Master Thesis Report

Water Management of Textile Sector in Bangladesh

Analysis of Partnership for Cleaner Textile Project in Bangladesh

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Abstract

Water scarcity is an evolving challenge that is caused by polluting the limited water resources and the inefficient consumption of this resource. One of the main polluters and consumers of this valuable resource is industry specifically textile industry. Most of textile manufacturing is conducted in developing countries such as Bangladesh which already suffers from water stress. The textile sector highly contributes to the economic growth of Bangladesh and it also has huge environmental impacts on the water sources in the country. Textile sector in Bangladesh consumes large quantities of freshwater mainly from groundwater sources and is considered one of the major contributors to the water pollution of the water bodies in the country. This research aims at answering research questions regarding the current situation of water management in textile industry in Bangladesh and the measures in place to enhance the situation. Moreover, it analyzed one of the good practices (PaCT) which currently exists in the country to have a cleaner textile sector with efficient water consumption and lower water footprint. The analysis is conducted by two different tools (SWOT) and (GAT). The results of GAT showed that the governance context for the project is slightly positive (supportive or at least neutral) the main findings are that not all the actors were involved in the project and the used instruments are not enough to urge and monitor the long term behavioral change. Also, SWOT analysis concluded that the absence of some actors and the monitoring instruments are considered a weakness point along with the low level of awareness of the participated facilities. Overall, the project is considered a good start that supports the change to cleaner production and water efficiency in the textile sector in Bangladesh. Also, the two tools showed areas of improvement that was used to provide recommendations for enhancement. The study recommended that the project can find incentives and target the involvement of all actors and stakeholders, involving the local communities and governmental parties in the raising awareness activities is important for achieving the change from current situation, the instruments should be improved to observe and monitor the long term changes in behavior because of the project, and finding incentives to involve the smaller facilities.

Keywords: textile industry, water footprint, water management, water sustainability and cleaner production.

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List of Abbreviations

BGMEA	Bangladesh Garment Manufacturers and Exporters Association
BWDB	Bangladesh Water Development Board
DoE	Department of Environment
ECA	Environmental Conservation Act
ECC	Environmental Clearance Certificate
ETPs	Effluent treatment plants
GAT	Governance assessment tool
IFC	International financial corporation
MoI	Ministry of Industry
NGOs	Non-governmental organizations
NWRC	National Water Resource Council
PaCT	Partnership for cleaner textile
PPD	Public Private Dialogue
SWOT	Strengths, weaknesses, opportunities and threats
TSP	textile sustainability platform
TTBC	Textile Technology Business Center
WARPO	Water Resources Planning Organization
WDF	Washing, dyeing and finishing

1. Introduction

1.1 Background

Although water covers 70% of our planet the fresh water sources are considered only 3% of the total water available (Pegram, 2010). Water resources have a global significant value as it indispensable for the sustenance of life as well as the economic growth. The adequate availability of clean water for drinking, sanitation, agriculture and industrial use is one of the biggest challenges of this century (Hussain & Wahab, 2018). Hence the problem of water scarcity is considered as continuous evolving risk for our current and future.

Governmental and non-governmental organizations (NGOs) define water scarcity as limited availability of clean water resources for satisfying the human and environmental needs (White, 2012). Continuous increase of population density, intensive agriculture, water demanding industries are putting high pressure on the water resources and the sustainability of the eco-systems (Hussain & Wahab, 2018).

Water scarcity occurs where there are insufficient water resources (low quantity) and/or insufficient usable water sources (water with low quality). Low quantity of water can occur naturally in arid areas that originally have very limited access to fresh water resources (surface water, rains, etc.) or can occur from the excessive unsustainable exploitation of the existing water resources that go beyond the water system recovery. Moreover, water pollution comes from many sources such as pesticides and fertilizers used for agriculture, and industrial wastewater. The rapid growth of populations accompanied with economic development and industrialization put high pressures on the available usable water resources and raise concerns about water availability as freshwater consumption continues at unsustainable manners. The rapid industrialization growth becomes one of the activities that participate in water scarcity either by the high consumption or by the wastewater generated from it. Accordingly to preserve water resources; the reasonable and efficient use of water for industrialization becomes essential which can push towards adopting water sustainability concept.

Industry, in particular textile production, consumes large amounts of water. In 2015, the global textiles and clothing industry was responsible for the consumption of around 79 billion m^3 of water (Šajn, 2019). Moreover, the textile industry uses more than 1,900 chemicals in the production processes, of which 165 the EU classifies as hazardous to health or the environment (Šajn, 2019). The World Bank estimates that textile wet processes are responsible for 17 to 20 % of the total industrial water pollution. Around 72 toxic chemicals have been recognized in water bodies from textile dyeing processes, 30 of these chemicals cannot be removed from the water (Kant, 2012).

According to the 2017 Pulse of the Fashion Industry report, the average water consumption of dyeing process is 100 -150 liters of water per kg of fabric and, in developing countries, where

most of the production takes place and where environmental legislation is not as strict as in the EU; the wastewater is often discharged unfiltered into waterways which causes water pollution to the water sources in the developing countries (Boston, Global, & (GFA)—, 2017).

As mentioned above, developing countries are currently the main producers for textiles and fabrics. Therefore, the focus to introduce water sustainability in this sector should be steering towards the main producing countries. One of the major producer and exporter for textile and clothing is Bangladesh which is considered the case study in this thesis.

1.2 Problem Statement

The textile sector is one of the major sectors in Bangladesh and the country is considered the second exporter for textile in the world which is considered the largest exported good in the country (Hasan, Mia, & Rahman, 2016). On the other hand, the rapid growth of the textile sector in Bangladesh is putting pressure on the water sources of the country as it consumes large amounts of water. The average water consumption in Bangladesh for producing 1 kg of fabric is estimated to be around 250 to 300 liters of which is almost triple the amount of water for the global benchmark (Sagris & Abbott, 2015b). Moreover, the textile sector participates in the environmental pollution of the water bodies because of the untreated wastewater discharged to them (Dey & Islam, 2015). Bangladesh's textile sector has a massive contribution to water pollution disaster, especially near the large industrial clusters and adds pressure on the limited water resources in Bangladesh (Yardley, 2013).

1.3 Research Objective

The objective of this research is to describe the current situation of water management in the textile industry in Bangladesh and analyze the Partnership for Cleaner Textile (PaCT) project which is considered in this research a proxy for good practices which currently exist in Bangladesh. Recommendations are provided based on the analysis results, to have better conditions for achieving cleaner textile industry and minimize water footprint in the sector.

1.4 Research questions

The four main research questions are:

- What is the current situation for water management in the textile sector in Bangladesh?
- What are the measures in place such as policies (national level) and international initiatives that mainly focus on water efficiency in textile manufacturing phase (which is in this case PaCT project) to manage/enhance the situation?
- What are the internal factors (strength and weaknesses) and external factors (threats and opportunities) as well as governance context conditions of the PaCT project?
- From the PaCT project analysis, what are the recommendations to overcome the factors and governance conditions that impede implementation of the project in order to participate in achieving better water management and to have cleaner textile sector in the country?

The first and second questions are “descriptive questions” that describe the current situation in the country regarding the water management in the textile sector. This includes the water footprint of the sector, main actors involved in water management in the sector. Also, it describes the measures in the country that participates in enhancing the situations such as legal framework and policies applicable to the water usage in the sector as well as the PaCT project which is presented in this research as the representative of the current good practices in this sector in Bangladesh. These two questions are answered in chapter three of this thesis.

The third question is an “evaluative question” that analyses the internal and external factors as well as the governance context conditions (extent, coherence, flexibility and intensity) of the PaCT project and identifying opportunities for achieving cleaner textile sector in the country. This question is answered in the fourth chapter where the analysis results are addresses. Finally the fourth question, which is answered in chapter five of this study, is an “analytical question” that provides recommendations -based on the results of the third question- to achieve better conditions for water management in the sector.

1.5 Knowledge gap

This thesis research is adding to the body of knowledge in the textile sector. Most scientific researches focus on the “fast fashion model”. Hence, promoting sustainable textile is overlooked as it is not considered a competitive to the fast fashion model (Toemen, 2017). Moreover, the few literature and research covering sustainable textile topics are focusing on the textiles as final products or the water consumption in the agricultural phase of the supply chain such as farming cotton as a raw material for textiles. However, resources consumption such as water in the manufacturing phase and how to encourage resources sustainability in it is overlooked especially in developing countries. This means that this part of the chain needs to be solely studied and addressed as it is considered an untapped opportunity for the academic research fields. Accordingly, this research is adding to the body of knowledge in the context of Bangladesh as it aims for addressing water sustainability and cleaner production concepts in the textile manufacturing which is one of the dominating industrial sectors in the country. Finding such opportunities will help Bangladesh which suffers from critical situation in regard of water availability to have more efficient textile sector. Forza and Vinelli (2000), Bralla (2007), Sen (2008), Yi, Ngai, & Moon (2011) presented the textile supply as the flow of materials, services and information among farmers (raw material suppliers), producers, distributors, and users and divided it into sections starting from farming the raw material to the final usage of textile items (Ngai, Peng, Alexander, & Moon, 2014). The following figure (1-1), which is created by the author, shows simplified textile supply chain and this research focus. Also, it is obvious that in order to have “sustainable textiles” the national and international concerns should cover the whole supply chain not only part of it. Accordingly, this supply chain might be embedded in policies and programs at varying levels, reaching from local to international. However, the focus of this study is the industrial and manufacturing part of this supply chain to narrow down and to get a zoomed in research focus.

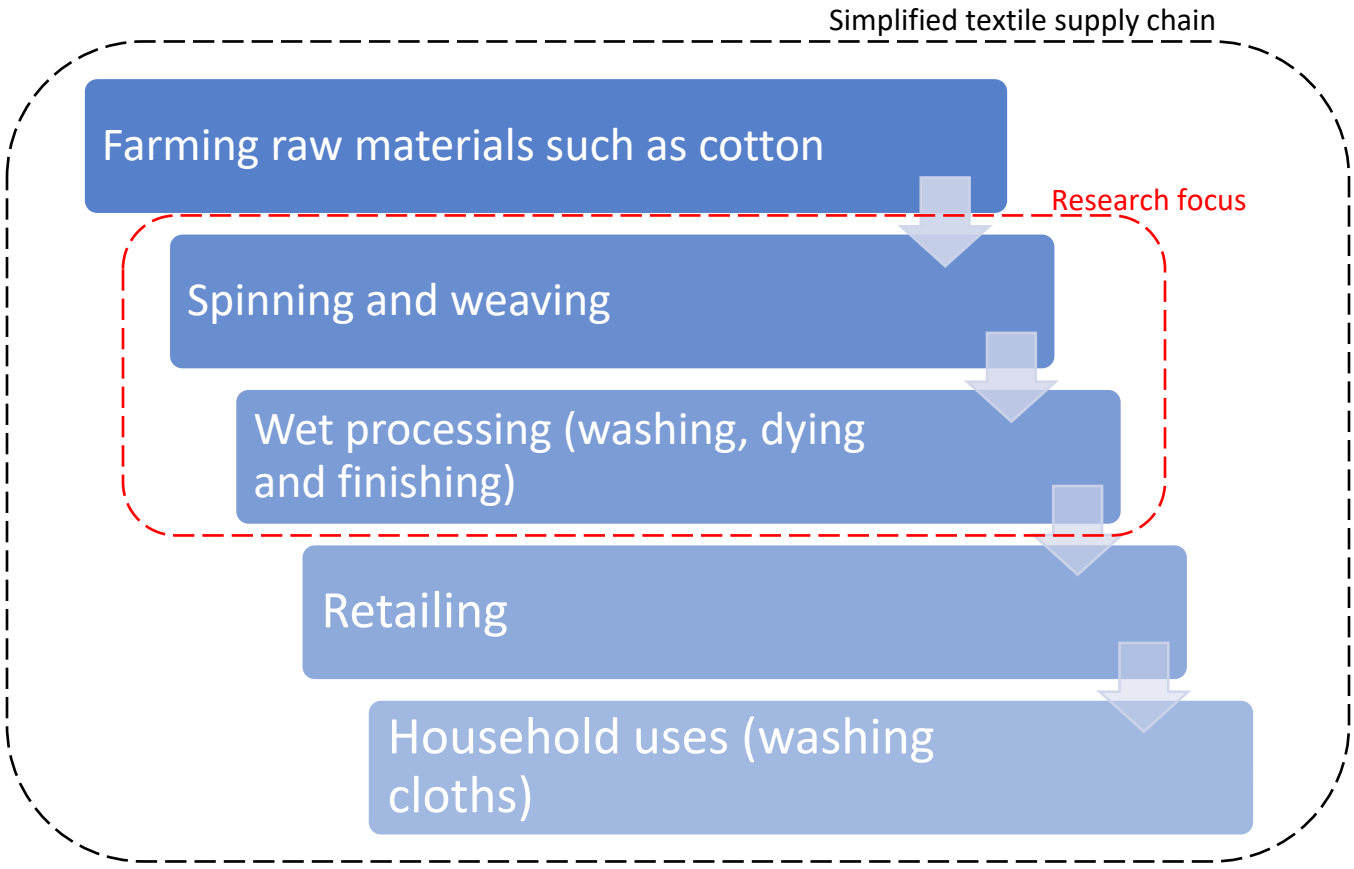

Figure (1-1) simplified textile supply chain and research focus.

