, unreliable power supply creates significant risk to production. A number of solution approaches to the issue have been taken, such as improving gas supply, promoting energy efficiency and conservation, as well as developing power capacities.
2. Compliance
   Even before the Rana Plaza incident in 2013, suppliers' compliance to safety, social and environmental standards has been an important issue raised by international buyers. There have been more regulations from the government to improve compliance while enforcement on the ground remains very challenging. Better transparency of value chain is critical in assuring confidence of buyers regarding sustainability issues in order to maintain long-term relationships with them.
3. Productivity of workers and suppliers
   Bangladesh key comparative advantage of competitive labour cost cannot guarantee its continued success in export growth, given the pressure of global competition and potential arrival of future competitors with a better wage-productivity combination.[8] It is estimated that wage productivity of Bangladesh textile workers is about 77% of that Chinese workers and 88% of Pakistan. At the same time, the industry also lacks the skilled middle management workers as a limiting factor to higher productivity of suppliers.
4. Raw materials
   Despite the recent growth of more traditional upstream textile value chain, the country's high dependency on imports of raw materials render it very vulnerable to volatility in input

prices. Furthermore, this import dependency also increases garment lead time up to 30 days when raw materials are sourced from China.

2.2. Textile Industry Water Use

The main manufacturing processes of the textile and garment manufacturing as shown in Figure 4, entails yarn production, fabric production, wet processing and garment production. It was estimated that 1,700 wet processing units in Bangladesh were dedicated to the washing, dyeing, and finishing (WDF) of textiles.[14] Nevertheless there has not been any evidence to support such figure. The actual number might be much lower at 500-700 units.[15]

The WDF textile units impose the largest environmental footprint of the industry due to intensive freshwater abstraction for washing, dyeing, and finishing; large volume of wastewater generation and discharge; large use of chemicals; and high energy use for heating of water and steam generation. These environmental footprints are illustrated below.[16]



Source: adapted from Cotton Incorporated (2010).

Figure 6 Environmental Footprint of Textile and Garment Manufacturing

Water use of the textile units in Bangladesh is estimated to be around 250-300 L/kg fabric produced, which is equivalent to daily water use for two people.

Around 70% of WDF textile units are located around or in Dhaka, and the remaining units are in Mymansingh and Chittagong. Over 95% of all WDF textile units are situated near water bodies in two major cities, i.e. Dhaka and Chittagong, due to good access to services, infrastructure and markets as well as the possibility of direct daily discharges of large volumes of wastewater to those water bodies.[14] Aside from a few dozen WDF textile units in the six export processing zones (EPZ), most textile units are concentrated in informal, heterogeneous, under-serviced industrial clusters. These clusters comprise a mix of small and medium factory units from a range of industries and often interspersed with some residential dwellings. As a result, the environmental impacts generated by

these WDF textile units, in terms of overexploitation of groundwater resources, water pollution and pressure on energy supply, tend to be highly localized.[17]

Textile manufacturing processes employ a high use of chemicals for cleaning and dyeing purposes. As a result textile effluents contain considerable amounts of hazardous pollutants, where heavy metals are very common. Most of these effluents are discharged into rivers without proper treatment causing severe water pollution, which is claimed to be responsible for about two thirds of water-borne diseases in Bangladesh.[18] Textile sector is ranked as the most polluting sector compared with other polluting industries in Bangladesh.[19]

Table 1 Ranking of Industrial Water Pollution Sources in Bangladesh

Industry	Water Pollution Level	Pollution Product	Ranking
Textile	High	3.35	1
Leather	Extremely high	1.88	2
Sugar	Extremely high	1.72	2
Agriculture	Moderate	1.08	3
Paper	Very high	0.67	4
Construction	Low	0.14	5
Transport	Low	0.02	6

Source: Hannan et al (2011)

With the diversity of processes and products related to textile industry value chain, pollution control efforts have been increased to address the pressing water pollution issue, among others through more stringent regulations and effluent discharge standards. Nevertheless the industry still experiences difficulties in meeting those standards, particularly with regard to dissolved solids, pH, BOD, COD, sometimes, heavy metals and color.

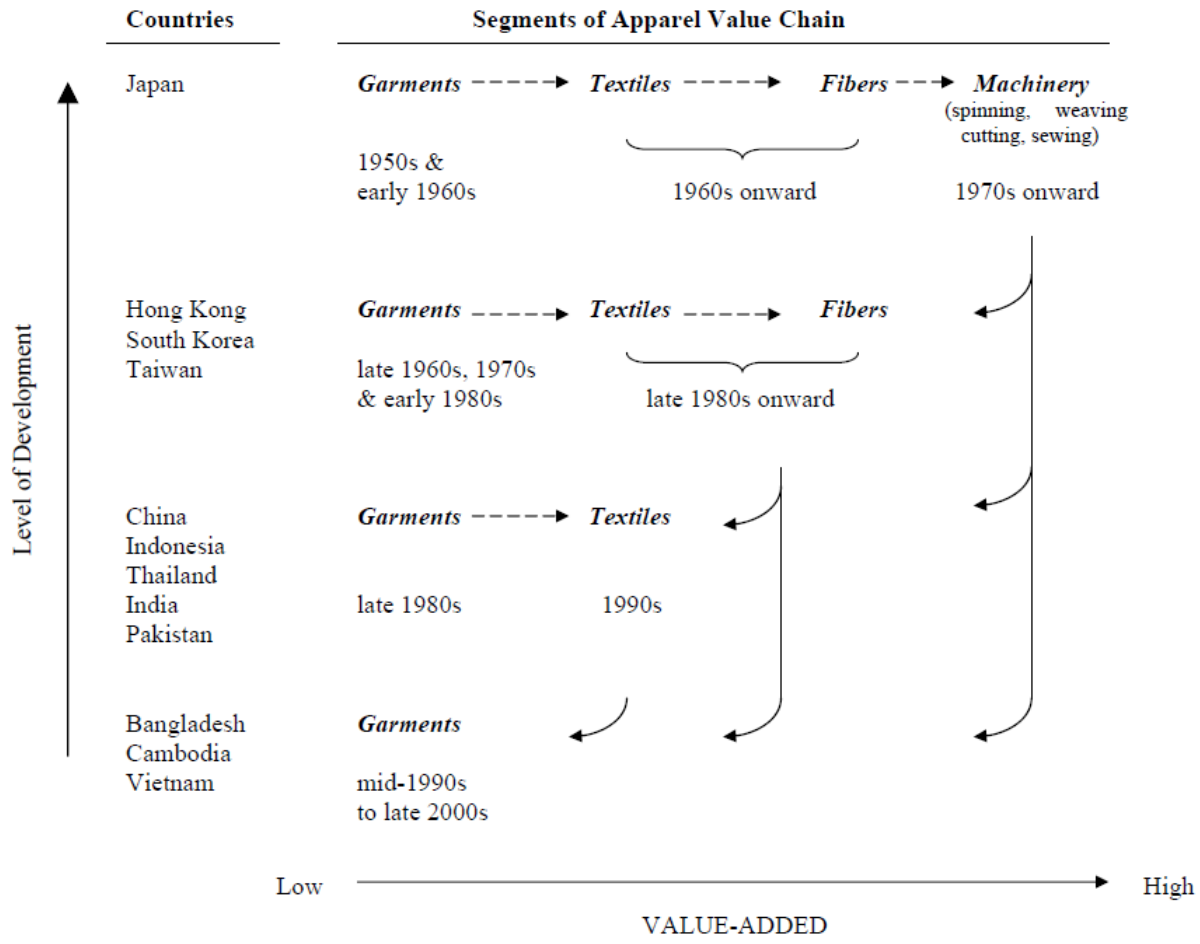
2.3. The Outlook for Bangladesh Textile Industry

The economic importance of the industry is expected to grow further with an export target of USD 36 to 42 billion in 2020. However, the government recently updated its ambition with a target of export values of $50 billion by 2021, the year Bangladesh celebrates the golden jubilee of independence.[20] It has been projected that the sector could grow to USD 66.25 billion by 2030 under a mid-growth scenario. Considering the significant employment generation in textile sector for the country's ability to make progress on reducing extreme poverty and boosting shared prosperity, the realisation of the ambition is crucial to these development objectives.

To reach its goal, Bangladesh should shift toward an export-led strategy that builds on the existing labor-intensive exports and focuses on diversifying products, skills, and markets. Faster export

growth requires both consolidating strengths in RMG by increasing volumes and moving into higher-value garments. In the medium term the sector needs to complete its transition of the RMG to higher value-added products exported to a wider range of markets.

The following figure illustrated where Bangladesh lies within the dynamics of clothing value chain in Asia.



Source: Gereffi and Frederick (2010).

Figure 7 Industrial Upgrading of Apparel Value Chain by Asian Economies

Several strategic directions for Bangladesh to realise its prospects and goal in textile sector are discussed in the following:

a. Expansion of existing activities

This strategy is basically doing "more of the same" in terms of undertaking labour-intensive production and taking advantage of its comparative advantage in low wages. This strategy requires addressing serious constraints to the expansion, i.e. infrastructure bottleneck (transport and utility), business environment, skilled labour shortages and lack of financing. Infrastructure ranks first as the barrier for doing business in the country according to the latest report of the World Economic Forum report.[21] Business environment in the country ranks 174 out of 189 countries in the world according to Doing Business 2016.[22] Shortage of skilled labour is estimated

at 25% and a third of garment firms as well as a quarter of textile firms identified this issue as a major constraint. Organised skills development is still at an early stage, mostly in the form of on the job training, and seldom complemented with other kinds of trainings. Financing was mentioned by 42% of firms as a severe constraint for expansion.

b. Optimize the contribution of the textiles segment (fabrics) of the value chain

   As global demand for clothing as well as domestic demand for fabrics and yarn keep rising, this strategy seeks to "fill the linkage gap" of the textile value chain. The barriers to building backward linkage are quality improvement of local garment manufacturers, incentive favouring fiber imports through GSP preference, as well as investment gaps, in addition to the barriers for expansion of existing activities as in point (a) above. The Ministry of Textile and Jute estimated investment needs of more than USD3 billion for 2014-2015. The cost of unethical business in financial institutions in general has been raised as a serious impediment of industrialisation in Bangladesh.

c. Upgrading to higher value products.

   This strategy provides a leverage to labour-intensive production by generating higher values from garment manufacturing. There has been an increased production of higher value items, such as overcoats, track suits and swimwear of up to 50% in 2010 although these items still make a small share of overall garment exports. Similar barriers exist as for the other strategies, especially quality improvement. Nevertheless, progress has been made to improve compliance on labour and social standards and to regard this compliance as investment rather than merely costs.

d. Moving into adjacent segments of the value chain.
   This strategy is basically extending the value chain backward or forward. To extend backward linkage, the industry needs to better identify which linkage that is more feasible and potential for the country, such as chemicals production, which might be more challenging. On the other hand, added value from building a forward linkage might be relatively easy to do by offering further services on top of the finished garment, such as packaging services or attaching price tag.

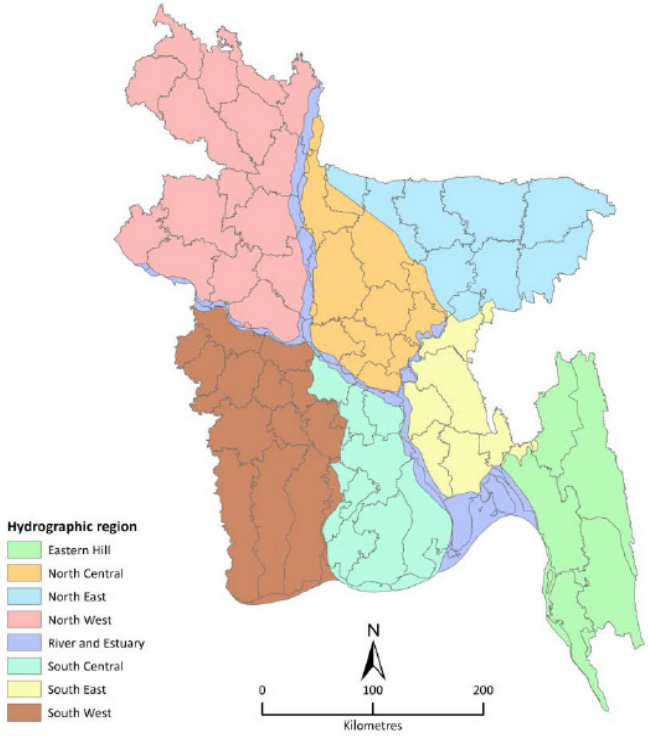
In realising all these strategies, it remains crucial to address some key barriers and to improve compliance regarding environmental and social standards.