1.6 Structure of the report

This report is structured as follows: Chapter 1 is the Introduction. Chapter 2 shows the research methodology that was used. Chapter 3 presents the empirical background. Chapter 4 is findings and results that include the results of the conducted analysis and discussion. Chapter 5 is the recommendation to enhance the situation and conclusion of this study and reflections on the study. Finally, chapter 6 is discussion about the research and synthesizing the analysis results and conclusion.

2. Methodology

This chapter presents the methodological framework used in this thesis. It gives an outline of the research framework followed by describing the research design chosen for this thesis and the reasons for this choice. The instruments that were used for data collection are also described and the procedures that were followed to carry out this report are included. The methods used to analyze the data are addressed and lastly, the quality assurance of the data which were followed in the process is also presented in this chapter.

2.1Research framework

The research is presented in the frame of the next main concepts. Water resource management (WRM) is a concept that combines all functions and activities related to water. WRM is the process that includes planning, designing, constructing and operating water resource systems (Savenije, 1996). In industry the WRM process is considered the cycle of extracting, using, treating water and disposing wastewater. Industrial sector is a significant water consumer as it is responsible for 10% of Asia's water consumption and 57% of total water consumption in Europe. Industrial fresh water consumption can be reduced to around 50% by applying sustainability concepts which is mainly considering and achieving the most efficient use possible through the whole cycle (World Business Council for Sustainable Development. WBCSD, 2017). Applying sustainability concept is very crucial when dealing with a limited and valuable resource such as water. According to the United Nations Environment Programme (UNEP), cleaner production concept is "The continuous application of an integrated environmental strategy to processes, products and services to increase efficiency and reduce risks to humans and the environment"[1]. The research framework started by identifying the research objective which is presented earlier in section 1.3. This was followed by selecting the research object which is water management in textile industry in Bangladesh. Afterwards, the (PaCT) project was chosen as the research unit in this research as it is considered an example for good practices in the country to get cleaner and sustainable sector. Therefore, this approach which is identifying and analyzing one of the good practices to recognize gaps and obstacles that hinder the situation enhancement and provides recommendation for improvements. A combination of analysis and diagnostic research was used to fulfill the research objective. The diagnostic part was used to identify the current situation, the main actors' roles and responsibilities, legal frameworks and policies relevant to the water in the sector. The analysis part was used to analyze the research unit with different tools. Also, the research perspective was based on theories such as water sustainability, cleaner production, and water management.

The following figure (2-1) shows a schematic presentation of the research framework.

[1] http://www.unep.fr/scp/cp/

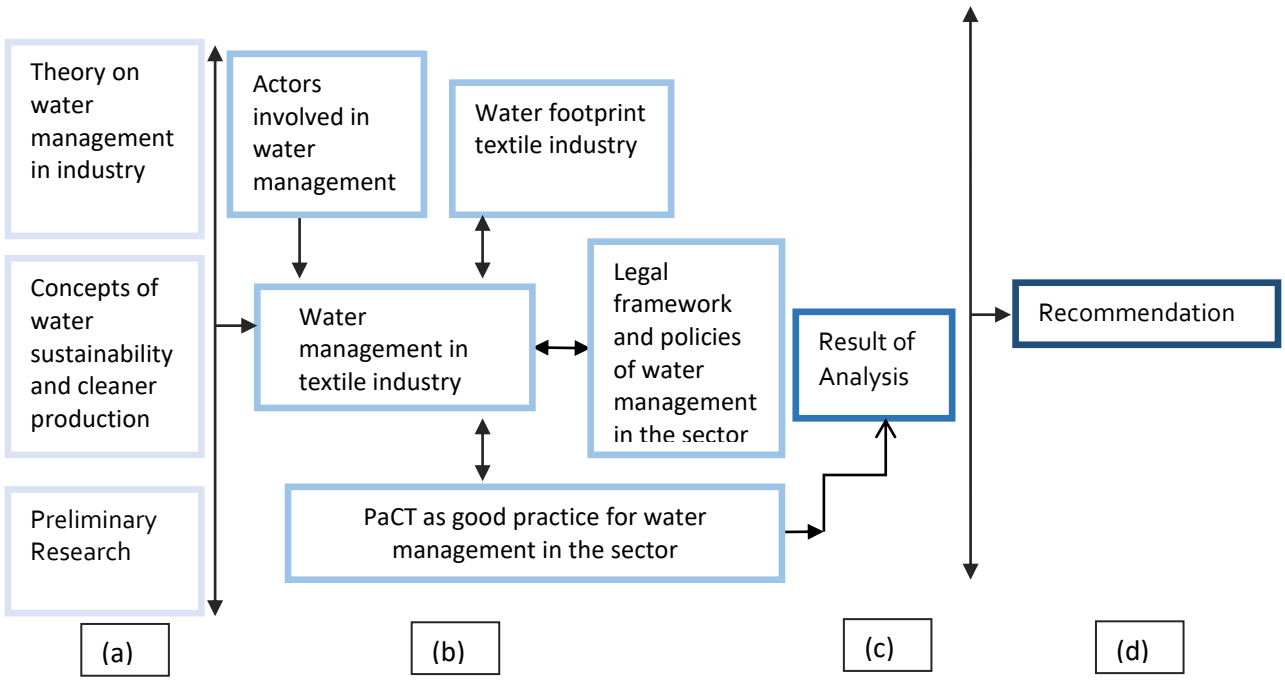

Figure (2-1) schematic presentation of research framework

(a) Addressing the used theories in the study to formulate the research framework and background.
(b) Addressing current water management in the sector, the main actors involved, water footprint of the sector, legal framework and the chosen proxy of available good practices, within the boundaries as set in figure 1-1.
(c) Addressing results and findings of the analysis as the basis for recommendations
(d) Providing recommendations in order to enhance the situation by overcoming existing obstacles

2.2 Research design

Researchers use research design as a tool to formalize their understanding of the topic under study as it is considered a good strategy to develop and refine theories (Edelson, 2002). In qualitative studies, research design is usually flexible and continually reflects the process of research development (Maxwell, 2012). This thesis was designed based on the evaluation research method which is frequently used to analyze the context of policies, public and voluntarily initiatives and activities (Payne & Payne, 2004). In this thesis the PaCT project, which is the selected project for good practices in Bangladesh, is analyzed and evaluated by two different tools described in section 2.5. The analysis aims at identifying factors and governance conditions of the project. Also, this aims at providing recommendations to enhance the current situation. Accordingly this method adequately fits the objective of this thesis.

2.3 Data collection procedures: Sources and accessing methods

Interviews, open ended questionnaires and desk research are used as the main data sources for answering the research questions. Diverse secondary data sources are used for data collection

which includes reviewing scientific publications and journal articles to understand the background concepts and theories regarding water management, sustainability and cleaner production in industry. Moreover, documents, reports and media sources such as newspapers and official organizations' websites are used with journal articles and scientific publications to address the current situation for water management in textile industry in Bangladesh. Accordingly, desk research is mainly used to answer the first and second research questions of this research and the collected data was used as a base knowledge for the analysis conducted to answer the third question.

The internet was used as the main access method/tool for desk research as this tool is considered the most quick and cheap tool for collecting data through accessing several search indices. Accordingly, the "electronic search" is the most used tool for accessing scientific publications that can be viewed online or downloaded to computers (Verschuren, Doorewaard, & Mellion, 2010). Different search systems and keywords were used to find extensive online data about the research topic. The main keywords for the search are: textile industry, water footprint, water management, water sustainability and cleaner production.

The third research question was answered using a combination of semi- structured interviews and open-ended questionnaires and further desk research. Appendix 1-A shows a copy of the interview guide and questionnaire used in this research. Although interviews were conducted based on questions listed in an interview guide, participants were allowed to share their own opinions and ideas as the interview was designed to be semi-structured. The interview was audio recorded as the tape recorder is considered one of the most popular tools to record the interviews to ease the data collection and analysis (Dicicco-bloom & Crabtree, 2006).

Interviews and questionnaires were conducted with total of four participants with different backgrounds and field of expertise to verify the collected data and to ensure the quality of it. The participants are water experts, international clothing brands and international organizations. All these participants are actors in the PaCT project. Appendix 1-B shows list of organizations participated in the study through interviews and/or questionnaires.

Representatives of all actors in the PaCT project were approached in order to get whole opinions and point of views and perspectives from each category of actors. Unfortunately, not all actors responded, even after several trials there was still no response from their side. Also, some actors were not willing to participate so the researcher respected their choice.

The actors who participated in the PaCT project can be divided into two categories international and national. The category that did not respond to any of the participation requests for this research is the national one (private actors and national nongovernmental trade and industrial organization). In other words, none of the textile facilities that were approached responded either by agreeing or rejecting the participation and the same situation was repeated with the national trade organization which is an important actor in the project. This can give an indication that the level of transparency at the national and local level is not high enough to accept sharing information with strangers and having trusting issues. This reason was based on comment of one of the interviewees who mentioned that although the facilities shared information with experts during the conducted audits as one of the project's main activities, it

can be sensed that they were not welcoming the idea of sharing these information about their facilities. Another reason can be that the researcher did not offer any incentives for them because of lack of resources and the participation was only on voluntary basis. This reason was formulated from the answers of all interviewees who claimed that almost all the facilities that participated in the project were searching for economic benefits and to strength their business relations with the international clothing brands to be their potential customers. So, they are always searching for financial benefits out of their participation. Also, the lack of direct connection between these respondents and the researcher can be a reason for their non-response. This reason was based on the fact that the industrial organization was always in the picture with the international actors as a technical supporter and connection link between them and the facilities. It is difficult to identify the exact share of each reason for their non-response but there is high chance to be a combination of all these reasons. The representatives who were not willing to participate come under the other category of international actors. These people replied that they left the organization that participated in the PaCT project and they felt it is not ethical to reply any question about the project as they are currently working with other organizations. In this situation the researcher asked them about the possibility of providing contact details of people who currently work with the approached organizations but they replied that either they do not have such contact details anymore or they cannot share such information.

Accordingly, the interviews were conducted and questionnaires were sent to the people who had the willingness to participate in the research and replied to the request for participation.

The fourth research question was answered based on the output of the first three questions as well as the analysis tools used for answering the third question.

2.4 Ethics of research

This research does not have major ethical issues. However, interviews and/or questionnaires might highlight slightly sensitive details such as the information about the PaCT and the problems faced by different actors in this project.

Accordingly, the researcher asked the interviewees for their permission to contribute in this research on a voluntarily basis. Also, a brief description of the project and its objective were sent to the interviewees. After the interviewees' approval for participation, the researcher asked about their preferred method of participation either through interviews or questionnaires. The researcher always chose the most convenient method of participation for the interviewees. All the interviewees agreed to conduct interviews except only one interviewee preferred to reply an online questionnaire. In conducted interviews, the researcher informed the interviewees beforehand that the interviews are recorded. Two interviewees were ok with recording the interview while only one interviewee stated that their organization's policy refuses audio recording of interviews so this interview was not recorded and the data were collected from the written notes during the interview. Moreover, the researcher informed the interviewees that they can withdraw from the interview at any time and none of the interviewees did this as all the questions were asked and they replied to all of them and all the interviews went smoothly without any troubles or inconveniences.

The researcher ensured the confidentiality of the data and that it will not be shared with others. The collected data was saved on digital devices such as laptops with a password to ensure the data safety. Also, the researcher will delete the collected data after six months of submitting the final thesis.

2.5 Data analysis

In qualitative research, data analysis is a continuous process during the whole research projection, starting from formulating the conceptual design to the data collection process until the evaluation and research writing stages. In other words, it occurs concurrently with the writing process (Van Gog, T. et al., 2008).

In this research, qualitative data analyses have been conducted by two different tools: the governance assessment tool (GAT) (Bressers, Bressers, Kuks, & Larrue, 2016) and the Strength, weakness, opportunities, threats (SWOT) analysis tool.

2.5.1 GAT framework

The GAT (Bressers et al., 2016) is part of the contextual Interaction theory which is designed to assess the governance context and processes as a multi-actor interaction process for the implementation of relevant policies or projects. GAT describes all relevant aspects of the governance context and consists of two parts: a descriptive part and an evaluative part. The descriptive part is illustrated by answering set of descriptive questions relevant to the five dimensions of the tool. These dimensions are: **levels and scales**, **actors and networks**, **problem perspective and goal ambitions**, **strategies and instruments**, and **responsibilities and resources**. The second part of this tool consists of an evaluative part which indicates the situation of the abovementioned dimensions. This part of the tool is defined by answering set of evaluative questions relevant to the four quality criteria: **extent**, **coherence**, **flexibility** and **intensity.**

The **extent** aims at identifying if the regime is complete or not. In other words, the focus of extent is not the amount of levels, actors, instruments and resources involved in the project but the degree of completeness of these factors to reflect the project purposes and objectives.

The **coherence** is to what degree the different parts of the regime are strengthening and not weakening each other. When a project deals with natural resource, in most cases this means the involvement of different levels. So, coherence here means that the activities of these different levels are collaborative and cooperative. Also, because in most cases more than one level is involved when dealing with a natural resource, the impacts of interaction should be taken into consideration as these levels have an impact on each other's effects.

When dealing with projects that include different actors and stakeholders, coherence means there is a high level of interaction in the actors' network. It is always preferred to have a productive interaction that provides capacity to coordinate. Also, the involvement of different actors may lead to having different problem perspectives as each actor or group of actors can see the problem from different point of view. In this case, coherence means integrating the

different problem perspectives that different actors may have in order to create a common ground for productive considerations of all point of views and desires. This same concept of coherence applies for the different strategies and instruments that can be used to achieve different objectives. In the resources and responsibilities dimension, the coherence means coordination between the different actors or the different resources and responsibilities they use to participate in applying the project.

Flexibility here means to what degree the elements of this regime (structural context) are supporting and facilitating the adaptive actions and measures if this adaptation can be beneficial to the integrated objective. Accordingly, it can also be defined as the degree of avoiding any impedance for such adaptive behavior. And just as extent and coherence, the flexibility can be explained and introduced in terms of the five dimensions of governance mentioned above. For example, flexibility in the dimensions of levels and scales reflects the relationship between the different levels and the regime is considered flexible when this relationship is decentralized which reflects that there is the trust between the levels and their relationship is built upon empowerment and not controlling. This can apply for the rest of the dimensions.

Intensity is to what degree the regime parts and dimensions push towards changing the current situation. So, the term intensity can be relevant to the size of tasks to create new dynamics. In other words, the tendency to use adaptive strategies increases when the intensity of the regime increases.

This tool can be used by different users in variant situations. One of these uses is for scientific research purposes. In such cases the interviews and published documents are used for the data collection process. The tool in such cases is for assessing different variables in the project context. It is worth mentioning that, the evaluative questions depends on the assessors' judgment. In other words, quantification methods are hard to achieve with such tool.

In this research the GAT was used to analyze the governance context conditions for the PaCT project. The five dimensions along with the four criteria create a matrix that represents the core and the essence of the GAT. The researcher used the questions presented in the matrix as a base for the prepared interview guide. The questions and terms used in this matrix were explained to the interviewees to ensure their full understanding of the question. Also, one of the supervisors of this thesis, who personally used and applied the GAT in several projects and researches, was asked for guidance and advice for matrix preparation and the way of presenting the collected data to ensure robustness of outcomes.

Table (2-1) shows the matrix that presents the GAT questions used in this thesis to analyze the PaCT project. These questions were designed to identify the status of the governance context in the PaCT project, whether it is supportive, restrictive or neutral to recognize if this context supports or restricts the implementation of the project.

Table (2-1) The governance assessment tool matrix. Source, (Bressers et al., 2016)

Governance Dimensions	Quality of the governance regime			
	Extent	Coherence	Flexibility	Intensity
Levels and scales	How many levels are involved? What are these levels? Are all the existing levels included in the project?	Is there cooperation and trust between the levels? What is the level of dependency between the levels?	What is the possibility of moving between the levels (up and down)?	Can any level have an impact to promote behavioral changes and better management?
Actors and networks	Who are the involved actors? Are all relevant stakeholders involved? Are there any stakeholders not involved or excluded?	What is the level of interactions between actors? Do they have experience in working together? What forms of dialogue between them	What is the possibility of including new actors? Can the lead shifts between actors when there is a valid need for that?	Is there any actor pushes towards changes in behavior and better management?
Problem perspective and goal ambitions	What are the different problem perspectives? Are all problem perspectives taken into consideration? To what extent?	To what extent do the various perspectives and goals support each other?	Is there any possibility to reassess goals, if needed?	How different are the goal ambitions from the current situation?
Strategies and Instruments	What types of instruments and strategies are used? To what extent do they reflect a certain strategy of influence (incentive, communicative, technical, etc.?	To what extent are the used instruments supplementing each other? Are there any overlaps or conflicts in the project's instruments?	What is the potential for combining different instruments to achieve the goals?	What are the implied changes in behavior to deviate from the current situation? To what extent the instruments support and enforce that?
Responsibilities and resources	Which organizations have responsibilities for what tasks in this project? Are all responsibilities allocated clearly and supported with the needed resources?	What is the impact of the assigned responsibilities on the interaction between different organizations?	What is the possibility for combining responsibilities and resources?	Are the allocated resources sufficient to implement the required measures to achieve the goals and make the change?

2.5.2 SWOT analysis

The SWOT analysis is a tool that offers comprehensive analysis and can be used for planning or elaborating perspectives on influential factors (Jackson, 2015). The SWOT analysis was initially invented by the Harvard Business School in the 1960s to be used for the improvement of organizations' management strategies. However, some studies and researches are currently using SWOT analysis in wider contexts such as the natural resource management. The tool can nowadays be used to analyze the management process of natural resources. The analysis consists of internal (strengths and weaknesses) and external factors (opportunities and threats). The internal factors highlight the strengths and weaknesses within the project under study that can influence the project. at the same time, the external factors highlight the opportunities and threats that can be affecting the project from the surrounding environment (Baycheva-merger & Wolfslehner, 2016).

In this research, the SWOT analysis was used to analyze the context of the PaCT project, in terms of identifying and analyzing both internal and external factors. In other words, the internal factors of the project such as activities, involved organizations and parties' cooperation, and structure will be analyzed while taking into consideration the impact and influence of external factors such as legal contexts, society awareness, and the available database. This kind of assessment that have two different lenses and focuses on the internal and external contexts enables the presentation of positive and strong parts of the project while identifying areas for improvements in order to encourage and improve such a good practice to be widely adopted. Accordingly, the SWOT analysis was adjusted to match the requirements of this study. Table (2-2) below

Table (2-2) SWOT analysis: internal and external factors

	Positive	Negative
Internal Environment	Strengths What are the internal factors of the project that allows the project to have positive impacts on the water resource in the country?	Weakness What are the internal factors of the project that can hinder it from having positive impacts on the water resource in the country?
External environment	Opportunities What are the external factors (from surrounding environments) that can support and improve the project to provide better results?	Threats What are the external factors (from surrounding environments) that can have negative potential or threats on or from the project?

2.6Validation of data

Data collection procedures and the research methods highly affect the quality and validity of the data, specifically in qualitative researches. Thus, they affect the results of the research

(Kallio et al., 2016). Triangulation is considered a qualitative research strategy to ensure the validity of collected information and data from different sources (Carter. et al., 2014).

Accordingly, in this research, triangulation strategy was used to ensure validity and quality of data to avoid potential biases from the use of one method. The triangulation of methods was accomplished by using different tools (GAT and SWOT) for the analysis of the PaCT project as they are complementing each other. SWOT is a simple tool that most people are familiar with its terminologies so it was used as a base for preliminary data collection in the interviews. Using such familiar tool to collect data about the project's factors was intended to break the ice in the interview as the researcher has no direct connections with the interviewees. So it was necessary to have a simple and familiar start with this tool to collect preliminary data and ease the communication and strengthen trust with the interviewees. On the other hand, GAT is more complicated and unfamiliar tool to all participants so it was important that the researcher correctly explain the terminologies to get the most accurate answers during the interviews and questionnaire. Collecting more specific and precise data for GAT was easier and more accepted as participants felt convenient after answering the questions relevant to the first part of the interviews. Also, GAT focuses on the project's governance conditions which applies different perspective and lens than SWOT that focuses more on the project factors (internal and external). Accordingly, both tools were used to diversify the lenses while analyzing the PaCT project to get a comprehensive point of view which will support in confirming and validating the findings. Also, triangulation of methods is presented in the different data collection methods that were used such as interviews, open ended questionnaires and desk research. The triangulation of sources is reflected in the different data sources that was used in the research such as people, literature, documents and media. It was mentioned before that the participants in this thesis were only four people and this was for reasons explained earlier in this chapter (sec.2.3). This limited number of participants was a challenge faced in this research to ensure the robustness of results. Participants were chosen on basis of involving different actors to diversify the source of information and ensure the validity of the collected data. Accordingly, different measures were used to select the participants. First, the participants from same organization were chosen from different levels (managerial and operational) to get the different point of views and experiences from people working at the same organization but they had different experiences while working in the project. Also, interviewing the water expert who is considered an external party (indirect actor) was intended to get as neutral point of view as possible about the project from an external expert who is not considered a direct actor in the project but still have enough involvement in the project to be good addition to the list of interviewees. Finally, interviewing a representative of the international clothing brands was crucial as they considered one of the powerful actors in the country (power of customer) and they have great exposure in the textile sector in the country.

Moreover, to ensure the robustness of the results, the researcher conducted interviews individually with each of the participants without sharing the identity or the answers of the

other interviewees to ensure that their replies will not be affected by the others. Afterwards, the researcher compared the answers and replies of each participant to check any disagreements or different opinions on the same issue. After revising the answers from the conducting interviews and questionnaire, no disagreements occurred and the answers to the question gave almost same or close results. Accordingly, this matching in replies from the participants can be considered a validation for the collected data.

3. Empirical background

This chapter starts with stating the history of the textiles and the global water footprint of textile manufacturing to briefly describe the global context before zooming in the situation of the textile industry in Bangladesh. Also, the chapter is mainly answering the first two research questions as it includes description of the current situation of water management in Bangladesh and who are the involved actors in water management in the sector as well as describes the current measures such as policies and an example of good practice (PaCT) which is relevant to enhancing the water management in the textile sector in Bangladesh

3.1Global (History of) Textile industry

Textile items are ranked as the second required products for people. The textile industry transforms fibers to yarns and threads then the yarns will be processed to turn into fabrics. Fabrics are used as raw materials to produce cloth and other textiles. Fabric, textiles and cloth can be further processed through other manufacturing steps such as dying and bleaching (Madhav, Ahamad, Singh, & Mishra, 2018). The textile industry started even before the industrial revolution and the preservation of resources came as a natural process at this time as the textile industry was not mature enough and it heavily consumed time, labor and resources which were very limited back then (de Haan, 2017).