Chapter 3 Water Resources Management in Bangladesh

3.1. Current Water Resources Situation

3.1.1. Rainfall, Floods and Droughts

Bangladesh is mostly situated in a low lying, flood plain at the confluence of the Ganges-Padma river system, the Brahmaputra-Jamuna river system, Surma-Meghna Rivers and Chittagong river system. It is one of the largest deltas in the world with a total area of 147,570 km^2. The total length of all rivers, streams, creeks and channels is about 24,140 km. Approximately 405 rivers cross the country, out of which 57 of them are transboundary. The draining system covers an extensive area of 1,750,000 km^2 and only 7% catchment lies inside of the country. The combined annual discharge passing through the system into the Bay of Bengal reaches up to 1,174 billion m^3. Most of the rivers are characterised by fine sandy bottoms, flat slopes, substantial meandering, banks susceptible to erosion, and channel shifting. The country is divided into eight hydrological regions as shown below.

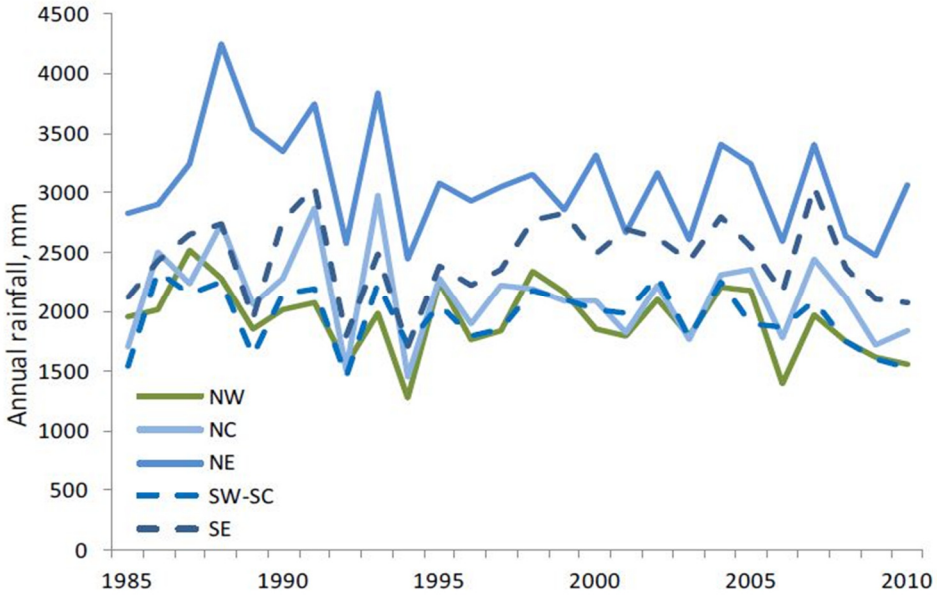


Source: CSIRO et al (2014)

Figure 8 Hydrological Regions of Bangladesh

With its location in the tropical monsoon region, the country is characterised by high temperature, heavy rainfall, often excessive humidity, and fairly marked seasonal variations. Three main seasons in

Bangladesh are the cool dry season from November through February, the pre-monsoon hot season from March through May, and the rainy monsoon season that lasts from June through October. Average annual precipitation ranges from 1950 mm in the southwest to 3091 mm in the southeast.[23] The least rainfall occurs in December and January, while the peak of rainfall occurs between May and October. Total winter rainfall (October to May) averages about 180 mm in the east and less than 80 mm in the northwest. Nearly 80% of the annual rainfall falls from May to September. The data from 1985 to 2009 period shows that in general there have been overall declines in annual rainfall across regions, except for the southeast region (Figure 9).

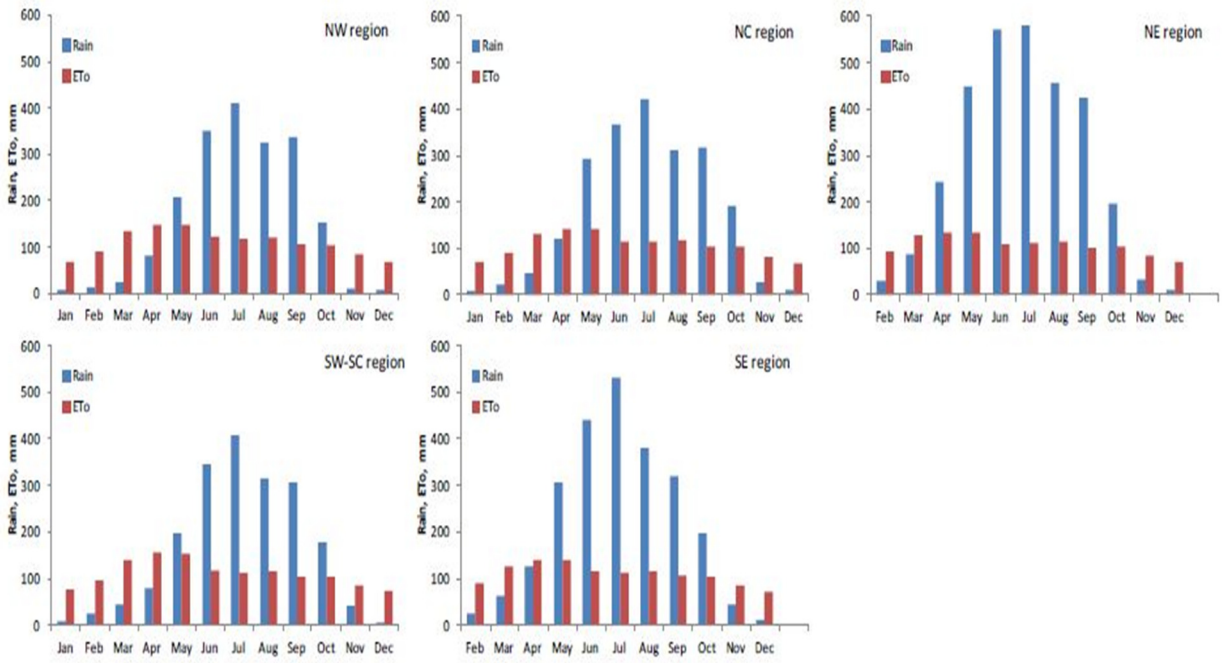


Source: CSIRO et al (2014)

Figure 9 Annual Rainfall Across Hydrological Regions in Bangladesh

Despite its high annual precipitation, droughts are recurring phenomenon with substantial economic losses in terms of agricultural production loss that might be greater than flood losses. Seasonal droughts can take place not only in dry season but also during periods without rain in wet seasons.[24] Combines with high evapotranspiration across the regions that range from 1261 mm in northeast region to 1327 mm in southwest-southcentral region. The driest regions lie in the westerly part, i.e. northwest and southwest-southcentral, with the lowest annual rainfalls and the highest evapotranspiration rates. Monthly rates of rainfall and evapotranspiration across regions are shown in Figure 10.

Bangladesh location in the floodplain renders more than 20% of the country flooded annually, especially during wet seasons and in some areas such as the *haor* region of the northeast. Three main sources of floods are rivers, flash flood from sudden runoff during intense storms, and coastal flooding from storm surges. Severe river flooding occurs when the rivers have particularly high flows and when the peak flows of different rivers coincide, such as record level flood in 1988 and the longest flood period in 1998.[25] Bay of Bengal is one of the most active areas for cyclone development in the world that imposes high exposure of destructive storm surges to Bangladesh coastal areas.[26]



Source: CSIRO et al (2014)

Figure 10 Monthly Rainfall and Evapotranspiration Across Hydrological Regions in Bangladesh

3.1.2. Water Balance

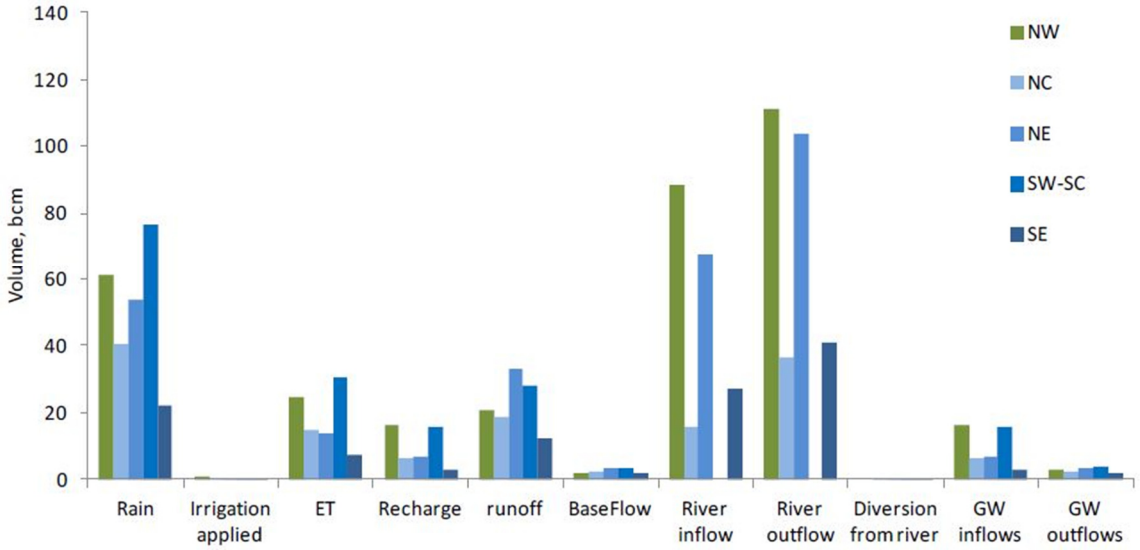
Regional Water Balance

The regional water balance across hydrological regions in Bangladesh takes into account rainfall, evapotranspiration, runoff, recharge to groundwater, baseflow from groundwater to the rivers and irrigation water use. Available estimations were calculated for wet seasons and dry seasons as shown in Figure 11. During dry seasons, evapotranspiration clearly exceeds rainfall due to the use of groundwater by vegetation and the less available surface waters in those periods.[27]

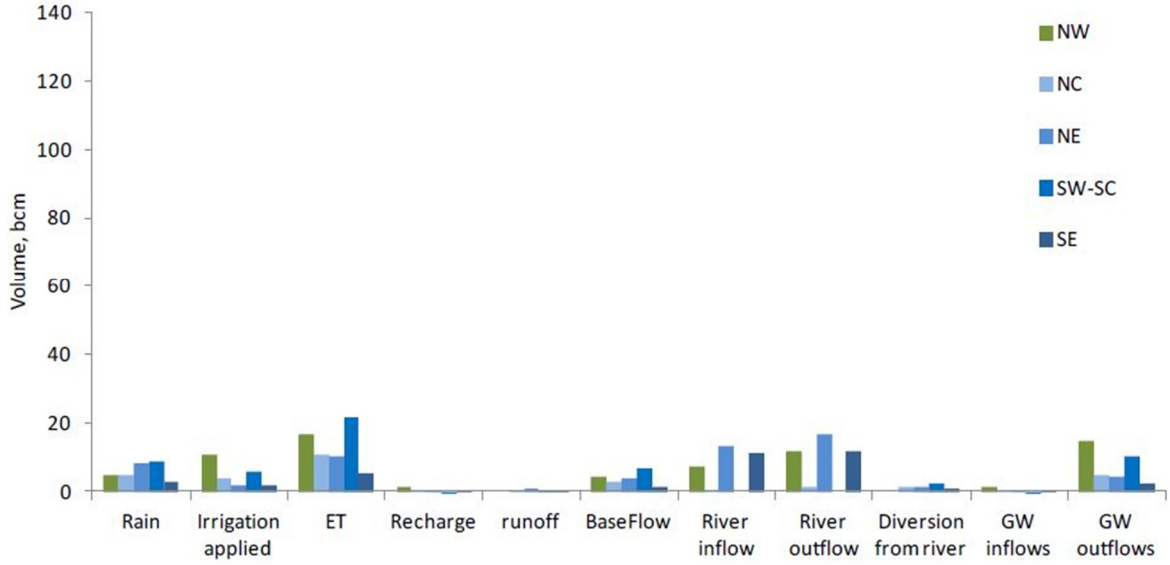
The seasonal variation of availability of water, along with the competing demands of water for the water supply and sanitation, agriculture, industry, fisheries and wildlife, navigation, hydropower and recreation as well as the environment and the preservation of water bodies has made the water management and planning a very challenging task. In the monsoon, too much water produces floods and in the dry season too little water causes water scarcity as well drought. The increasing reduction of transboundary flows is evident both in the monsoon and dry season due to upstream uses and storage.