With the beginning of the industrialization period and fossil fuel use, some of the manufacturing processes such as spinning and printing turned into automated technologies (de Haan, 2017). The industrialization came accompanied with inventions which made some processes such as dying and printing become even easier and more doable. This shift participated in increasing the production volume which made the prices go down as the supply was getting increased. The accelerated increase in production rates adversely affected the environment as the amount of untreated effluents that includes different chemical and harmful materials also increased in the water bodies near the production locations. These water bodies were affected by the disposal of textile wastewater that was polluted with several t kinds of hazardous and nonhazardous chemicals (de Haan, 2017).

In the beginning of the 20th century the clothing brands such as Chanel were only producing two ready-made collections annually from their original location in Paris. After the second world war (from 1950's onward) the production of only two collections per year was not enough because of two reasons: on one hand, the countries wanted to revive their economies by producing more collections per year to overcome the negative impacts of the war on their economies, and on the other hand, the people were asking for more quick and new trends as the 2 collections per year were obsolete and not enough anymore especially for the younger generations in Europe (de Haan, 2017). Again, this increase in demand and supply created more pressure to the environment and it was not accepted to continue this path in Europe. The resistance started after issuing the book Silent Spring by Rachel Carson in 1962. The book revealed the negative environmental impact caused by the usage of chemicals in the industry

specifically for textile industry that consumed large amounts of hazardous chemicals that was then disposed directly to the environment (de Haan, 2017). Afterwards, the awareness about the environmental protection continued to increase in Europe as well as increase of the labor wages which eased shifting most of the textile industry from Europe to developing countries that have lower labor wages and where the environmental regulations are less stringent than in Europe. Most of the developing countries such as India and Bangladesh welcomed the textile industry in their countries as they considered it a first step to enter the industrialization phase aiming for the economic prosperity that comes with it as well as the benefits of exporting the products to the European countries (Kim, Traore, & Warfield, 2006). Shifting the industry to the developing countries did not solve its problems as this shift highlighted even more problems such as the high consumption of water and chemicals needed for the textile manufacturing which put more pressure on the countries producing textile. So, the social problems such as the low wages, long working hours and no specific requirements for the health and safety in the working environment that were considered as "favorable conditions" to shift the industry were just part of the bigger problem. Moreover, these problems will increase if the textile and fashion industry are only focusing on the economic benefits gained from the linear economy trends in this industry (de Haan, 2017).

3.2 Water footprint of the textile industry and the need for sustainable behavior

Textile manufacturing industry is considered the third largest water consumer worldwide because it consumes enormous amounts of water during different production processes (Hossain, 2017). The problem of the huge consumption of resources is coming from the linear economy in the production processes which adversely affects the environment and people (Ellen MacArthur Foundation, 2017). Water is one of the nonrenewable and valuable resources and with the increase of water scarcity in different regions this resource is becoming even more precious and valuable. Therefore, adopting - more sustainable behavior in water consumption specially for industries that are water intensive can be the solution to preserve this valuable resource (Mattioli et al., 2005).

The textile industry is an intensive water consumer specifically for wet processing of textile. Moreover, the industry generates large amounts of polluted wastewater. The high pollution comes from the organic and inorganic chemicals with different compositions and characteristics that have been used in the processes and disposed in the wastewater generated from this industry (Saxena et al., 2017). The chemical characteristics of generated wastewater from textile industry contains high levels of Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), total dissolved and suspended solids, while the physical characteristics are mainly the color (Madhav et al., 2018).

The global textile production consumes billions of cubic meter of water per year; for example producing one pair of jeans, as the most used and produced item of cloth, consumes around 7,000 liters of water (Snoek, 2017). The production process requires huge amounts of fresh water for different uses in manufacturing processes. The industry uses water for different

purposes such as solvents for chemicals, heating purposes, medium in some processes and washing agent. The amount of water needed for production depend on the used raw materials such as type of processed substances, dyes and finishing agents. Also the type of used technology defines how much water is required in each process. The best average for water consumption is 50 to 100 liter of water per 1 kg of textiles (Madhav et al., 2018).

The average sized textile mill produces around 8,000 kg of fabric daily and consumes 200 liter of water/kg of fabric. 16 % and 8% of the water consumption is consumed by dying and printing processes respectively (Kant, 2012). Dying process consumes from 30 to 50 liter/kg of fabric and around 60 liter/kg of yarn as the water consumption varies with different types of dyes and fabric material (Kant, 2012). The high consumption volumes put more strain and pressure on the production regions that suffer from water scarcity. The textile economy is based on the linear economy concepts which produce large quantities of textiles with low circularity or recycling rates which put even more pressure on the scarce resource which is water. Although there is no sufficient data on the actual consumption of chemicals in the textile industry, it is recognized that the industry generates high volumes of polluted wastewater that contain large quantities of hazardous chemicals which makes the textile industry responsible for 20 % of the global water pollution (Ellen MacArthur Foundation, 2017). A study by Kant (2012) emphasized that the textile industry is not only consuming intensive amounts of chemicals in the production process but it is also considered the first polluter for clean water bodies after agriculture. The study stated that more than 3,600 different types of textile dyes are being produced by the industry in 2012. Moreover, more than 8,000 hazardous and nonhazardous chemicals are used in different processes in the textile industry. These chemicals are disposed with the wastewater for example the dying process generates around 15% to 20% of the total wastewater generated from the textile manufacturing processes (Kant, 2012).

The amounts of chemicals consumed in this industry makes the wastewater generated from it a massive source of potential pollution if not treated properly before disposal which makes the adverse social and environmental impacts of the industry pass by the factory borders. Although, the society in the production companies may benefit from the employments rates of this industry as it is an intensive labor industry as mentioned before, the society can suffer from the poor environmental practices by the factories. The discharge of untreated wastewater will pollute the water bodies in the area which can affect other users for fishing, agriculture and drinking etc. (Ellen MacArthur Foundation, 2017). Most of the textile manufacturers are located in developing countries and the majority of them are small and medium-sized enterprises (SMEs). They lack the proper knowledge and resources regarding new technologies and treatment methods for their wastewater which causes the pollution for the water bodies (Madhav et al., 2018; Saxena et al., 2017)

Currently, different factors are pushing the textile industry towards restructuring and minimizing the water consumption as well as adopting cleaner production concepts and steering the industry's direction towards water circularity. These factors are, water scarcity in

production countries, consumer awareness and the environmental regulations on the specifications of the generated wastewater (Hussain & Wahab, 2018).

Therefore, it is argued that to achieve the success in the water aspect in the textile industry all efforts including the governmental efforts, the private sector buyer forcing power, the consumer and producers' awareness are needed (Kim, Traore, & Warfield 2006).

3.3Textile industry in Bangladesh

This section presents the current situation of water management in the textile sector in Bangladesh. This includes introducing importance of the textile industry to the economy, water footprint of the textile industry in Bangladesh, and identifying main actors involved in water management in the textile industry. Accordingly, this is answering the first research question.

3.3.1 Importance of the Textile industry to the economy in Bangladesh

Since the late 70's Bangladesh has become an active and emerging player in textile and readymade garment sectors and this sector helped the country to enter the industrialization phase (Hasan et al., 2016). Textile sector participates massively in country's economy as it is considered the first exported good in Bangladesh and the country is the second biggest exporter of textiles worldwide (Khan, 2014). The importance of this sector to country's economy emerged from several reasons. Textiles export is developing and emerging very fast in the country through the last 25 years. Textile sector is the biggest source of foreign currencies' exchange because of the huge numbers of exported textiles (Hasan et al., 2016). In 2018, exported textiles was 82% of the total exports in the country with annual value of almost 28 billion U$ (Hossain, Sarker, & Khan, 2018). The textile sector in Bangladesh contributes with a share of 15% of the total Gross domestic product (GDP) (Khan, 2014). Also, the sector is one of the main employers in Bangladesh. This industry has 45% of the total employment shares in the industrial sectors and is responsible for 5% of the total income in the country (Khan, 2014). In 2016, the total number of direct employees in textile sector in Bangladesh was almost 1.5 million employees (Hasan et al., 2016). Also, the sector highly participated in developing the socio economic situations in the country as the average annual growth of this sector for the last fifteen years exceeds 15 % (Hasan et al., 2016). In 2015, the number of wet processing textile plants in the country was around 1,700 plants. Bangladesh is aiming for increasing the number of wet textile processes facilities. This means that the washing, dyeing and finishing (WDF) textile plants will be significantly increased in the near future to achieve the country's' goals towards expanding the textile sector (Sagris & Abbott, 2015a)

However, this sector is facing many challenges because of the evolving demands for sustainability in the sector, stricter environmental requirements, competitive markets and variations in the demand-supply patterns (Khan, 2014).

3.3.2 Water footprint of the textile industry in Bangladesh

The textile sector in Bangladesh has a huge water footprint by its massive water consumption and the amount of water pollution generated from this industry. Textile and readymade

garment sector is considered one of the biggest water consumers of fresh water in the country; especially for dying and washing processes. Around 98% of this consumption is from groundwater resources (Sagris & Abbott, 2015a).This consumption is negatively affecting the groundwater levels in the country and causing fast depletion of ground water sources (Hossain et al., 2018). The water consumption for textile and leather sectors in Bangladesh is around 4 million liters per day (Light Castle Partners, 2018). The average water consumption for textile plants in Bangladesh is 250-300 liter of water for every kg of produced textiles (Sagris & Abbott, 2015a). The rapid growth of this industry in the country is putting pressure on the water sources in Bangladesh. In general, it is challenging and hard to find reliable information of the amount of groundwater extraction for textile uses in Bangladesh as most of these consumptions are not measured and the facilities extract this water directly without any metering. In Dhaka, the capital of Bangladesh, the groundwater extraction put the city in a hard and critical situation as it was estimated that the water consumption of textile facilities in and around the city can reach the same consumption of cities with more than 10 million inhabitants. With the rate of growth the country is aiming for this sector, the consumption will keep increasing unless sustainable behavior and more efficient techniques are taken into consideration (WB, 2014). The WDF textile facilities have the biggest water footprint because of the water consumption needed for the washing, dyeing and finishing processes. Most of the WDF plants are mainly located in Dhaka, Mymensingh and Chittagong. Almost all of the WDF plants in Bangladesh are located in these major cities because of the proximity to water sources, availability of infrastructure and services and accessible markets (WB, 2014). Figure (3-1) below shows a map of Bangladesh that includes the main three cities for textile clusters.

Figure (3-1) map of Bangladesh. Source[2]

[2] https://www.worldatlas.com/webimage/countrys/asia/lgcolor/bdcolor.htm

Moreover, textile sector is considered the biggest source of water pollution among the industrial sectors in Bangladesh (Hannan, Rahman, & Haque, 2011). The environmental regulations in Bangladesh categorize industries into four categories based on their environmental impacts. The categorization from the lowest to the biggest is Green, Orange-A, Orange-B, and Red. The WDF textile facilities are categorized in the red category while the washing textile facilities are categorized Orange-B (Khan, 2017). Although WDF plants are obligated to install effluent treatment plants (ETPs) in their facilities, experts are estimating that only 30% of the around 1300 textile factories in Bangladesh include ETPs (The Daily Star, 2015). Accordingly, most of the wastewater generated from textile plants are discharged directly to the water surfaces or groundwater without efficient treatment which causes contamination to the water sources and aquatic ecosystems (Hossain et al., 2018). The low quality of wastewater treatment or in some cases the absence of the wastewater treatment in textile facilities have an adverse impact on the water bodies in the countries. Almost all the water pollution caused by this sector is coming from the inefficient water management in these facilities and the disposal of the untreated wastewater to the nearby water bodies (Dey & Islam, 2015). It was estimated that around 2 million m3 of untreated wastewater generated from textile facilities are discharged daily in the country (Dey & Islam, 2015). The contaminated water is mainly generated from the WDF processes. Each process consumes water and different kinds of chemicals are added in each process such as strong acids and alkalis, dyes with different colors, organic and in organic compounds (Dey & Islam, 2015). The main processes in textile manufacturing that highly contribute to water footprint of the sector are sizing, desizing, scouring, bleaching, mercerizing, dyeing, printing and finishing (Dey & Islam, 2015). The following figure (3-2) by Hossain et al (2018) shows the main chemicals used in different processes and the characteristics of the generated wastewater.