Surface Water Resources

Three main rivers that enter Bangladesh, i.e. the Ganges, Brahmaputra, and Meghna (Barak) contribute to annual average inflows of 981 billion m^3. The dry season inflows are 186 billion m^3 in which 148 billion m^3 is provided by the Brahmaputra. The Ganges inflows have been significantly reduced on average by 1.4 billion m^3 annually, probably due to upstream diversions.



(a) Wet season regional water balance



(b) Dry season regional water balance

Source: Kirby et al (2014).

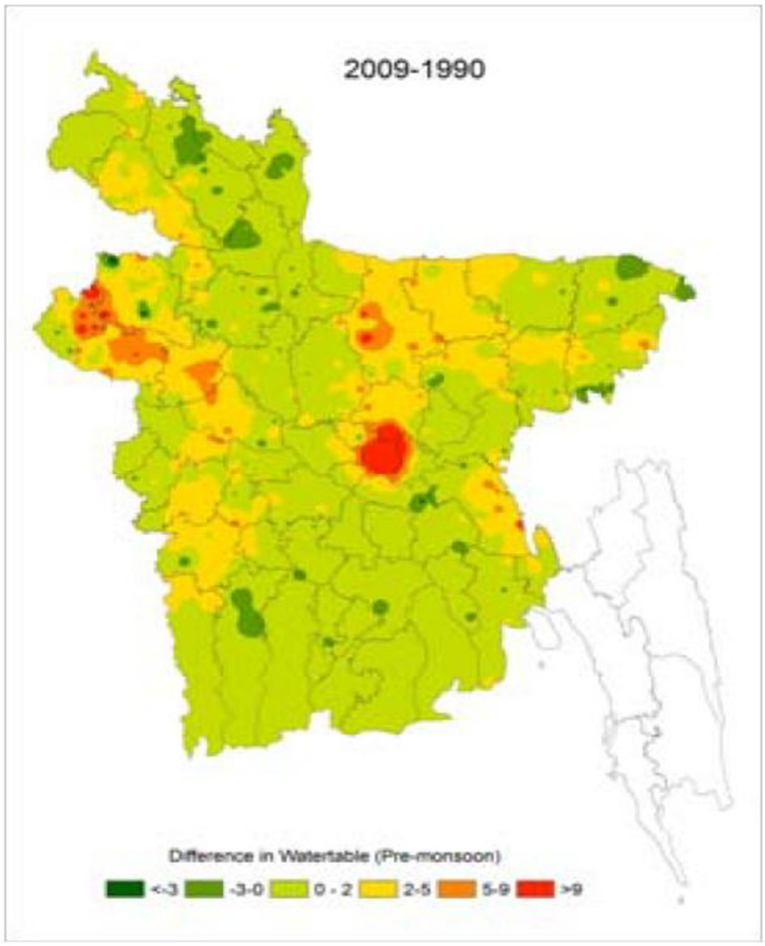
Figure 11 Regional Water Balance in Bangladesh

The low inflows during dry seasons have caused serious issues of saltwater intrusion up in the distributaries of the western part of the delta in the southwest region. Further decline of inflows and upstream withdrawals have worsened the severity of salinity issues.

Groundwater Resources

Annual groundwater resources availability is estimated at 65 billion m^3.[23] Net groundwater recharge is estimated around 28-32 billion m^3 per year.[27] The Bangladesh Water Development Board (BWDB) undertakes extensive groundwater monitoring that entails 1200 wells and maintains database from 1960s. The deepest groundwater water tables are in pre-monsoon periods (April to May) while the

shallowest ones are during post-monsoon periods in November. Fluctuation of water table across the year could be up to 10 meters. The north central region, which includes Dhaka, has greater groundwater depth both in pre and post monsoon seasons due to large extractions for urban water supply.[23]



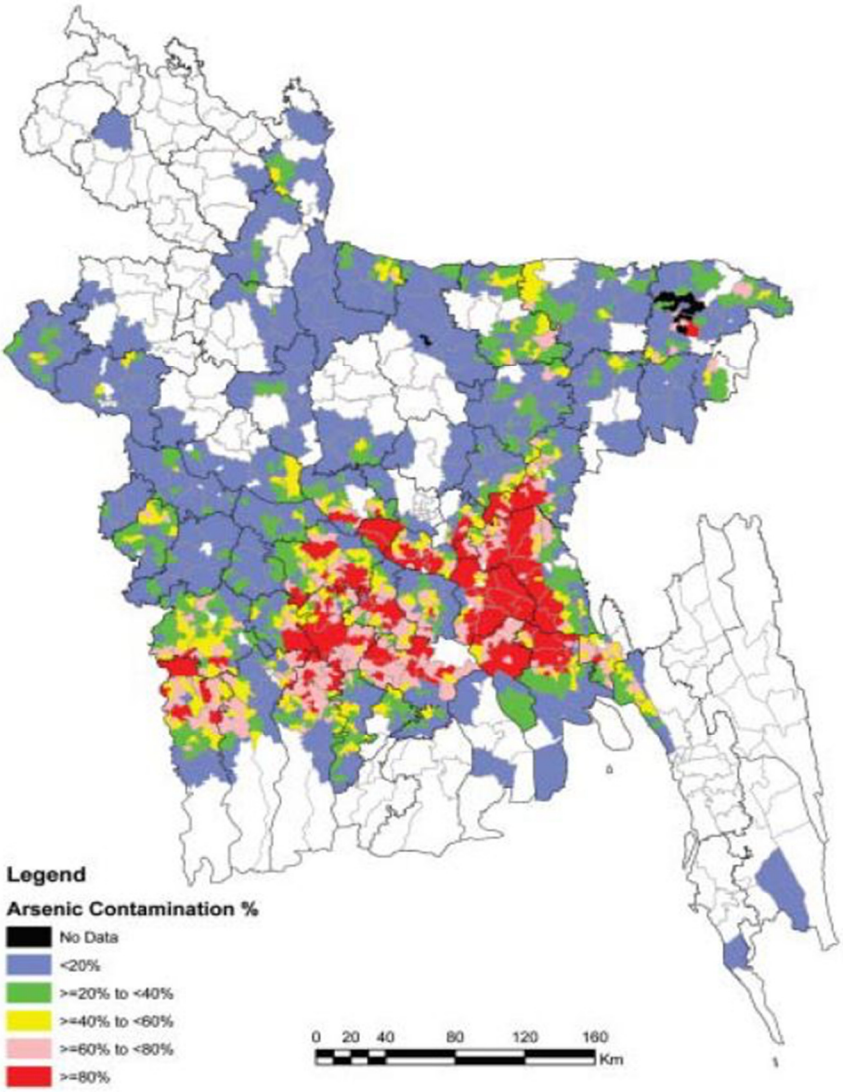
Source: CSIRO et al. (2014).

Figure 12 Fluctuations of Groundwater Depth in Pre-monsoon Seasons in Bangladesh

3.1.3. Water Quality

Both surface and groundwater quality in Bangladesh have been declining due to arsenic contamination, saltwater intrusion and land-based pollution activities, such as agrochemicals, industrial effluents, domestic waste as well as oil and lube spillage. As untreated wastewater from these activities are mostly discharged to surface water bodies, inland surface water quality has dropped below the threshold of the Department of Environment in dry seasons and render their use unsuitable for domestic uses.

The situation of arsenic contamination in Bangladesh is shown in the following figure. The limit of arsenic for drinking water in Bangladesh is 0.05 mg/L, which is higher than the standard of World Health Organisation (WHO) at 0.01 mg/L. If arsenic concentration in an area is above the standard in Bangladesh, it is considered to be arsenic contaminated area. The figure shows that in the southern part of the country, more than 80% of the area is severely affected in some districts. Drinking arsenic contaminated groundwater can cause several diseases, such as lesions, hardening and loss of feeling in limbs, and cancers. About 40000 people in Bangladesh had been identified to suffer from the symptoms of arsenicosis.[28]



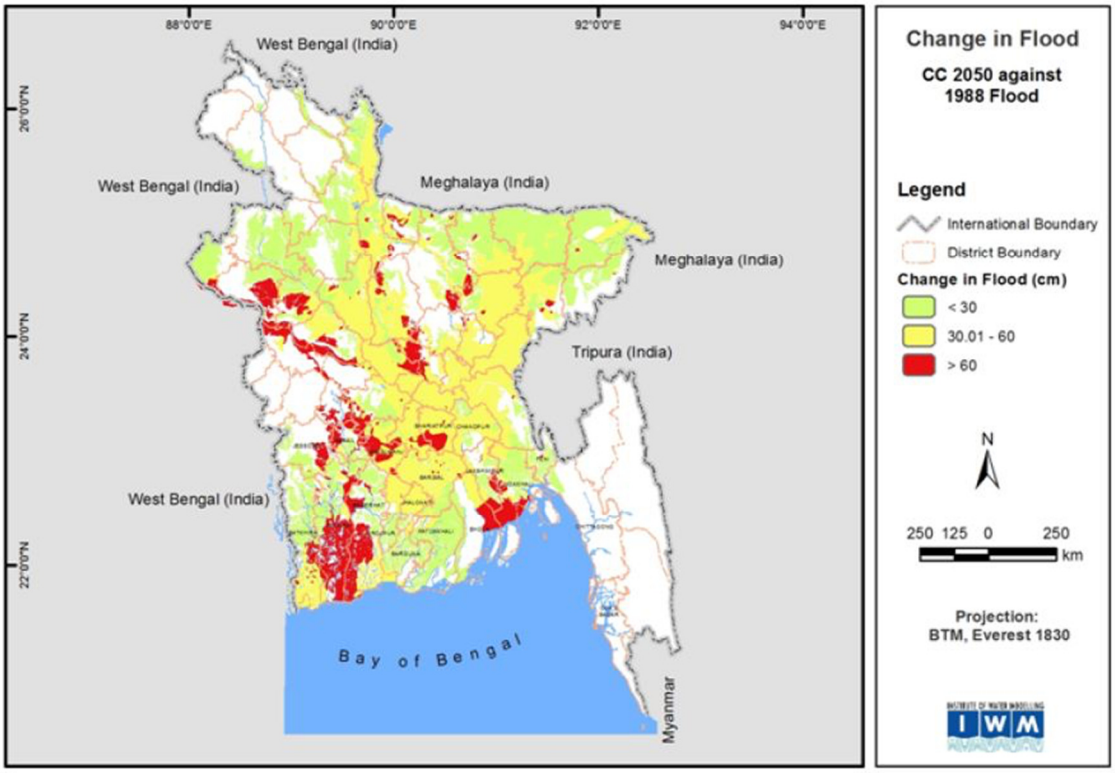
Source: Department of Public Health Engineering.

Figure 13 Arsenic Contaminations in Bangladesh

3.2. Key Impacts of Climate Change to Water Resources

Observed temperature and rainfalls have increased over the last 50 years in Bangladesh. Extreme temperatures and precipitation are expected to increase. The level of uncertainty within existing projection models render difficult estimation of the magnitude of the impacts. Nevertheless, the natural variability of rainfall and river flows is expected to dominate water resources situations more than climate change impacts by 2050.[29]

Projected changes to river flows are determined by several factors: the change in storage of water in Himalayan glaciers, precipitation and temperature changes in the basin, vegetation water use, and groundwater recharge. Overall, climate change is projected to increase extreme rainfall and temperatures and thus exacerbate floods and droughts phenomenon in Bangladesh. The increased depth of flooding due to climate change by 2050 is illustrated as follows.[30] As there is a greater risk and extent of flooding, climate change might also reduce land availability in the coastal zone and pose threat to food security.

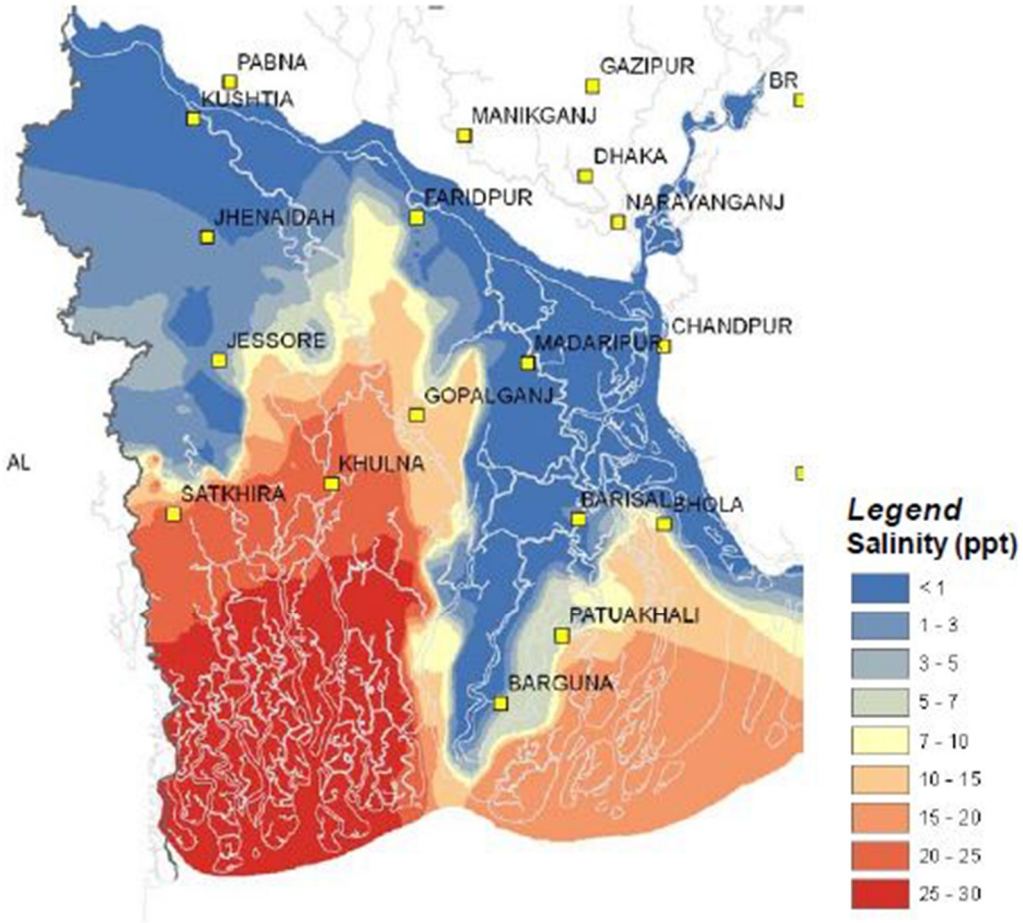


Source: IWM.

Figure 14 Increased depth of Flooding by 2050 Due to Climate Change

The impacts of climate change on groundwater resources are more difficult to understand. Projected increases to rainfall and temperature might affect vegetation water use and demand for irrigation water. Groundwater recharge is determined by changes to rainfall amount and timing, flood extent and duration and consumption of surface water by vegetation. Under caveat of uncertainty, it is suggested that recharge may decline due to fewer, more intense storm that might lead to greater runoff and shorter periods for recharge. Due to currently poor understanding of the impacts, it will be more prudent to anticipate slightly reduced groundwater resources.

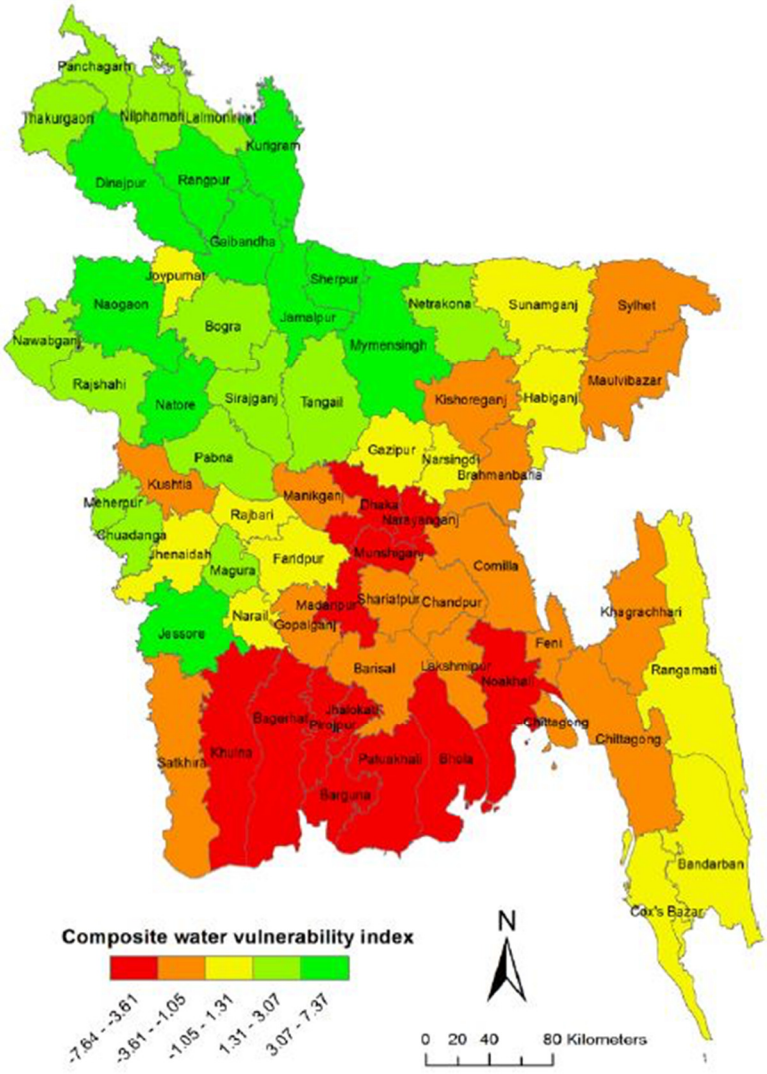
Sea level rise from climate change is also projected to exacerbate salinity problems in Bangladesh. The southwest region is envisaged to suffer the most from higher saltwater intrusion further upstream of the rivers as shown in the following figure.[31] It has also been pointed out that upstream water diversion on dry season might have comparable impacts as those from climate change.



Source: IWM (2014)

Figure 15 Projected Saltwater Intrusion by 2050 Due to Climate Change

Water related hazards in terms of floods and droughts will exacerbate the vulnerability of the poorer. The districts in the coastal zone and around Dhaka are found to be the most vulnerable. [32]



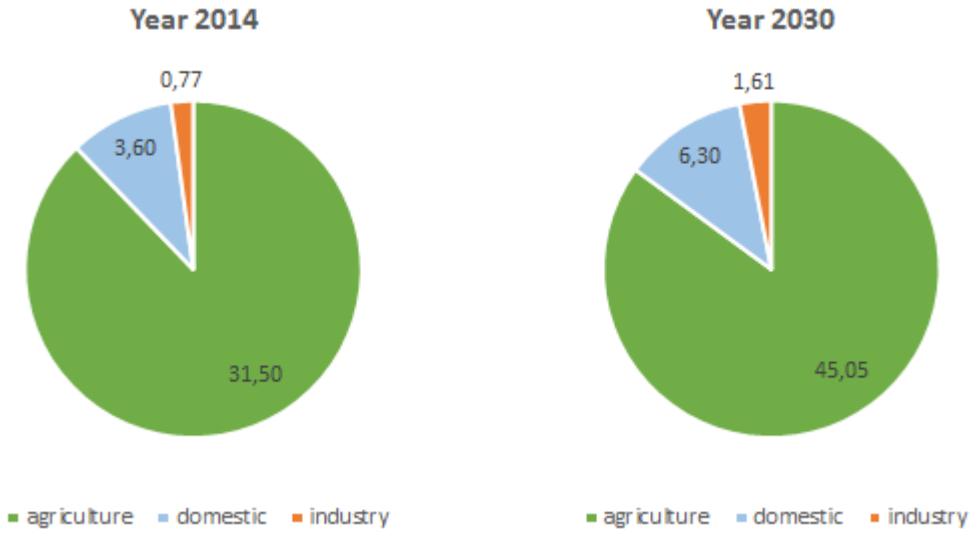
Source: BIDS (2014)

Figure 16 Composite Water Vulnerability Index by District

Chapter 4 Water Risks Outlook to Bangladesh Textile Industry

4.1. Water Supply and Demand of Textile Industry

According to the latest FAO data on sectoral water use, Bangladesh total annual freshwater withdrawal in 2014 was 35.87 billion cubic meter in which total industrial water use only accounted for about 2.147 % of Bangladesh total water use, while agricultural sector is the largest water use with 87.82 % followed by domestic water use of 10.04%. It is projected that industrial water demand can increase by 109%, domestic water demand by 75% and agricultural water demand by 43% in 2030.[33] Textile and RMG industry is the main contributor to that industrial water demand.



Source: Modified from FAO (2015) and PricewaterhouseCoopers (2015).

Figure 17 Projection on Sectoral Water Demand in Bangladesh by 2030

Most industrial water is sourced from groundwater (estimated at 98%[15]) and industries are required to have a licence for groundwater abstraction or to pay the industrial or commercial rate of water supplied by municipalities. About 90% of urban water supply is also sourced from groundwater[34].

The figure of industrial water use above is nevertheless an underestimation of the actual water use due to a substantial amount of unrecorded industrial water abstraction, either from unregistered abstraction, unmetered abstraction, or lack of monitoring and enforcement. In Dhaka alone where 70% of WDF units are located, there are currently 1640 private wells in 2012. This number of wells however does not take into account of those units located outside the administrative limits. For registered commercial wells, water abstraction is generally unmetered due to lack of monitoring and enforcement or flat rate pricing by some municipalities.

Since there are no official figures of how much groundwater that the textile industry actually consumes annually, the demand for textile water can only be estimated based on a few proxy indicators. A study estimated that the overall water use of the textile and RMG industry is around 1.5 billion m^3 (BCM) per year in 2009. This estimation was based on factory water consumption of 300 L/kg fabric and annual textile production of 5 million tonnes. [14] Another current estimate provided textile and leather water demand of 4.027 billion liter per day (BLD) in 2014, in which 4.013 BLD is textile water demand. The estimate was based on the assumption that textile water demand is roughly twice domestic water demand and per capita water demand.[15] It can be said that those two figures provide an upper and lower estimates of textile water demand.

In line with the ambitious RMG export target of USD 66.25 billion by 2030, it is anticipated that textile water demand will be increased by 270,3 % compared to 2014 to 3.959 BCM per day for the lower estimate and 8.382 BCM per day for the upper estimate, creating water demand gap between 2.495 to 5.282 BCM per year. The increase in textile water demand should be put in the context of the overall increase of sectoral water demands from both domestic and agricultural purposes. As these two sectors have a higher priority than industrial water demand, any available water will be allocated first to those sectors, imposing much higher risk of water shortage to the textile industry in 2030.

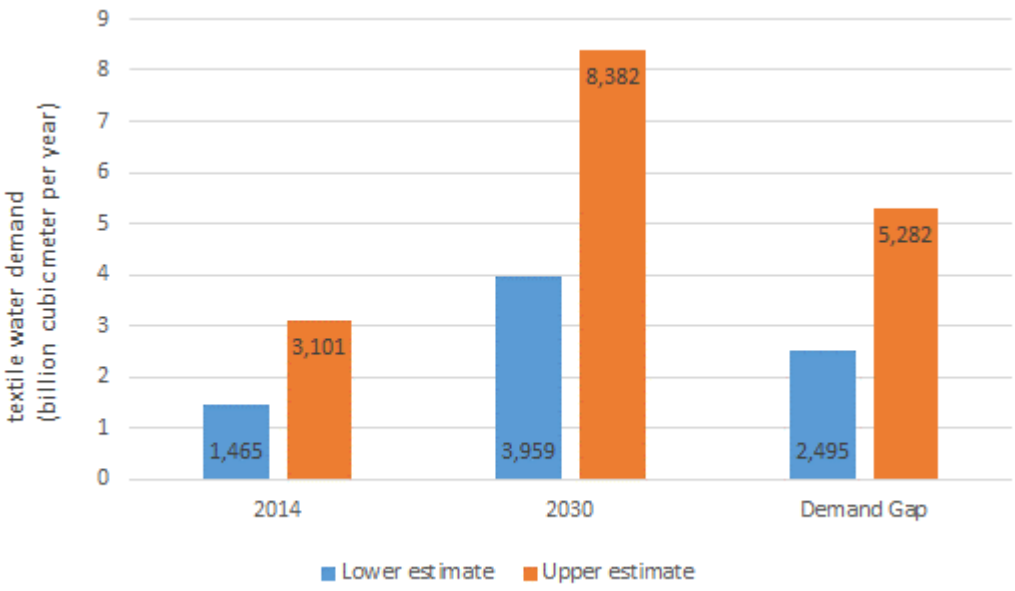
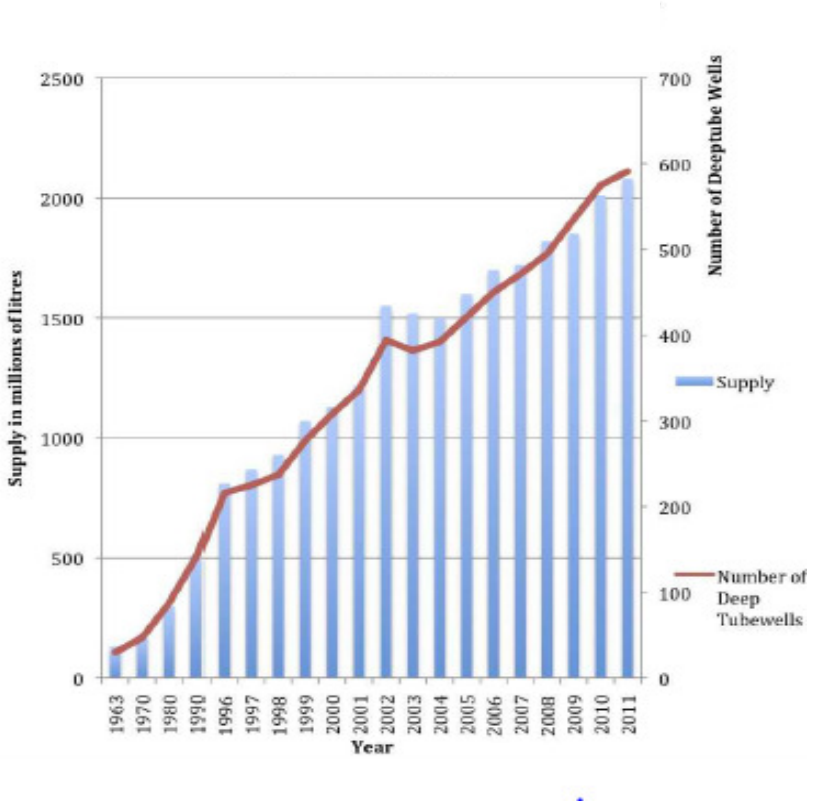