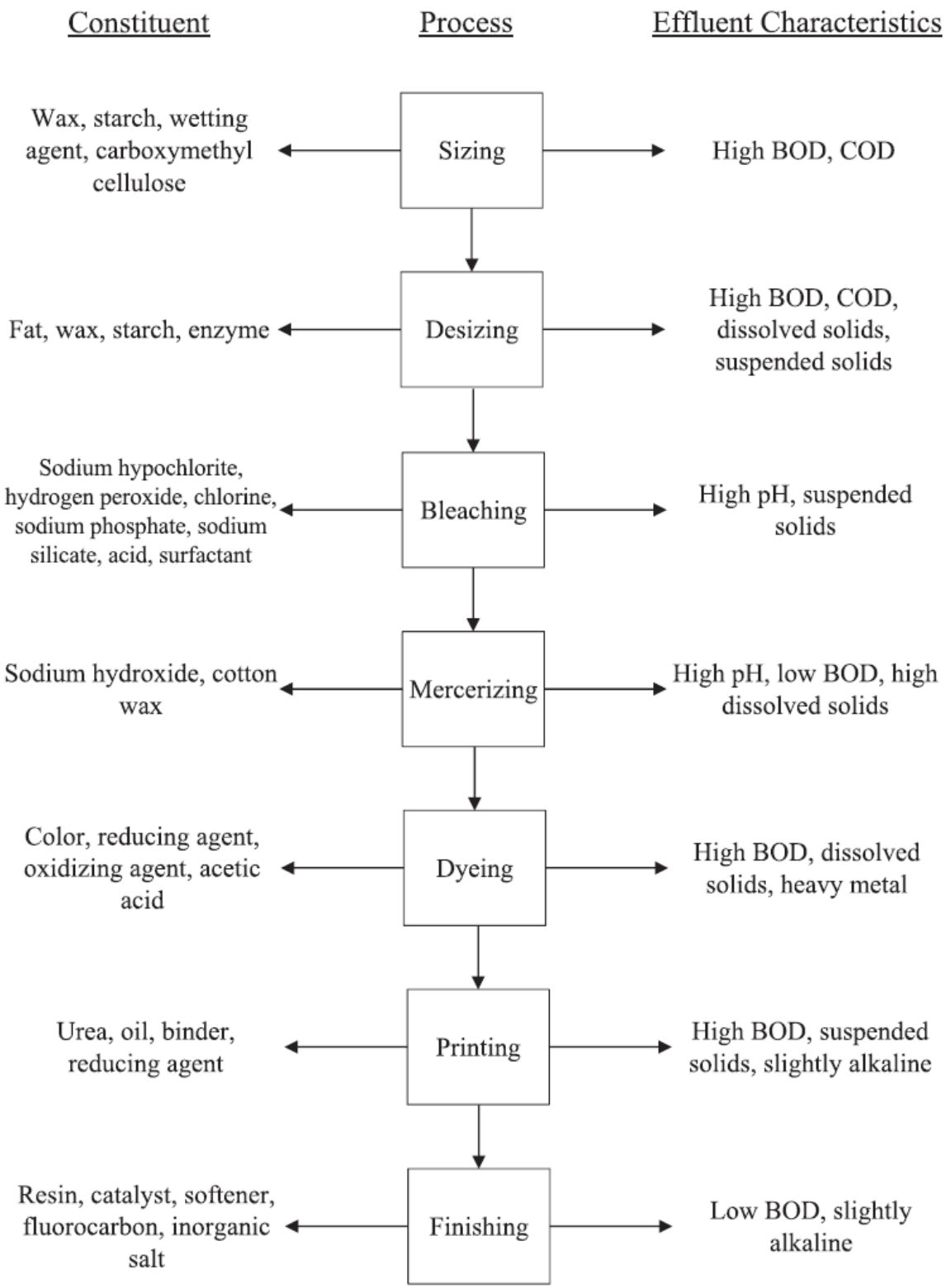

Figure (3-2) Main used chemicals and generated pollutants from textile manufacturing processes. source: (Hossain et al., 2018).

In conclusion, there are two major water issues and risks that the textile sector in Bangladesh will face in the near future. The first one is the continuous increase in the gap between the water demand for the textile industry and the water availability in the country. The increase in water demands will also be needed for other uses such as the domestic needs and agriculture. These uses have higher priority than the industry in the country which means that the textile sector may face a water shortage and higher costs for water consumption which makes the water sustainability and efficient uses required in this sector. The second risk is the low quality of water sources because of the continuous discharge of low quality or even untreated wastewater from the textile clusters in the major cities. The low and poor quality of easily accessible water sources will force the industry to search for more expensive alternatives for water sources in the future (Restiani, 2016).

3.3.3 Main actors involved in water management in the textile industry in Bangladesh

The actors involved in the textile sector in Bangladesh are divided into three categories: governmental organizations, national trade and industrial organizations and NGOs that include national and international parties. All these actors have different roles and participation in the sector according to their power and position. The following describes these three categories in detail.

3.3.3.1 Governmental organizations

- National Water Resource Council (NWRC): the council and its executive committee are chaired by the Prime Minister and it is considered the inter-ministerial institution that have the authority for strategic decision making regarding the water governance issues in the country. The council was issued by the enactment of Water Act (2013) and it is responsible for providing strategic views on water resource planning and policy-making. Also, the NWRC is responsible for ensuring the implementation of the National Water Resources Plan prepared by the Water Resources Planning Organization (WARPO) under the Ministry of Water Resources (Restiani, 2016).
- Ministry of Textiles and Jute (MoTJ): The ministry is responsible for formulating and issuing policies to govern the sector. Also, it is responsible of issuing approvals and registration for textile plants upon installing effluent treatment plants (ETPs) and the ministry is responsible of the continues monitoring of the (ETPs) to ensure its proper operations (Restiani, 2016). The ministry has under its authority The Directorate of Textile (DoT) which is considered the executive arm responsible for implementing the policies to ensure enhancing the sector efficiency and productivity. Also, since 2014, this directorate is responsible for monitoring the sector activities (Restiani, 2016).
- Ministry of Water Resources (MoWR): is responsible for the water management in the country and the main water regulator. The most relevant agencies under this ministry which are relevant to the water management in textile sector are: Water Resource Planning Organization (WARPO) and Bangladesh Water Development Board (BWDB). WARPO is responsible for the planning process for the water levels in the national level. This includes

planning for the industries allocation putting into consideration the demand of these industries and the available water supply. BWDB is responsible for the implementation, operation, and maintenance of water related projects in the country.

- Ministry of Industry (MoI): Is responsible for issuing national policies and strategies regarding the implementation of sustainable development in industries and achieving national economic growth. For example, the ministry issued the Industrial Policy (2010) that obligate industries to install ETPs in order to increase the competitiveness of the sector in the international market (Khan, 2017).
- Ministry of Local Government, Regional Development, and Cooperatives (MoLG): it is responsible for implementing national water supply and sanitation policies. Also, it is responsible for planning, constructing, operating and maintaining the water supply and sewage systems such as charging for water consumption for industrial purposes (Khan, 2017).
- Department of Environment (DoE): This department is under the authority of Ministry of Environment and Forest (MoEF) (Restiani, 2016). The MoEF has the authority to take legal actions against water polluters, particularly industries. It has the most notable role in the environmental governance in textile sector. The DoE is responsible for issuing Environmental Clearance Certificate (ECC), conducting environmental inspection and monitoring especially for the (ETPs) performance and enforce complying with environmental regulations(Khan, 2017). The website of DoE is stating that the government expanded the number of offices of DoE across the country and open new offices in more than 21 areas to reach more districts. This was intended to increase the department's capacities and to decentralize the work and responsibilities of it. Also, this means that it will get more coverage on the local level instead of the current national level coverage[3].

3.3.3.2 Nongovernmental parties

International brands (buyers) such as (C&A) and (H&M) and international development organizations such as the international financial corporation (IFC) are part of the actors involved in water management in textile sector in Bangladesh as an important producer of textiles (Khan, 2017). Also, national and nonprofit organization and financial institutions and banks can support in the transfer towards resources efficiency and sustainability. These organizations are pushing towards implementing cleaner production measures in Bangladesh by different tools such as using the power of consumer/customer to positively impact the environmental behavior of this industry in Bangladesh, raising awareness regarding implementing measures that benefit the environment and save water resources and the financial support for implementing cleaner production measures. For example, in 2013, the IFC organization initiated the Partnership for Cleaner Textiles (PaCT) program which is funded by the Netherlands and some international apparel brands such as (C&A) and (H&M) aiming for reducing the environmental impacts caused by textile sector in Bangladesh (Khan, 2017).

[3] http://www.doe-bd.org/overview.html

3.3.3.3 National trade organizations

Bangladesh has three main trade organizations that promote and support sustainable water use in textile sector in order to increase the competitiveness of Bangladesh textile sector in the international market. The three main organizations are: Bangladesh Garment Manufacturers and Exporters Association (BGMEA), the Bangladesh Knitwear Manufacturers and Exporters Association (BKMEA), and the Bangladesh Textile Mills Association (BTMA) (Khan, 2017).

The following figure (3-3) shows main actors involved in water management in the textile industry in Bangladesh.

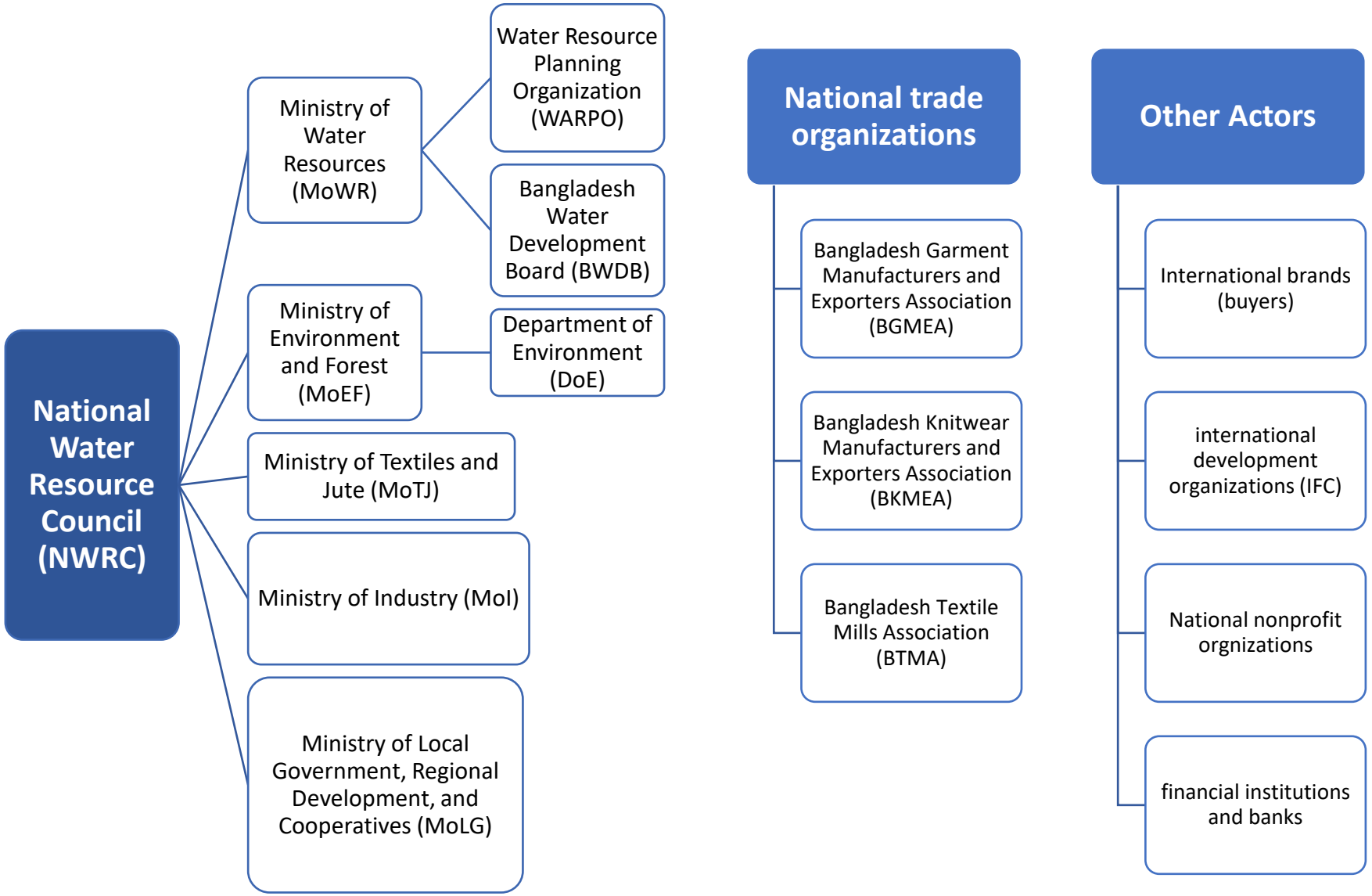

Figure (3-3) main actors involved in water management in the textile industry in Bangladesh

3.4 Legal framework of water management relevant to textile sector in Bangladesh

The following describes the main and most recent governmental measures such as acts and policies relevant to better water management in textile sector in Bangladesh and answers the second research question.