Figure 18 Textile Water Demand and Gap by 2030

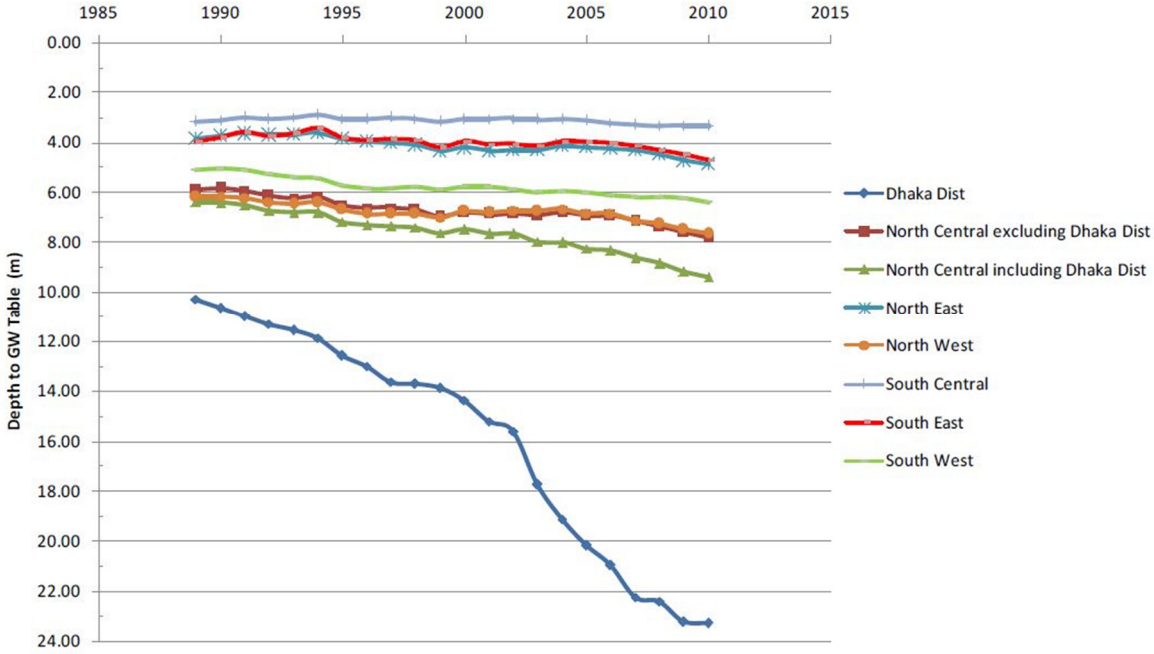
Heavy reliance on groundwater as the primary water source for all sectoral water use has brought about over-extraction of groundwater, which is clearly indicated by a rapid decline in groundwater table, especially in areas with textile clusters. In Dhaka alone the number of tube wells had been increasing from just about 100 wells in 1980 to 300 wells in 2000 and more than doubled to 615 wells by 2011.[35] Dhaka Water Supply and Sewerage Authority latest statistics shows a record of 702 deep tube wells in 2015 with a production capacity of 2 billion L per day.[36]



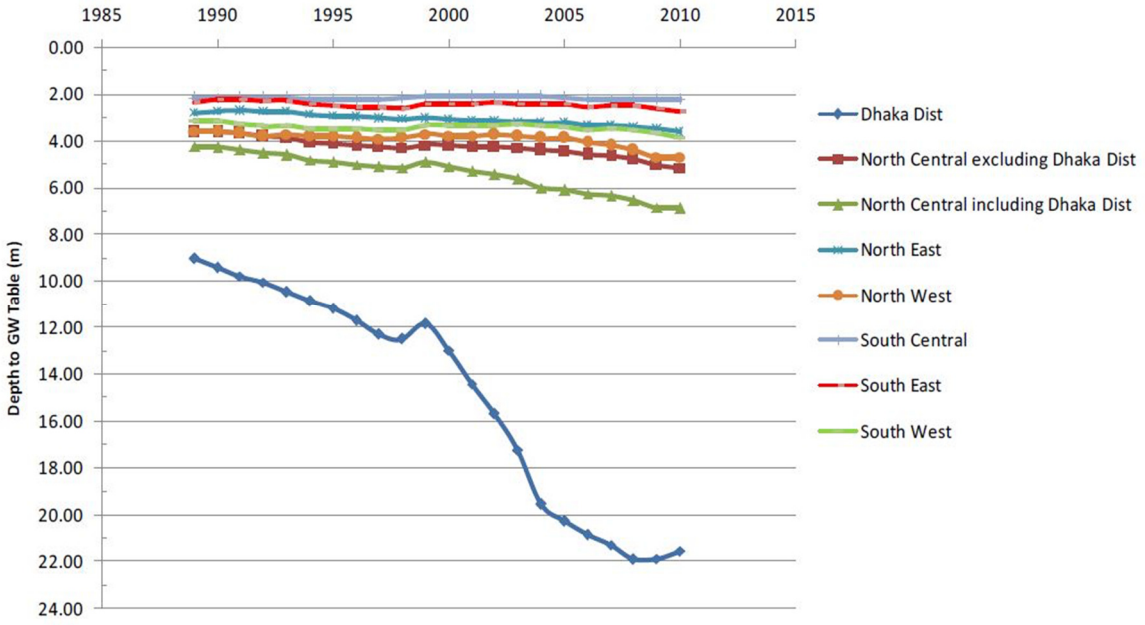
Source: Dhaka Water Supply and Sewerage Authority in Sengupta et al. (2012).

Figure 19 Number of Deep Tubewells and Water Supply in Dhaka

As a result, groundwater table in Dhaka has dropped by around 10m during 2000-2010, much higher than other regions in Bangladesh (Figure 20). If this trend is to continue, there will serious water risks not only to the industry but also to other sectoral water use, especially domestic water use.



(a) Groundwater table over the years in pre-monsoon seasons, five year moving average



(b) Groundwater table over the years in post-monsoon seasons, five year moving average

Source: CSIRO (2014)[23]

Figure 20 The Decline in Groundwater Table Across Regions in Bangladesh

4.2. Water Quality Risks of Textile Industry

4.2.1. Textile Effluent Characteristics

As shown in Table 1, textile industry has been indicated as the most polluting industry in Bangladesh with high level of water pollution due to the characteristics and volume of textile wastewater. Effluent discharge from textile wet processing units is affected by the cleaning and dyeing agents used and is characterised by high levels of BOD, COD, color, toxicity, fibers, turbidity, dissolved solids, chemicals, and to some extent heavy metals. High BOD levels in textile effluents are attributed to fiber residues and suspended solids. Heavy metals in the effluent may comprise of chromium, lead, copper, zinc, and mercury. The characteristics of textile effluent at each process of the value chain is elaborated below.

Table 2 Characteristics of Textile Effluent

Process	Effluent Composition	Pollutant Nature
Sizing	Starch, waxes, Carboxymethyl Cellulose (CMC), Polyvinyl Alcohol (PVA), wetting agents.	High in BOD, COD
Desizing (removal of starch materials from fiber)	Starch, CMC, PVA, fats, waxes, pectins	High in BOD, COD, SS, dissolved solids (DS)
Scouring (removal of oily and waxy substances)	H_2O_2, $NaSiO_3$ (organic stabilizer)	High pH, high SS
Bleaching	Sodium hypochlorite, Cl_2, NaOH, H_2O_2, acids, surfactants, $NaSiO_3$ (organic stabilizer), Sodium phosphate, short cotton fibre	High alkalinity, high SS
Mercerizing (enhancing luster)	Sodium hydroxide, cotton wax	High pH, low BOD, high DS
Dyeing	Dye stuffs, urea reducing agents, oxidizing agents, acetic acid, detergents, wetting agents.	strongly colored, high BOD, DS, low SS, heavy metals
Printing	Pastes, urea, starches, gums, oils, binders, acids, thickeners, cross-linkers, reducing agents, alkali	Highly colored, high BOD, oily, appearance, SS, slightly alkaline

Source: Dey and Islam (2015)[18], Babu *et al.* (2007)[37]

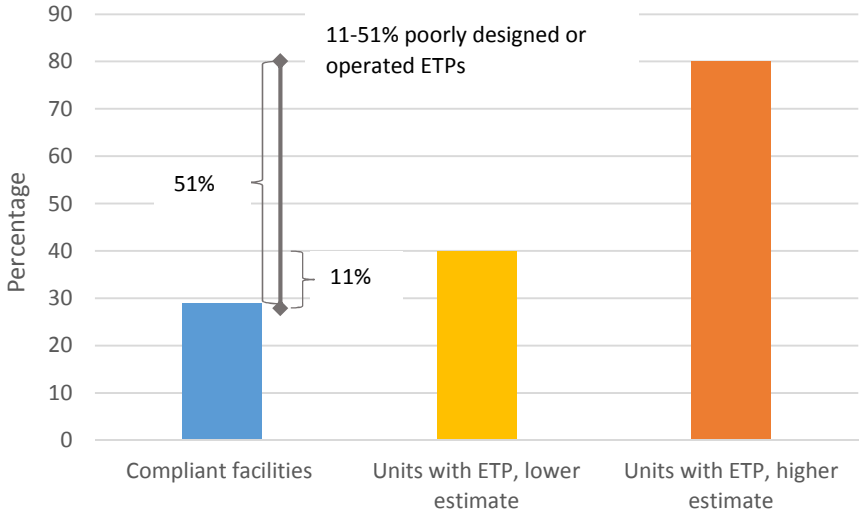
4.2.2. Poorly Designed and Operated ETP Facilities

The Bangladesh Ministry of Environment and Forest (MoEF) enacted an environment protection law in 1995 that demanded that all new textile wet-processing plants must install an effluent treatment plant (ETP). According to a study by UNIDO, there were 806 industrial facilities across all sectors that required an ETP of which 489 (61%) had complied by December 2010. [38]

Roughly 29% of textile wet processing units covered by that regulation was found to be compliant.[38] At the same time, it was estimated that around 40 to 80% of all textile wet processing units was

equipped with ETP.[15] The difference in those figures confirm the wide acknowledgement that many of the ETP facilities were poorly designed or not operated in an appropriate and responsible manner.

The compliant units were mainly large to medium sized enterprises. Many of the small to medium sized enterprises could not afford the capital expenditure to install ETP; while the companies that had installed such ETP facilities in place stated that the operational costs were the difference between profit and loss so that such facilities might be run sporadically, if at all. Many companies were more concerned with high ETP operational costs than the capital costs. These companies mentioned that large international retailers with sustainability agendas that insisted on wastewater treatment were often not prepared to respond to an increase in price from the suppliers. The government vies, however, that textile wet processing suppliers must include their capital and running costs of ETP in the sales price of the product.



Source: Analysis based on Park (2011) and Sagris and Abbot (2015).

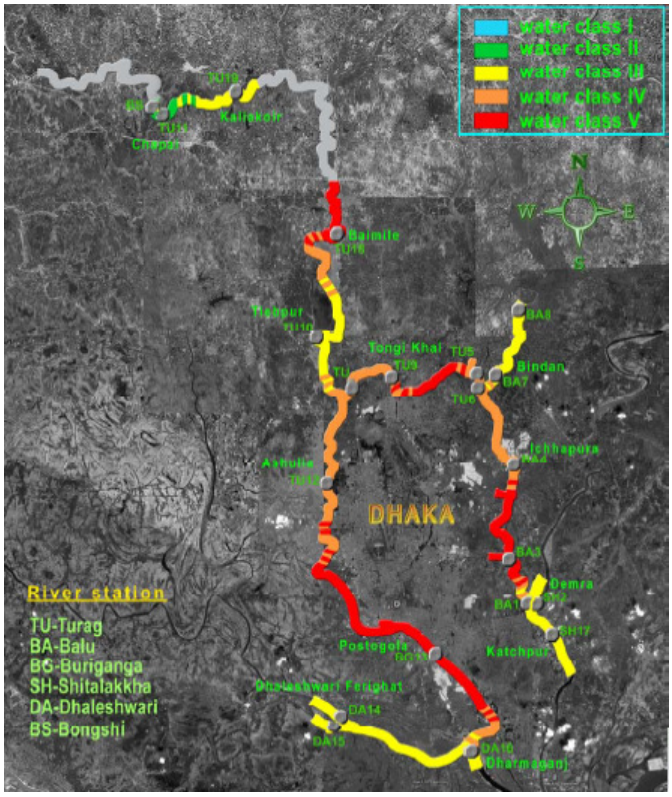
Figure 21 The Percentage of Poorly Designed or Poorly Operated ETPs in Bangladesh Textile Wet Processing Units

4.2.3. Degrading Water Quality of River Bodies Around Textile Clusters

As untreated or improperly treated textile wastewater is discharged directly to surface water resources, the impacts of increasing textile production with its large volume of mostly, highly polluting effluent over time at concentrated industrial locations can be observed from degrading water quality of the rivers around the industrial clusters, such as those around in Dhaka. Figure 22 illustrates how these rivers are highly polluted in some sections and overall lie within the category of water class III (poor) to class V (unsuitable for drinking water and aquatic life)[39].

The latest Bangladesh Water Quality Report provides observation of the water quality of three main rivers around Dhaka: Buriganga river, Shitalakshya river, and Turag river, in the period of 1975-2014

for three main pollution indicators: pH, DO and BOD, during dry and wet seasons. The report shows the Buriganga river was within the Environmental Quality Standards (EQS) for fisheries on pH parameter, but not for DO and BOD with an decreasing trend for DO and increasing trend for BOD, as clear evident of higher pollution. Due to the condition, the river is deemed to be ecologically dysfunctional. Similar patterns were also observed for Shitalakshya and Turag river. [40]



Source: Bari and Badruzzaman (2008)

Figure 22 Poor Water Quality of Rivers around Dhaka

Chapter 5 Water Governance Landscape Pertaining to Bangladesh Textile Industry

5.1. Landscape of Bangladesh Water Governance

Bangladesh is often identified as one of the most vulnerable country to climate change due to the significant impacts of climate change to higher risks water-related disasters and lower adaptive capacities to deal with the impacts. Textile industry physical water risks echo Bangladesh water challenges in general, where increasing water scarcity is characterised with significant future water demand gap, in the presence of high overreliance and severe depletion of groundwater resources and increasing industrial wastewater pollution to surface water resources limits their potential to replace groundwater resources. Water governance significantly influences the adaptive capacities of Bangladesh in reducing and coping with those risks.

The development of water governance institutions in Bangladesh is influenced by the dynamics of the governance of Bangladesh in general since its independence in 1971. The country administratively comprises of seven divisions, namely Dhaka, Khulna, Rajshahi. Barisal, Chittagong, Sylhet and Rangpur, which are further divided into 64 districts; and the local governments have very strong roles in water governance at different administrative levels together with the Ministry of Water Resources.

5.1.1. Key Actors in Water Governance

The key governmental actors involved in water governance in Bangladesh is depicted in the water governance structure (Figure 23). According to Bangladesh Water Act 2013, the National Water Resources Council (NWRC) is an inter-ministerial institution with the highest strategic decision making authority for water governance in Bangladesh. The NRWC has the mandate to policy-making, policy direction, coordination for effective Water Resources Planning, and approving and ensuring implementation of the National Water Resources Plan prepared by the Water Resources Planning Organisation (WARPO) under the Ministry of Water Resources. The Executive Committee of the National Water Resources Council (ECNWRC) performs the activities of the Council, including publication of directives of the Council on water resources, advising the NWRC on issues in water resources management, coordinating amongst concerned authorities, and other functions as the NWRC determines.

The line ministries with key mandates in water governance are the Ministry of Water Resources (MoWR) and the Local Government Division under the Ministry of Local Government, Regional Development and Cooperatives (MoLG). MoWR is the main institution responsible for for water sector development and management including expansion of irrigated areas, water conservation, surface and groundwater use, and river management. The Local Government Division under the MoLG implements water supply and sanitation policies through local government departments.

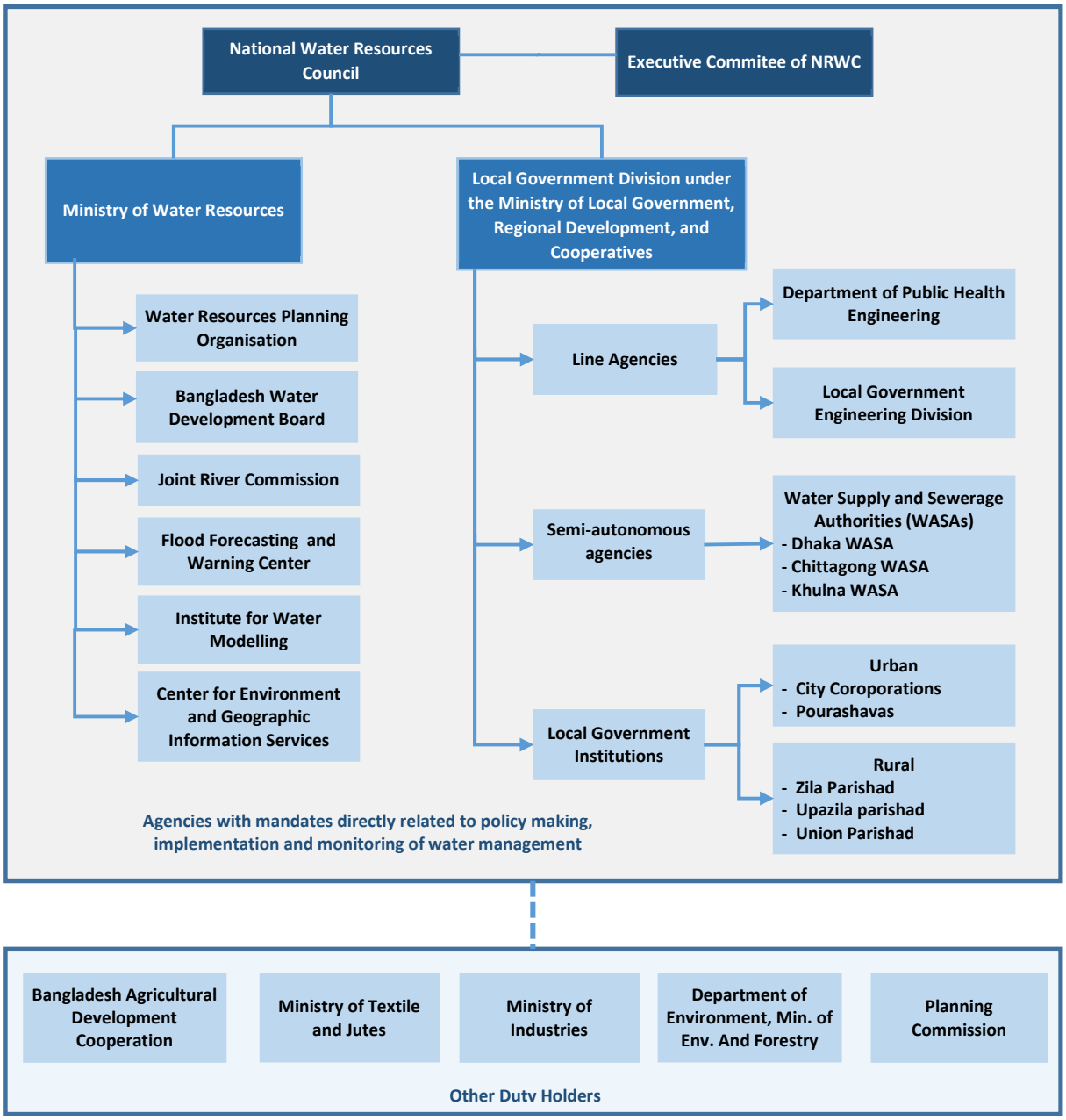
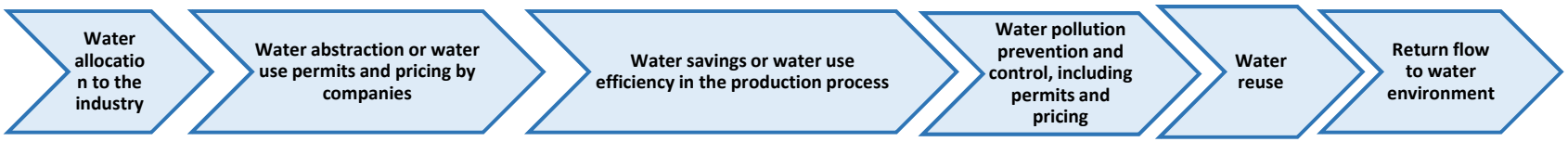


Figure 23 Water Governance Structure in Bangladesh

Those institutions have different roles in the governance of the value chain of textile water use, which consists of: 1) water allocation to the industry; 2) water abstraction or water use permits and pricing by companies; 3) water savings or water use efficiency in the production process; 4) water pollution prevention and control, including permits and pricing, 5) water reuse and 6) return flow to water environment. The mapping of key institutions, their roles and supporting regulations involved in each textile water value chain is illustrated in the following figure.



Key actors	WARPO under MoWR	Water Utilities under MoLG	Ministry of Textiles and Jute Ministry of Industries	Ministry of Textiles and Jute Water Utilities under MoLG Dept. of Environment (DoE)	Dept. of Environment (DoE)
Roles and responsi-bilities	**Water Resources Planning Organisation (WARPO), under Ministry of Water Resources (MoWR)** • High level water resource planning and management through National Water Management Plan. • Planning the location of new industries based on water availability and effluent discharge requirements.	**Water utilities under MoLG** • Three types of water utilities under MoLG: Water Supply and Sewerage Authorities (WASAs), city corporations and pourashavas. • Role: planning, construction, operations and maintenance of water supply and sewerage services, including issuing licences for sinking deep tube-wells and charges for industrial water use. ***Other actors:*** **The Prime Minister's Office through Bangladesh Investment Development Authority (BIDA) and the Bangladesh Export Processing Zones (BEPZA)** • Approval of foreign, joint-venture and local projects. • Facilitate utility connections including water. • Water supply and sewerage services within Export Processing Zones (EPZs). **ECNWRC** • Extraction of water, construction that may potentially change the direction of flow of water in a natural water body.	**Ministry of Textiles and Jute** • The National Institute of Textile Engineering & Research (NITER) aims to enhance the overall productivity, quality of products and raise efficiency of textile sector • Monitoring of the textile sector from 2014. **Ministry of Industries** • Developing new policies and strategies for promotion, expansion and sustainable development of Industries. ***Other actors:*** **Bangladesh Garment Manufacturers and Exporters Association (BGMEA)** • Promote workplace safety and compliance by regular monitoring of its member's compliance and organising training on social and environmental standards. **Bangladesh Knitwear Manufacturers and Exporters Association (BKMEA), Bangladesh Chambers of Commerce and Industry (FBCCI)** • Monitoring of site water use reduction.	**Ministry of Textile and Jute** • Approval of registration of textile wet processing units given the installation of effluent treatment plant (ETP). • Monitoring existing ETP capacities in the textile sector from 2014. **Water Utilities under MoLG** • Setting charges for sewerage and wastewater treatment services. **DoE, under Ministry of Environment and Forest (MoEF)** • Monitoring operations of the activities affecting environmental quality and enforce the standards of environmental conservation, including monitoring of ETPs. ***Other actors:*** **BEPZA** • Water supply and sewerage services within Export Processing Zones (EPZs). **BGMEA** • Promote workplace safety and compliance by regular monitoring of its member's compliance and organising training on social and environmental standards. • Requiring industry to have ETP after 2010 to be its member	**Dept. of Environment (DoE), under Ministry of Environment and Forest (MoEF)** • Monitor operations of the activities affecting environmental quality (water, air, land pollution etc.) and enforce the standards of environmental conservation, including monitoring of ETPs.
Laws, regulations, policies	**WARPO, MoWR** • Water Act, 2013 • Water Resources Planning Act, 1992.	**MoLG:** WASA Act, 1996; Local Government Acts 2008; **BIDA:** BIDA Act 2016 **BEPZA:** Authority Act, 1980 **ECNWRC:** Water Act, 2013	**Ministry of Textiles and Jute:** Textile Industry Act 2015 **Ministry of Industries:** Industrial Policy	**DoE**: Environmental Conservancy Act 1995, Environmental Conservation Rules 1997 **Ministry of Textiles and Jute:** Textile Industry Act 2015 **Ministry of Industries:** Industrial Policy	**DoE**: Environmental Conservancy Act 1995, Environmental Conservation Rules 1997.