- Bangladesh Water Act, 2013:
  The Water Act 2013 is considered the main and most recent act in Bangladesh relevant to water management and governance. This Act adopted and amended the older water related policies such as the National Water Policy 1999 (WWF, 2014). The Act is integrating all activities relevant to Bangladesh water resources such as extraction, distribution, usages, development protection and conservation. Also, it covers all the water sources in the country such as surface water, groundwater and sea water. The Act obligates any individual or organization to issue a permission/license from the Executive Committee of ministry of water resources to any of the abovementioned activities relevant to water sources in the country. Also, the act states that (WARPO) under the ministry of water resources is responsible for licensing any water-related project. Although the Act is prioritizing the water uses in areas that suffer from scarcity or critical conditions for water availability, it did not set maximum limit of water consumption per individuals or organizations. On the other hand, the Act did not set any limits for pollution prevention of water bodies however it stated that Bangladesh Environmental Conservation Act (ECA) will be applied to handle this topic. Moreover, the Act formulated the NRWC and its committee that include the prime minister as the chairperson of the council and the committee and different ministers such as the minister of water resources and minister of environment and forest as members. Also, the Act assigned the council to be the highest decision making body for water relevant issues and sets the tasks and responsibilities of this council and its committee.

- Bangladesh Environmental Conservation Act (ECA), 1995:
  ECA, 1995 is considered the main legal framework concerned with protecting the environment in Bangladesh. The ECA sets the environmental standards for pollution prevention. Also, the act is concerned with controlling and monitoring the environmental pollution and emissions. The act issued the establishment of the DoE and sets its tasks and responsibilities. The DoE is responsible for issuing and improving environmental standards as well as monitoring and mitigating the environmental pollution. The act states in section (12) that ECC shall be issued from the Director General of DoE before the commencement in establishing any industrial facilities or units (Islam, 2018). Moreover the act sets quality standards for the wastewater disposed from industrial facilities and has specific quality standards for the large scale integrated textile plants.

- National River Protection Commission Act, 2013:
  The act delegates the government to apply any required legal action protection of rivers from pollution, violations and unreasonable uses. The act issued the National River

Protection Commission. According to article 12 of the act, the commission is responsible for:

a) *"to make recommendation to the Government for coordination of the functions among all concerned Ministries or Divisions related with river;*
b) *to make recommendation to the Government to free the rivers from illegal occupation and to prevent reoccupation;*
c) *to make recommendation to the Government to evict illegal installations established on the rivers or on the banks of rivers;*
d) *to make recommendation to the Government to keep the water of rivers free from pollution;*
e) *to make recommendation to the Government regarding excavation of extinct or moribund rivers;*
f) *to make recommendation to the Government for developing information store house relating to rivers"*

- National Water Policy, 1999:
  Under this policy, monitoring of effluent disposal will be conducted by relevant Government agencies. Also, the policy states that polluting water bodies such as surface water and groundwater from the untreated effluent generated from industrial centers and clusters in Bangladesh is considered a "critical water management issue". The policy on this regard sets the following points in this regard:
  a. *"Zoning regulations will be established for location of new industries in consideration of fresh and safe water availability and effluent discharge possibilities.*
  b. *Effluent disposal will be monitored by relevant Government agencies to prevent water pollution.*
  c. *Standards of effluent disposal into common watercourses will be set by WARPO in consultation with DoE.*
  d. *Industrial polluters will be required under law to pay for the cleanup of water- body polluted by them."*

- National Industry Policy, 2010:
  The main objective of this policy is to balance the industrial development in the country. The policy focuses on environmental protection and steers industrial facilities towards controlling their pollution to the environment by establishing (ETPs) to comply with the (ECA), 1995. Although this legal instrument exists on the national level, the enforcement of it is very weak as there are no human and financial capacities to monitor and enforce the facilities' compliance with the ECA law. Moreover, the policy is not covering water integrity or sustainable use of resources (Haque, 2017)

3.5 Selected good practice for water management in the textile sector in Bangladesh (Pact)

According to Food and Agriculture Organization (FAO), the good practice is the practice that have been applied and produced good results so it can be used as a model for further development or to be repeated in other contexts and places (FAO, 2014).

In 2010 the international financing corporation (IFC) launched a two year technical assistance pilot project for implementing resource efficiency measures in 12 wet processing textile factories in Bangladesh. This pilot project was implemented in cooperation with an NGO (Solidaridad[4]) and 10 international textile brands such as H&M, Levi's and Primark. The project applied cleaner production concepts in the 12 facilities; specifically for reducing water, chemical and energy consumption. The project results highlighted the potential for reducing resources consumption, hence reducing the industry's footprint in the environment. The project focused on low-cost measures that showed significant results. By applying most of the recommended measures the 12 facilities saved around 800 million liters of water per year. The promising results of this pilot project encouraged the IFC to scale up the project to cover 200 wet processing facilities. The scaled up project started at 2013 to 2017 and this project is (PaCT). The project aimed at reducing the environmental impacts of the industry in Bangladesh to increase its competitiveness.

3.5.1 PaCT overview

The project helped in guiding the wet processing facilities towards adopting cleaner and sustainable production as well as participated in the implementation of the recommended measures. Also, the IFC conducted different discussions with local banks and financial institutions to develop lending process that can assess the facilities for their investments for cleaner production (IFC, n.d).

The implemented measures achieved good and promising results. The project achieved 21.6 billion of water savings annually and 18.8 billion liter of generated wastewater has been reduced annually along with energy savings and greenhouse gases (GHG) reduction. The investments for achieving these results were US$39 million and facilities savings are around US$16.3 million/year (WB, 2018).

One of the main activities of PaCT project is conducting water footprint assessments in the wet processing textile facilities that participated in the project (Birner, n.d). These facilities were nominated by the international clothing brands and the facilities participated to gain the trust of these brands and become their suppliers accordingly the economic benefit was the main driver for facilities' participation. The assessment was conducted in three different scales

[4] Solidaridad: solution-oriented civil society organization accelerating global sustainable and inclusive development

(Birner, n.d). First scale targeted raising awareness regarding cleaner production concepts in 500 facilities. The second scale was a preliminary assessment that was conducted in 200 facilities. This preliminary assessment focused on implementing opportunities for no and/or low cost measures for cleaner production. The third scale was extensive assessment targeting 100 facilities. Technology investment plans have been prepared for these 100 facilities to achieve more savings by applying higher level of measures (IFC, n.d). The low level of awareness for the participated facilities along with the visible pollution for water bodies around the textile clusters indicate that the participated facilities did not apply effective resources efficiency measures or even pollution prevention measures. Although there is no clear evidence, but the pollution around the textile clusters is so obvious which gives an indication that most of the facilities in the country do not apply pollution prevention measures such as installing ETPs to reduce pollution.

Also, PaCT project partnered with (BGMEA) to initiate the first of its kind Textile Technology Business Center (TTBC) in Bangladesh on 26th of May 2014. The TTBC was created by the cooperation between (BGMEA), (IFC), and the Embassy of the Kingdom of Netherlands (EKN) in Bangladesh (Braak, 2015).

The center aims at supporting the textile wet processing facilities to adopt and implement cleaner production measures by providing the needed technical and financial guidance to the facilities (IFC, n.d). TTBC facilitate the contact between wet processing textile facilities, technology suppliers and financial institutions through conducting business to business links (Birner, n.d). Moreover, TTBC is collecting, analyzing and translating best available technology (BAT) for the textile facilities (Braak, 2015).

Additionally, PaCT project established the textile sustainability platform (TSP) in 2016 which is a public private dialogue (PPD) that promotes resources efficiency and sustainability in textile sector in Bangladesh. TSP aims at bringing national and sector level stakeholders together to address water sustainability challenges in textile wet processing (WB, 2018).

Finally, in cooperation with leading wet processing textile facilities in Bangladesh, the PaCT project will contact actors from business, government and communities surrounding selected textile clusters in the country to develop and start evolving a cleaner textile clusters vision. The first selected textile cluster for this activity is Konabari, North of Dhaka (IFC, n.d).

The following uses the five dimensions in the GAT matrix to describe the governance context of the PaCT project.

3.5.2 Project's levels and scales

PaCT I started in January 2013 and ended in December 2016. The project aimed at helping textile facilities to apply cleaner production and sustainable measures in their operations and raising the awareness in the facilities (Birner, n.d). The structural context of this project consists of three levels. The first level is the International level which is presented by the international organizations such as IFC, Dutch Embassy in Bangladesh, Solidaridad and international clothing

brands. The second level is the national level which is presented by BGMEA (national industrial organization). The third level is the private level which is presented by the textile factories that participated in the project. Some levels are not presented in the project such as the local and public levels and this is discussed in details in the next chapter.

3.5.3 PaCT actors and networks

The project was launched by IFC in partnership with wet processing textile plants in Bangladesh, 13 international textile brands, wet processing technology suppliers, the Embassy of the Kingdom of the Netherlands in Dhaka, BGMEA, and Solidaridad (Braak, 2015).

The project is collaborating with the international textile brands for integrating the sustainable practices in their decisions related to design and sourcing. Also, textile plants are one of the major actors of this project as the project is dedicated to identifying and implementing sustainable measures and good practices in the textile sector in Bangladesh. In addition to that, the project is creating a platform for dialogue and discussion between public and private sectors to identify challenges facing water sustainability in the textile clusters (IFC, n.d). Accordingly, the project is conducted by the collaboration between these different actors. Each one of the involved actors participated with their own sources and experience.

It is worth mentioning that during the conducted interviews, the interviewees stated that although governmental parties were invited for discussions and to participate in the project, they did not show willingness to participate. One of the interviewees said that “the project is private and voluntary project after all and if the government does not want to participate then this is their decision”. Other interviewee claimed that during the period of PaCT I the government was focusing on the health and safety concerns inside the facilities and no much attention was given to the environmental impacts and resources efficiency and this could be the reason for the poor or almost no governmental participation in the discussions and meetings for the project.

3.5.4 Problem perspectives and goal ambitions

The project is aiming for minimizing the negative environmental footprint of the textile sector in Bangladesh as well as encouraging the adaptation of more sustainable concepts. The project is targeting raising the awareness regarding cleaner production in 500 textile plants, implementing low and/or no cost resource efficiency measures in 200 plants, and facilitates financing cleaner production investments using bankable Cleaner Production technology investment plans created in coordination with 100 plants (IFC, n.d). The project focuses on reducing resource consumption to increase the sustainability. The focus areas for the project are water consumption, wastewater generation, wastewater quality by adopting the zero discharge hazardous chemicals (ZDHC) guidelines and energy consumption (WB, 2014).

This goal ambition and perspective was adapted by all actors and networks in the project. However, the national, private and international clothing brands had additional perspectives and goals from their participation in the project beside this main goal. Based on the conducted

interviews, the textile facilities that participated in the project were aiming for getting financial benefits from their involvement. Also, they wanted experts' support to enhance their environmental situation in order to attract more international clothing brands. So, for them the goal and perspective was more economic than environmental. On the other hand, BGMEA participated in this project to increase the competitiveness of the sector in the international market as well as helping the sector to be more efficient and sustainable as this is becoming more required for the international markets. Also, the international clothing brands that participated in this project have sustainable policies and codes of conduct that they have to comply with when they are dealing with their suppliers and trough their supply chain. Bangladesh is considered one of the major suppliers worldwide and the international clothing brands did not want to lose such promising supplier because of the noncompliance on the environmental and sustainable perspectives. Accordingly, they found that the project is good opportunity to introduce these concepts in the facilities which will ensure that the brands can continue cooperation with these textile facilities after the adaption of the sustainable behavior.