Figure 24 Water Governance Value Chain Pertaining to Textile Industry Water Use in Bangladesh

Ministry of Water Resources (MoWR)

The Ministry of Water Resources (MoWR) is the apex body responsible for the development and management of the whole water resources of the country. It formulates policies, plans, strategies, guidelines, instructions and acts, rules, regulations, etc. relating to the development and management of water resources, and regulation and control of the institutions reporting to it. Main institutions under MoWR and their responsibilities are as follows:

a. **The Water Resources Planning Organization (WARPO)** is the Ministry's macro-planning arm that prepares National Water Policy, the Coastal Zone Policy, National Water Resources Database (NWRD), National Water Management Plan (NWMP) and Integrated Coastal Resources Database (ICRD). With the inputs from under relevant institutions, WARPO also decides on sectoral water use, including industrial water use, and plans the location of new industries by considering water availability and effluent discharge requirements.
b. **The Bangladesh Water Development Board (BWDB)** is the implementing arm of MoWR with regard to flood control and drainage (FCD)/flood control, drainage and irrigation (FCDI); and other development projects.
c. **The Flood Forecasting and Warning Center (FFWC)** provides flood forecasting and warning information for BWDB.
d. **The Institute of Water Modeling** is a public trusty organisation established that undertakes mathematical modelling of Bangladeshi river systems, GIS, environment and groundwater modelling .
a. **The Center for Environmental and Geographic Information Services (CEGIS)** for integrated environmental analysis using GIS, remote sensing (RS), database and IT.
b. **The Joint Rivers Commission (JRC)** in Bangladesh was established to address issues related to sharing and management of water of transboundary rivers among co-riparian countries of India, China, Bangladesh, and Nepal.

Ministry of Local Government, Regional Development and Cooperatives (MoLG)

The Local Government Division (LGD) under the Ministry has the mandate to provide overall guidance to the water sector. The LGD performs a wide range of functions including policymaking, planning, financial mobilization, and allocations and the development and maintenance of the institutional framework for Water Supply and Sanitation. It consists of:

a. **Line agencies: the Department of Public Health Engineering (DPHE)** and **the Local Government Engineering Department (LGED)**.
   The DPHE is the national focal agency for water and sanitation in rural and urban areas, except those under WASAs. The DPHE carries out the implementation works in collaboration with the City Corporations, Pourashavas, and Union Parishads. LGED implements water and drainage projects in urban areas as part of urban infrastructure development projects.
b. **Semi-autonomous agencies: Water Supply and Sewerage Authorities (WASAs)**.
   WASAs exist in Dhaka, Chittagong, Khulna and Rajshashi, which are also the areas where most industrial clusters are located. Currently, WASAs are responsible for planning, construction, operations and maintenance of urban water supply and sewerage services, although they require technical and financial improvements.

Specifically on industrial water use, WASAs issues licences for sinking tube well for commercial water abstraction, and set and collect charges of industrial water use, sewerage and wastewater treatment services.

In the future, WASAs are expected to: provide technical assistance to local government institutions (LGIs) to plan and implement WSS projects and efficient systems operation, including water safety plans; support the LGD to set service standards and monitor the service level; and advise and monitor the use of surface and groundwater.

c. **Local government institutions (LGIs): City Corporations** and **Pourashavas** in urban areas, and **Zila Parishad, Upazila Parishad,** and **Union Parishad** in rural areas.
City Corporations and Pourashavas have the mandate in water supply and sanitation services outside of the jurisdiction of WASAs. Previous that mandate was given to DPHE but it has gradually transferred to LGIs and leave DPHE with more sophisticated technical interventions, such as treatment plants, production wells, and transmission lines whereas City Corporations and Pourashavas implement pipe networks. Nevertheless, all operation and maintenance responsibility falls to the City Corporations and Pourashavas.

Other Duty Holders

a. **The Department of Environment (DoE**) under the Ministry of Environment and Forest (MoEF).
Under the Environment Conservation Act 1995, DoE is mandated to monitor operations of the activities affecting environmental quality (water, air, land pollution etc.) and enforce the standards of environmental conservation. The Environmental Conservancy Rules 1997 also state that any water related project requires and Environmental Impact Assessment (EIA) before approval.

b. **The Prime Minister's Office: The Bangladesh Investment Development Authority (BIDA) and .**
Since textile industry is crucial for the country's economy, sector development is conducted directly under the Prime Minister Office, through among others BIDA and Bangladesh Export Processing Zones (BEPZA).

BIDA is the principal private investment promotion and facilitation agency of Bangladesh. It is mandated with diversified promotional and facilitating services in order to accelerate industrial development of the country. One of its functions is investment facilitation, including registration/approval of foreign, joint-venture and local project; Facilitate utility connections including water; and assistance in obtaining industrial plots.

The BEPZA is the official authority to promote, attract and facilitate foreign investment in the Export Processing Zones (EPZs). BEPZA performs inspection & supervision of the compliances of the enterprises related to social and environmental issues, safety and security at work place in order to maintain harmonious labour-management and industrial relations in EPZs. Accordingly, BEPZA has similar functions as WASAs within the EPZs and is responsible to provide Water supply and sewerage services within Export Processing Zones (EPZs).

c. **Ministry of Textiles and Jute**

The Directorate of Textile (DoT) under the Ministry of Textiles and Jute is mandated to supply skilled manpower for the textile sector. The National Institute of Textile Engineering and Research (NITER) under the management of Bangladesh Textile Mills Association (BTMA) within the Ministry in particular aims to enhance the overall productivity, quality of products and raise efficiency of textile sector. The DoT is also responsible for monitoring of the textile sector from 2014.

d. **Ministry of Industry**

The Ministry of Industry (MoI) is primarily responsible for developing new policies and strategies for promotion, expansion and sustainable development of Industrial sector of the country. MoI also regularly formulates, implements, monitors and update the country's industrial policy. The Industrial Policy 2010 aims to provide a policy and institutional framework that will help achieve economic growth through industrialization, create employment opportunities on a long and sustained basis, and improve the standard of living. MoI develops new policies and strategies for promotion, expansion and sustainable development of Industries, which is highly relevant for textile industry's water use efficiency.

e. **Planning Commission**.

The Planning Commission has a procedural responsibility of approving projects and programme initiatives proposed by the government.

f. **Bangladesh Agricultural Development Corporation (BADC)**.

It is responsible for providing irrigation facilities to farmers, using surface water and groundwater sources.

g. **Bangladesh Garment Manufacturers and Exporters Association (BGMEA)**

BGMEA is one of the largest and most influential trade associations in the country representing the readymade garment industry. As one of its activities, BGMEA also has a watchdog function for workplace safety and compliance by regular monitoring of its member's compliance and organising training on social and environmental standards.

5.1.2. Key Regulations and Incentive Instruments

5.1.2.1. Laws, Regulations and Policies Incentive Instruments

The National Water Policy (1999)

The National Water Policy (NWP) states that the National Water Resources Council coordinates all water resource management activities in the country and sets the responsibilities of The Executive Committee of the Council (ECNWRC) and WARPO. The NWP aims to provide direction to all agencies working with the water sector, and institutions that relate to the water sector in one form or another, to achieve the objectives of: a) efficient and equitable development of all form of water resources; b) ensure water availability for to all groups in the society, especially the poor, women and children; accelerate; c) accelerate the development of sustainable public and private water delivery systems with appropriate legal and financial measures and incentives; d) bring institutional changes to decentralise the management of water resources and enhance the role of women in water management; e) Formulate a legal and regulatory environment in water management systems;

and f) Develop a state of knowledge and capability to design future water resource management plans by itself with economic efficiency, gender equity, social justice and environmental awareness through broad public participation.

The NWP sets forth policies within essential areas, such as: 1) transboundary river basin management; 2) comprehensive planning and management of water resources under WARPO leadership; 3) the governance of water rights and allocation; 4) public and private involvement in the delivery of water-related services; 5) public water investment; 6) water supply and sanitation; 7) sectoral water use, including water for environmental purposes; 8) economic and financial management of water resources; and 9) stakeholder participation.

Considering industrial water use, the NWP highlights the issue of salinity problem as barrier to industrial growth and industrial pollution to surface and groundwater resources. Main policies that the government pursues entail industrial zoning, monitoring of effluent disposal, effluent standards to be set in collaboration with DoE, and legal requirement for cleaning up polluted water bodies by pollution sources.

Bangladesh Water Act, 2013

Bangladesh Water Act 2013 (BWA) is a framework law to integrate and coordinate water resources management in the country. The Water Act entails a coordinated and comprehensive water regime in respect of development, management, extraction, distribution, use, and protection and preservation of water resources in the country. The Act reinforces the mandate of the Executive Committee of the National Water Resources Council (NWRC) as the principal water regulator as stated in the National Water Policy 1999. Water Resources Planning Organization (WARPO) is the secretariat to the ECNWRC. The Bangladesh Water Act will ensure: a) the best use of water resources; b) integration of the acts of different organizations; c) legitimize water rights of poor and disadvantaged; d) control of uncontrolled/unaccounted abstraction, diversion, pollution; and e) an optimal, efficient way of using scarce water resources.

The Act mentions that water quality degradation caused by industrial discharge and other sources of pollution are deferred to the provisions of the Environmental Protection Act of 1995 without additional clarifications. It also includes several provisions of enforcement such as compliance orders, protection orders, removal orders, imprisonment and compensation. The maximum penalty for violations is set to five years of imprisonment and/or monetary penalty of Tk 10,000 (less than USD130). The low level of penalty may encourage offenders to pay the penalty instead of complying with the law.

WASA Act, 1996

This Act gives power to the Government to establish WASAs in any area, with permission to perform any work relating to water supply, sewage systems, solid waste collection, and drainage.

The Environment Conservation Act of 1995

The Act establishes the Department of Environment and its mandates in the conservation of the environment and the improvement of standards. These mandates include the power to search industrial sites, examine equipment and processes or collect samples.

The Act is followed by the Environmental Conservation Rules, 1997 that creates a framework for environmental management and setting environmental quality standards, including water quality standards. The Rules entail a specification that all industrial projects must obtain an environmental clearance certificate (ECC) issued by the Department of Environment. It also defines strict penalties that may include imprisonment of up to 10 years. Where offences are committed by corporations, the owners, directors, managers or officers are deemed responsible.

National Water Management Plan: Development Strategy (2011)

Bangladesh embarked upon preparation of a National Water Management Plan (NWMP). In the course of this, a Development Strategy for the NWMP was subsequently adopted in June 2001. In accordance with Policy and the Development Strategy, this National Water Management Plan has been prepared to provide a framework at national and regional level within which line agencies, local Government and other stakeholders may plan and implement their own activities and projects in a coordinated manner, consistent with overall national and sectoral objectives.

The Seventh Development Plan (FY 2016-2020)

With the backdrop of solid development performance in the 6th Development Plan, the country having entered the ranks of middle income countries, and the UND post-2015 Sustainable Development Goals; the 7th Development Plan centres on three themes: 1) GDP growth acceleration, employment generation and rapid poverty reduction; 2) a broad-based strategy of inclusiveness to empowering every citizen to participate fully and benefit from the development process; and 3) a sustainable development pathway that is resilient to disaster and climate change; entails sustainable use of natural resources; and successfully manages the inevitable urbanization transition.

Among the goals and core targets of the Plan in its various components, the following are highly relevant to the textile sector as the driving force of the country's economy:

a. Environmental Sustainability component
   Promote Zero Discharge of industrial effluents; complete land zoning for sustainable land/water use; and environmental, climate change and disaster risk reduction considerations are integrated into project design, budgetary allocations and implementation process.
b. Income and Poverty component
   Creating good jobs for the large pool of under-employed and new labour force entrants by increasing the share of employment in the manufacturing sector from 15 percent to 20 percent.
c. Sector Development component
   Significant growth of agriculture, industry and services sectors; and increase the contribution of the manufacturing sector to 21% of GDP by FY20; and substantial improvement of exports to USD54.1 billion by FY20.

5.1.2.2. Incentive Instruments

The government of Bangladesh has in place some incentive instruments in the area of industrial water use, which mainly exist in two types: tariffs or charges and sustainable financing. The following table summarise these existing incentives.

Table 3 Existing Incentive Instruments for Industrial Water Use in Bangladesh

No.	Incentives	Descriptions	Regulator/ Implementing Institutions
Industrial Water Abstraction Tariffs			
1.	License for sinking tube well for groundwater extraction	For 6" diameter tube well: • License fee Tk 225,000 • Yearly renewal fee Tk 137,500	Chittagong WASA as implementing institution
2.	Industrial water tariff for connection from water utilities	Not all connections are metered. The rates for Dhaka WASA: Metered connection rate: Tk 24.44/m^3 Non-metered connection rate: Tk 128/month. Industrial water rates are in average 2.93 - 3.33 higher than domestic water rate across utilities.	WASAs, city corporations, pourashavas as implementing institutions
3.	New metered connection fees	Tk 8,225including VAT	Chittagong WASA as implementing institution
4.	Industrial water tariff for connection within EPZ	Tk 25,89 /m^3	Comilla EPZ as implementing institution
Sewerage and Wastewater Charges			
1.	Industrial sewerage charges for connection to WASA	Sewerage charge is the same as water abstraction tariff so that metered connection pays double amount in total.	Dhaka WASA as implementing institution
2.	Industrial wastewater charges within EPZ	Tk 38.8/m^3	Comilla EPZ as implementing institution
Green Incentives			
1.	Green banking policies and governance	It is a requirement for banks and financial institutions (FIs) to have a uniform reporting format on green banking activities, have their own Green Banking Policy Guidelines, Green Office and Green Banking Unit to conduct their green banking activities.	Bangladesh Bank as regulator
2.	Environmental risk rating (ERR)	Environmental Risk Management Guidelines for banks and FIs were issued to assess environmental risks in their credits.	Bangladesh Bank as regulator, bank and FIs as implementing institutions
3.	Green financing by banks and FIs through credit quotas	To accelerate climate resilient investments, the minimum credit quota of direct green finance is set at 5% of total loans from January 2016 onwards. Textile is one of the key targeted industries with sensitive (potentially high) environmental impacts.	Bangladesh Bank as regulator, bank and FIs as implementing institutions
4.	Bangladesh Bank Refinancing Schemes	Loans are provided for 50 green products in targeted green sectors at 5% interest rates chargeable to the customers capped at 9%. Around USD 500 million was pledged for these schemes. In 2015 Tk 2 billion (USD 200 millon) of the pledged funds, also called Green Transformation Fund (GTF), is allocated for water and energy use efficiency in textile industry, including ETPs.	Bangladesh Bank as regulator, bank and FIs as implementing institutions

5.1.3. Existing Initiatives and Programme

Bangladesh benefits from numerous water-related initiatives, programmes and projects that involve public funding from bilateral or multilateral donor agencies and international non-governmental organisations. A study has identified 46 selected initiatives, programmes and projects with specific focus on water issues that have been or are being implemented in the past[33]. On going initiatives related to textile water use are listed below.

Table 4 Existing Initiatives Pertaining to Industrial Water Use in Bangladesh

Initiative	Institutions	Region	Description
Bangladesh Water Multistakeholder Platform	Government, 2030 Water Resources Group, IFC	National	The objective is to address challenges in water sector with focuses on: water governance, greater Dhaka Watershed restoration and agricultural water
Establishing a regulatory Framework for water supply and sanitation sector	ADB	National	To support regulation and sustainability of water and sanitation services
Effecting the Water Act 2013	Swiss Agency For Development Cooperation	National, on going	Supporting WARPO in designing the regulations and rules under the Water Act 2013
Feasibility study about Initiatives for conservation of Buriganga	Department of Environment	Dhaka city urban settlements	Focus on management of industrial and urban discharge. Aim: to rejuvenate the Buriganga river with stakeholder participation
Formulation of the Drainage Master Plan	World Bank/ Dhaka WASA	Dhaka WASA area	Focus: Urban sewage management and treatment
Urban water supply	ADB DWASA	Dhaka urban water supply	The project aims to carry out due diligence on technical, economic, financial, governance, poverty, social, and safeguards for the ensuing loan. It will explore feasibility of public-private partnership (PPP) and propose the most viable alternative for improving service delivery of water supply.

5.2. Regulatory Water Risks

The current Bangladesh water governance landscape as shown in the value chain (Figure 24) and some of its ambitious regulatory framework, such as green incentives for sustainable industrial water use by Bangladesh Bank and its target toward zero discharge industrial effluents set in the Seventh National Development Plan, are still far from sufficient to equip the country in managing water risks related to the textile industry. A participatory study on the challenges of water governance in Bangladesh has been conducted[41].

When it comes to textile water specifically, the key challenges of the current water governance issues that contribute to regulatory water risks of the textile industry are:

1. **The problem of non-aligned incentives for sustainable textile water**

   While there exist effluent standards and regulation that penalise non compliant for properly treated industrial effluent discharge, weak enforcement of those standards and regulations provides hardly any compliance incentive for the industry. As a result the minority textile units that have ETPs do not operate them properly.

   Likewise, charges for industrial water abstraction are not always volumetric based and too low, hence they do not reflect the scarcity and externality costs of water use. The recently launched green incentives encourage better adoption of cleaner technology by the industry but the coverage of the incentives are still limited.

2. **Overlapping and ambiguity of responsibilities coupled with resource constraints weaken monitoring and enforcement capacities.**

   Existing laws bestow overlapping responsibilities between Department of Environment (DoE) and WARPO when it comes to water pollution and clearance of projects with water related impacts. Environmental Conservation Rule 1997 mandates the DoE for project clearance while the Water Act 2013 gives the mandate to WARPO.

   At the same time, the mandated institutions are often not ones with sufficient resources to undertake the responsibilities. The Directorate of Textile (DoT), for example has the mandate to approve ETP requirement for textile units but it does not have extensive monitoring mandate, which lies with the DoE. The institutional capacity constraints of the DoE, in terms of technical knowledge and sufficient manpower, have not empowered it to undertake regular monitoring of industrial areas and enforcing violations regarding water-related issues.

   On the other hand, some needed regulations have no clarity on which institution should take the leading responsibility, such as: a water code to ensure efficient water use and to strengthen water rights mentioned in previous regulations; and environmental quality standards mentioned in the Water Act 2013. Lack of coordination among government institutions within the complex regulatory landscape is a common challenge for all institutions of water governance in general.

3. **Lack of involvement of industrial line ministries in water governance**.

   The ministries and institutions related to the industries are part of the stakeholders in water governance but they have not taken a leading role in the issues of sustainable textile water use. The lack of leading institution in the value chain of water governance is particularly visible in terms of the industrial water use efficiency, wherein the conventional line ministries, such as MoWR and DoE, have very little or no mandate.

   The Ministry of Industry (MoI) as well as the Bangladesh Investment Development Authority (BIDA) have substantial influence to the export-oriented textile industry. Industry associations, such as Bangladesh Garment Manufacturers and Exporters Association (BGMEA), Bangladesh Knitwear Manufacturers and Exporters Association **(**BKMEA), and Federation of Bangladesh Chamber of Commerce (FBCCI) are also very influential in shaping the industry's shift toward greener practices.

Chapter 6 Conclusions and Recommendations

6.1. Conclusions

The growth trend of the textile sector as the driving force behind Bangladesh economy is expected to continue with the ambitious export target of reaching USD 50 billion in 2021 and USD 66.25 billion by 2030, from roughly USD 30 billion in 2014. As a highly water intensive sector, the realisation of this goal is only possible if the textile sector, especially RMG sector as the leading contributor, can address and manage its water risks, in addition to the other challenges of the industry, such as compliance issues, enabling infrastructure, productivity, and raw material availability. The capacities of the sector to manage its water risks are placed in the backdrop of the country's situations of water resources management, characterised by high flood risk due to its topographical location in the flood plain, high variability of water availability, rapid depletion of groundwater resources due to overreliance and overexploitation of the resources, and severe degradation of surface water quality; all of which will be reinforced by climate change impacts.

Key physical water risks that the textile industry should address are:

3) Increasing gap between the industry's water demand and water availability.
   In line with the ambitious RMG export target, textile water demand will be increased by 270,3 % compared to 2014 to 3.959 - 8.382 BCM per day, creating water demand gap between 2.495 to 5.282 BCM per year. The overall increase of both domestic and agricultural water demands, in which both have a higher priority than industrial water, means that there is a higher risk of water shortage to the textile industry by 2030. The industry's reliance on groundwater means there will be higher costs of water abstraction, either from deeper pumping or from securing freshwater from other sources due to higher scarcity.

4) Increasing water quality risks.
   The problem of low proportion of textile units equipped with ETPs is worsened by the fact that around 11-51% of them are either poorly designed or operated. Considering that the industry has been identified as the top industrial sources with the highest environmental impact (Table 1), the discharge of untreated or improperly treated textile effluents have brought about a declining quality of surface water bodies over time around the industrial clusters, such as Buriganga river, Shitalakshya river and Turag river. Ultimately, this will pose further risks to the industry presence and growth. Declining surface water quality renders finding the alternatives of groundwater more expensive and may spark social unrest from the environmental impacts.

The organisational structure of water governance (Figure 23) and the mapping of water governance value chain pertaining to textile water use (Figure 24) show the key actors involved in each value chain, the responsibilities relevant to textile water use and the regulations that strengthen their mandates. The current water governance landscape has shifted toward more integrated water resource management under the leadership of National Water Resources Council (NWRC) in which WARPO under the MoWR has an essential role in policy making and planning. Recent regulations incentives, and on-going initiatives have looked further into participatory water governance, strengthening of institutional capacities, providing incentives for cleaner technology, improving the efficiency of water utility operators, and restoration of river water quality.

Nevertheless, the capacities of current water governance landscape in Bangladesh to address the physical water risks of textile industry are limited by:

1) The problem of non-align incentives of textile water use, in which very little incentives exist in practice for the industry to have rational use of water and treat their effluent appropriately.
2) Overlapping and ambiguity of responsibilities coupled with resource constraints weaken monitoring and enforcement capacities of both efficient water use and compliance to effluent standards.
3) Lack of involvement of industrial line ministries with considerable influence in the area of water governance renders the current governance landscape has less relevance and capacities in addressing textile industry's physical water risks.

6.2. Recommendations

Based on the findings of this report, below are recommendations to improve the country's capacities in managing textile industry's water risks.

4) Align existing incentives and provide more targeted incentives toward cleaner textile industry.
   Existing incentives for industrial water use need better alignment and improvement in their levels (industrial water abstraction and sewerage charges) so that they can meet their intended objectives of encouraging behavioural change among textile units. Green incentives provided by Bangladesh Banks and other commercial banks and financial institutions need to be more targeted to medium and smaller enterprises, which face higher barrier in adopting cleaner technology. On the other hand, the government also needs to explore other kinds of positive incentives that reward the industry's initiative to be more water smart and innovative. The incentives that focus more on process efficiency than end-of-pipe technology will also be more effective and rewarding for the industry. This also means that green incentives should be better aligned with industrial incentives beyond environmental requirements, such as tax rebate for the adoption of greener technologies, tax exemption for import of cleaner technologies, and so forth.
5) Clarification of responsibilities and streamlining of water governance structure

   Greater clarity of responsibilities and streamlining can provide greater capacities and effectiveness to government institution in addressing water risks. For example, clearer differentiation in industrial water governance among WARPO, DoE, and industrial line ministries (MoI and DoT) can better empower these institutions in implementing their mandates with the same resources. The streamlining may also include greater delegation of some responsibilities from national institution to local government institutions.
6) Broader stakeholder engagement in building the capacity of textile industry toward sustainability should be anchored to the existing National Water Resources Council (NWRC).

   Industrial actors, either line ministries or industry's associations need to be involved more in the existing water governance structure under the NWRC. In terms of policies, the synergy between Bangladesh Water Act 2013 and the 7th Development Plan should also be reflected in the mandate for industrial line ministries (MoI, DoT, and BIDA) in improving the industry's

capacity toward sustainable textile industry. For example, the industrial line ministries can empower textile units to achieve the sector potential water use reduction of 15-18%, according to UNIDO study[38]. Better data sharing between conventional water-related line ministries and industrial line ministries will also improve coordination across these ministries.

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