Accordingly, additional PaCT indirect goal, based on the different actors' perspectives, was increasing the competitiveness of textile sector in Bangladesh by increasing its environmental sustainability that will improve the sector image and position in the international markets. Therefore, the project collaborated with the international textile brands for integrating the sustainable practices in their decisions related to design and sourcing.

3.5.5 Project's strategies and instruments

The main objectives for the PaCT project are to reduce the environmental impact of textile factories and raising the awareness regarding cleaner and sustainable production concepts in the sector. The project defined four main strategies and pillars to work with in order to achieve these objectives (WB, 2018):

1- Involving international textile brands to encourage the adoption of sustainable buying practices which will force some power on the production and manufacturing stage;
2- Encourage the textile plants to adopt good practices for better access to the international markets;
3- Easing access to green finance for implementing resource efficiency and sustainable measures in the industry by connecting the textile plants with banks and technology suppliers;
4- Highlighting the sustainable transformation in the sector and identifying gaps in regulatory policies.

The first, second and fourth strategies were mainly conducted using social instruments. These instruments are different campaigns, workshops and meetings with different actors for capacity building and raising awareness about the cleaner production options. In addition, another social instrument is creating a platform for dialogue and discussion between public and private sectors to identify challenges facing water sustainability in the textile clusters (Birner, n.d).

Also, the project is using a supportive financial instrument to conduct the third strategy. This instrument is supporting and opening opportunities for green finance as an incentive for implementing the sustainable measures and encouraging the facilities and the international brands to adopt these measures in the design and implementation phases. Moreover, the project used the financial instrument to ensure the commitment of the participating facilities as they had to pay small amount of money for their participation. These facilities are one of the major actors in this project as it is dedicated for identifying and implementing sustainable measures and good practices to reduce resources consumption and increase the efficiency of the textile sector in Bangladesh. The adopted good practices increase resources efficiency such as water, chemicals and energy while making financial profits and savings.

3.5.6 Project's resources and responsibilities

The project responsibilities and roles were divided between the different actors. The IFC is the managing actor and the implementer. Also, the IFC in corporation with Solidaridad are responsible for connecting the actors' networks and organizing the workshops for raising awareness and building capacities. Both organizations have the needed resources for conducting their roles such as the knowledge and good relationships with all actors, connections with water footprint experts to support in the technical part, the experience in working in different developing countries. Other international partners such as the Dutch embassy in Bangladesh and government of Australia in corporation with IFC and Solidaridad are the donors for this project and most of the financial resources were provided by them. The international clothing brands roles were suggesting and promoting textile facilities that can be part of the project and encouraging the textile facilities and putting some power on their suppliers to participate in the project in order to comply with the international brands' requirements. The resources needed for this role is the database of facilities that the international clothing brands have for their suppliers and the good relationships between these brands as a customer and the facilities as suppliers. On the other hand, the national level actor (BGMEA) has a role in the implementation as it can be considered the implementation partner to the IFC. BGMEA has a database of most of textile factories in the country and it has good relationships with these factories. This organization is a national industrial organization and it supports the facilities to enhance their situation to be recognized by international markets. Also, it is considered a technical partner along with other international water experts. The private actor (textile facilities) responsibilities were sharing the data about their facilities and implementing the recommended measures for achieving resource efficiency and reducing the negative environmental impacts for their operations. The resources needed for this role were not quiet available as some facilities did not have enough data about their consumption and their level of awareness was not high.

4. Findings and results

This chapter answers the third research question by analyzing the PaCT project using two different tools GAT and SWOT as a base for providing recommendations. The SWOT analyses the internal and external factors of this project while the GAT analyses the governance context conditions of the project. These findings are based on primary data that was collected from the conducted interviews and questionnaires and secondary data available on the website of the project.

4.1Analysis results

4.1.1 GAT

Following the observations on governance dimensions made in the previous section, this part presents the results of the GAT analysis according to the quality criteria conducted for the PaCT project in Bangladesh. This analysis looks at the governance conditions of the PaCT project. The following figure (4-1) shows the visualization of GAT findings.

	Criteria			
Dimension	**Extent**	**Coherence**	**Flexibility**	**Intensity**
Levels	↑ Involvement of public national levels can turn it into positive	Positive in general and will be more beneficial to involve local and public levels	It was flexible as no traditional hierarchical relationships existed	International textile brands are the powerful actors
Actors	↑ Involvement of actors from governmental and NGOs parties can turn it into positive	= As long as the public and governmental actors are not actively involved the coherence will remain stable	Involvement of new actors is difficult and not flexible	↑ International textile brands need to enforce their sustainability requirements on their suppliers
Goals and perceptions	All of them were taken into consideration	↓ The current solution to prioritize the economic goals will not last for long	= Changing goals and perceptions are limited in the project	Goals were different, e.g. Factories goals were to do the minimum just to be potential suppliers for the international brands
Instruments	↑ Used in a positive way but hard to tell the results of	Implementation consequences were relatively	↑ Limited because the project is private and	The used instruments supported the

	the social instrument	fragmented	voluntary and has no political support	change but did not enforce or monitor it
Resources and responsibilities	Resources were available and responsibilities were well distributed	Complemented and supported the interaction	This is the most flexible and adaptive part of the process	Needs to be improved to reflect the long term change in behavior
Colors Red: negative; Orange: Neutral, Green: positive				
Arrows Up: positive trend in time, Down: negative trend, Equal: stable trend				

Figure (4-1) visualization of governance context diagnosis in score card

- **Extent**

The extent aspect of the governance context in the PaCT project can mostly be regarded rather neutral with positive trend in time. It is neutral in terms of the medium extent of the levels and actors involved, used instruments, and awareness regarding water sustainability and environmental issues, especially from the private level (textile facilities). The extent is positive in terms of the high consideration of all goals and perspectives, resources availability and well distribution of responsibilities between actors.

Regarding levels and actors, the national level seems to withdraw from the process and they did not show interest to participate even when they were invited to the public private dialogues. This is mainly due to the fact that at this time the national governmental levels had different priorities. These actors were more concerned with the occupational health and safety issues in the textile factories more than the environmental and resources efficiency issues because of the Rana Plaza collapse[5] in 2013.

The tendency to be positive with time occurs from the involvement of potential actors that were relatively absent in phase one of the project. These actors are public local actors such as governmental organizations such as DoE, MOI, WARPO, local communities and national environmental NGOs.

In terms of goals and problem perceptions, it is considered positive as all the goals and problem perspectives of the different actors were considered and there were continuous discussions to find the balance between them. The main goal of the project (resource efficiency and pollution prevention) was used as the umbrella that combines other goals. In other words, the economic goals and perspectives of the private actors were taken into consideration. This was shown in the project's proposed measures as they were either no/low cost or in case of high cost they had to be feasible and profitable measures with maximum payback period of 2 to 3 years.

[5] On 24 April 2013, the collapse of the Rana Plaza building in Dhaka, Bangladesh, which housed five garment factories, killed at least 1,132 people and injured more than 2,500.

Since the project is based on a voluntary approach, two different instruments, only social and limited financial instruments, were used. The social instrument used was on terms of the raising awareness workshops and meetings with the workers and the management of the factories. The financial instrument was used in two different ways. The first way is the support from the project to the facilities to get green finance in order to implement the proposed measures while the second one is symbolic fees the facilities have to pay for showing commitment to the project. In case the governmental actors will be involved in future activities in the second phase of the project more instruments can be introduced such as legal and other financial instruments.

A multiplicity of relevant responsibilities and resources resides with the different types of stakeholders and their different areas of expertise and knowledge. The IFC and BGMEA are mostly the implementers of the project. The IFC is responsible for project management while BGMEA is a local organization that has good relationships with the facilities and has their trust. The IFC has the resources that adequately fit with their responsibilities such as the high level of experience on working in such developing contexts, connections with different experts in resource efficiency and water footprint, etc. BGMEA on the other hand has their local experience in the textile industry in Bangladesh and most of textile facilities are members in this organization as it supports them to be present in the international markets. The international clothing brands are already one of the powerful actors as they are considered the customers for these textile facilities and their role was to nominate the facilities that can join the project. Also, part of their responsibilities was to adopt the sustainable supply chain and include the design and supplying phases in their sustainability policies and code of conducts. The textile factories were the targeting group and one of the major actors and their role was to participate in the project by sharing the data relevant to their factories. Other actors such as the Dutch embassy and Solidaridad are supporting financially and/or technically the project. Accordingly, the resources and responsibilities were clearly allocated and the needed resources were available or the project would search for alternatives in case of the absence of one of the resources such as the data related to water consumption in the facilities.

- **Coherence**

The coherence aspect has a similar neutral to positive assessment with stable trend in time. Regarding the coherence of levels, although the private level (textile facilities) needed more effort to be involved in the project, the cooperation and trust existed between the levels. Also, the level of dependency was high as the structure of levels in the project was designed to complement and interact with each other.

The coherence of actors was neutral and stable. All actively involved actors have experience in working together except the public and governmental actors who were absent from the project as mentioned earlier. The private level deals with international levels continuously as the textile production is mainly for exporting. Also, the national non-governmental industrial organization BGMEA, in most cases, works as a contact party or median between the private level and the

international level. The forms of dialogue between them were based on meetings and workshops so the face-to-face interaction between the actors was always the main communication tool. However, the dialogues between the public and private lacked the coherency as the public actors had different priorities at that time and one of the interviewees from the international actors mentioned that the project is a private voluntary activity and the presence of public parties is not that important for the project. It is worth mentioning that this was mentioned only once in one interview but if this opinion has more support from other actors this can lead to losing the support and coherency between actors. So, the coherency between actors can be considered neutral and stable with the absence of important stakeholders such as governmental actors and local communities.

In terms of problem perceptions, environmental impacts and resources efficiency are not yet a fully shared priority. However, the project took other goals such as the economic goals into consideration and tried to find opportunities to balance between both goals. The lack of awareness from the facilities side and the fact that their water use is very inefficient, the opportunities to find no/low measures was so high that achieving both goals was possible. But in the future such measures will not be option so the change in behavior and raising awareness about the importance of these topics will be the only solution when dealing with water.

Instruments and strategies are relatively fragmented in their consequences for implementation. For example the use of raising awareness workshops (social instrument) was in parallel with the facilities assessment and implementing the proposed measures (financial instrument) so this can give the impression that the project made instantaneous change instead of really causing or pushing towards changing behavior. Doing these steps in different phases while monitoring the impact and effectiveness of each instrument alone is more beneficial on the long term. As for responsibilities and resources, they are positive as they complemented and supported the interaction between the different organizations.

- **Flexibility**

The flexibility aspect gets a neutral assessment with fair degree of adaptive capacity. Moving between levels was flexible as no traditional hierarchical relationships existed between the levels. The horizontal relationships made the communication between levels easier as the project is private and the participation is on voluntary basis. Regarding the actors dimension, the flexibility was weak. This was clearly reflected in the weak approaches for involving the local and public actors. Also, it is difficult to shift the lead of the project as it is originally launched by the IFC and this organization is considered the lead implementer in cooperation with the technical implementer BGMEA. So, it is difficult to change this situation within the context of the project. Reassessing the goals is not easy as the project is voluntary and the restriction to voluntary approach makes the governance context to some extent inflexible. The flexibility of approaches can increase with the involvement of governmental and local levels. The general strategy of the project is to convince or inspire textile facilities to join voluntary in the project. This makes the used instruments limited and dependent on the tendency for

participation such as the raising awareness meetings and workshops and the probability of getting green fund for implementing the proposed sustainable measures. Flexibility in resources and responsibilities is positive as the wide range of actors with the different responsibilities divided between them managed to provide needed resources that was considered flexible in different situations.

- **Intensity**

Intensity appears to be the weakest point of the governance context for the project. Clearly there is no political support for forceful measures, but only for voluntary ones proposed by the project for each case individually. Regarding the levels, the international level is the most powerful level because they have the needed knowledge about sustainability and resources efficiency topics and they have the power of costumers as the textile facilities in Bangladesh are targeting international markets and all of their production is for exporting. The international textile brands that participated in the project nominated their suppliers from Bangladesh to participate in the project as a step towards changing behavior. However, continuous monitoring on the supplier is needed to ensure their commitment. The goal ambitions are very different from the current situation and the goals of different actors were different than the main goal. The project participated in sharing the awareness and most of the participated facilities implemented the proposed measures however the project is not monitoring the facilities afterwards to ensure their continuous commitment to cleaner production concepts. Also, no instruments are used to observe the impact of the workshops and if it caused real changes in these facilities' behavior and mindset. So, the used instruments supported the change but did not enforce or observe it. The allocated resources are enough to implement the needed measures for each case individually but not enough to monitor and observe the real change in the sector on the long term.

The observations described above conclude that the governance context for the PaCT project can be regarded as moderately positive (supportive or at least neutral). It is worth mentioning that these results are subjective and they reflect the researcher's point of view and assessment that was based on the collected data.

4.1.2 SWOT

This part presents the results of the SWOT analysis conducted for the PaCT project in Bangladesh. This analysis looks at internal (strengths and weaknesses) and external (opportunities and threats) factors of the project. SWOT analysis is a simple tool and was used in this research for the preliminary collection of data and to start the data collection with a simple and familiar tool to break the ice with participants. The items listed in each of the four categories (S-W-O-T) are collected from the interviews and questionnaire. To ensure the validity of the data and to overcome biases with the limited number of participants, the researcher only listed the items that got consensus from the four participants. These items are

listed under each category of the four categories. Also, the SWOT tool gave the same results as GAT when the same aspect was analyzed such as addressing strengthen PPD as opportunity and raising awareness as strength. The following figure (4-2) summarizes the major findings for each item.

Figure (4-2) findings of SWOT analysis

- **Strengths**

The conducted workshops for raising awareness are considered (by all respondents) one of the major strengths of this project. Raising awareness has long term benefits as it gradually leads to changing facilities' behavior to be more willing to adopt cleaner production and water efficient technologies. The good relationships between the actors can also be considered as strength for the project as it facilitated the achievement of the goals. Also, the installation of TTBC is strength for this project as it will provide continuous support for the wet textile industry in Bangladesh (as described in section 3.5.4) even after the project closure in the country. The project's online website is considered one of the strengths as it eases the communication with the project implementers, eases the process of joining the project for the facilities and is also used to share data, information, guidelines and success stories of the project. This kind of real experiences can encourage potential wet textile factories to participate in the future.

- **Weaknesses**

One of the major factors that considered as a weakness in this project is the lack of awareness of the wet textile facilities about the importance of water sustainability. The facilities participated to get the attention of the international clothing brands. One of the interviewees stated that “majority of the facilities have insufficient interest because of their ignorance and that they do not see the value of water savings and how can they become profitable for them as it can turn them to be strategic suppliers for the international brands”. Another interviewee mentioned that some facilities already knew about the environmental problems and the water pollution that is happening as they can see and observe the problems. But the awareness to do something about it in Bangladesh is more driven by economic incentives rather than environmental incentives and this shift of mindset from economic to environmental perspective is very difficult to achieve. So, the goal of the private sector (wet textile facilities) was very different than the main goal of the project. Another weakness is the public private dialogues that did not lead to any results as the public sector (the government, local NGOs and communities) were not actively participating in the project. One of the interviewees stated that “The public private dialogues are the least successful part of the project and the engagement with the government was not going well”. The last weakness in the project is that it lacks instruments to monitor the facilities after finishing the project. So, there is no observation and monitoring for the results of the raising awareness workshops to see if it really helped the facilities or participated in changing behavior or not as these results can only occur on the long term.

- **Opportunities**

Major opportunity that can be supporting the project goals is the active participation of governmental parties, local communities and national environmental NGOs. This kind of participation will raise the awareness of these actors and will keep them involved in the process even after the project finishes its activities in the country. So, the real involvement of these actors is important to support the project goals and for the long term adoption of water efficiency and minimizing water pollution as a goal and strategy for the textile sector in Bangladesh. Accordingly, strengthen the PPD can be considered as an opportunity and a big potential for improvement in this project. Another opportunity is finding incentives to encourage smaller and medium to small factories to join the project and involve them as private actors in the project. The interviews revealed that almost all the factories participated in the project are big to medium size facilities. Also, an opportunity can be found in discussing with all actors and stakeholders the probability of changing the project strategy to target whole wet textile cluster at once instead of targeting individual factories scattered in the country. In other words, targeting the whole facilities in one wet textile cluster at once will result in achieving cumulative positive environmental impacts and will help the facilities to share experiences and raise concerns that is relevant to all of them. Additionally, the facilities in the same cluster can use this kind of cooperation to discuss group and centralized solutions

together such as discussing the feasibility of constructing centralized treatment plant for the whole cluster.

- **Threats**

The major external threats that face the PaCT project are the low awareness levels of the communities and local governmental actors regarding sustainability, resources efficiency and pollution prevention. This might pose a real threat on the project as these actors are not participating or supporting such projects because they may consider these issues not priorities in the meantime. Another threat is that most of the facilities do not have data regarding their water consumption and they do not monitor it. The water extraction for industrial use is normally from ground water and this consumption is not monitored neither by the facilities itself nor the government. The ignorance of the amount of consumption from the facilities side is mainly because there are no water tariffs for industrial water consumption which means that the facilities do not pay for their water usage. From the governmental side they do not have the prober laws, capacities and resources to monitor the industrial water consumption. This makes building an economic case for reducing water consumption very difficult task hence, some measures for reducing water consumption might be not feasible.

Finally, the analysis shows that the project can be considered a good start towards cleaner production and water efficiency in the textile sector in Bangladesh. However, an area of improvement can be found from the two different tools such as neutral and negative areas in the GAT and weaknesses and opportunities in the SWOT. The following chapter provides recommendations for improvements and reflections on the study and the conducted analysis.

5. Recommendations and reflections

This chapter provides recommendation based on the key findings of this research and summarizes and reflects the main research findings.

5.1 Recommendations

This part presents the recommendations based on the results of analysis by the two different used tools. The results of both tools are supporting each other and their results are homogeneous. Below are the proposed recommendations.

- **Involving new levels and actors in the governance context**: this will be beneficial to have more supportive governance conditions. The involvement of the public sector (local communities, national NGOs and governmental organizations) is important to improve and empower the project as they are considered one of the main stakeholders in this project. Involving these levels and actors will ensure that the country will continue the same trend even after finishing the project activates. Also, involving governmental actors will give political support for the project objectives which can be an incentive for the facilities to comply with it. Moreover, the governmental support can add other instruments such as financial instruments e.g. setting water prices for industrial consumption as for now the industries consume water for free, or legal instruments such as policies and strategies that enforce water sustainably.
- **Raising awareness and support for local communities and government**: local communities which are aware of the importance of the water resource and the negative footprint and impacts of this industry to this resource can be another pushing factor towards project's goals. Also, support can be given to the government as they lack resources and capacities. For instance, the legal requirements are requiring installing ETPs in the factories but the government does not have capacity to enforce such regulations. The public-private dialogues can be used to identify the needed development for the governmental sector to cope up with project and be an active actor.
- **Develop instruments to observe the long term results of raising awareness activities:** raising awareness and changing behavior is a long term process. So to check and monitor such change, continuous observation and supervision are needed. The fully aware local communities and the government with support of the project's actors can be responsible for that and develop instruments for it.
- **Involving small facilities in the project:** it is important to find incentives to involve small and (medium to small) facilities in the project. Most of these facilities were not willing to be involved as they did not find a financial incentive for them to participate and their level of awareness regarding resources efficiency and cleaner production is low. Accordingly, changing the project's strategy from targeting individual facilities to target

whole cluster at once can be an incentive for the smaller facilities in the cluster to gather up and find centralized solutions and measures that can be feasible for them.

- **The power of buyers can effectively push towards real change:** currently, the international brands are the most powerful actor in the country as they are the major and most important customer and market for the industry. Accordingly, these brands can use this power to push harder towards adopting sustainable measures in the textile industry in Bangladesh. This can be done by enforcing their sustainable and environmental policies on their supply chain and continuous monitoring for its implementation.
- **Targeting textile clusters instead of individual facilities:** the project is currently discussing such change in strategy to target textile cluster at once to turn it into cleaner textile cluster. If negotiations about this change succeeded the outcome will be beneficial as the results can be more cumulative and effective.

5.2 Reflections

Water management in textile industry in Bangladesh is a very important topic not only for the industry but for the whole country and the water availability in it. The industry has a great potential for achieving water sustainability and results from private projects such as PaCT is a good example for that. The positive impacts can be achieved by having supportive governance conditions between all levels and actors. Governance is considered a better approach when dealing with resources management such as water as it includes all the relevant stakeholders in one context which makes it a little hard to manage. Accordingly, the active involvement of all actors and levels is important even for voluntary private projects. The PaCT project will benefit from the cooperation with the local government and communities to urge an effective behavior change in this sector in Bangladesh. In such developing countries the government is one of the major stakeholders and involving them in the process will be pushing towards sustainability goals as it will become a national approach and strategy. Also, this project and its promising results can be incentivizing the national and public sectors to be more involved in the endeavors to have a more sustainable textile sector in Bangladesh Finally, the change is achievable and doable if all stakeholders gathered up and tried to find the balance and best tradeoff between the different goals (environmental, economic and social).

6. Discussion and conclusion

This chapter discusses the research objectives, focus and findings. Also, it summarizes and concludes the answers for the four research questions regarding water management in textile industry in Bangladesh.

6.1 Discussion

Textile industry is important for the Bangladeshi economy but it is putting pressure on the limited water resources in the country. This stress is coming from the water pollution caused by the industry and the massive consumption for production. Water shortage in the country is not only threatening the industry expansion but it threatens other water users. On this regard, it was important to know and identify the current situation and important actors involved as well as addressing the existing measures to enhance the situation. The existed measures are governmental (acts and policies) and non-governmental (such as PaCT). The governmental measures for water efficiency and sustainability either do not exist or weak in terms of addressing the proper measures and dividing roles and responsibilities between organizations. Also, there is no national vision or strategy to apply and enforce water sustainability and cleaner production in the textile industry. On the other hand, the chosen voluntary project (PaCT) is a proxy of international initiatives that aim at applying water sustainability and cleaner production in the sector. These initiatives can be the solution in such developing countries that lack the proper awareness, regulations and resources for applying such concepts that save this limited resource. The PaCT project set its targets and communicated with stakeholders and actors from different levels as a step towards changing the current situation. This project showed positive results that can help the country to find the balance between economic and environmental goals which inspired this research to analyze its factors along with its governance conditions to highlight the areas for potential enhancement. This is important to strength such initiatives as a way for replicating the experience in different places without repeating the same mistakes that hindered the progress in earlier projects as it adds to the learning process of such projects.

In order to analyze PaCT project, GAT and SWOT analyses were used. Analyzing the governance conditions was very important as they determine if the project have the supportive conditions to push towards achieving the goals and real behavioral change or not. Accordingly, understanding and analyzing these conditions can help in identifying the weak parts of the context for finding solutions to change their status from stable or restrictive to supportive. Using SWOT was supporting the GAT results at some areas and it was looking for other elements beyond the governance conditions such as the surrounding and outside environment represented in the external factors. These two tools were not used together before for analyzing the same item and this study is trying to synthesize them to get more solid findings and results.

The two tools have intersection points where they looked at similar aspects. In these points, both tools gave quite similar results which verified the findings. For instance, the analysis of the extent and coherence of levels, and actors from the GAT gave the same results when analyzing the internal factors from the SWOT. The results showed the weak involvement of national and local government and public sectors. Also, the GAT showed positive behavior for the used instruments such as raising awareness workshops that was considered a strength point in the SWOT. It is worth mentioning that GAT was more detailed in addressing these points than SWOT and it addressed the flexibility and intensity of the dimensions which was not presented in SWOT. On the other hand, SWOT was extended to address the external environment surrounding the project such as the weak data regarding water consumption, lack of measures for efficient use of water and recycling in regulations, weak enforcement for the existing pollution prevention (installing ETPS) measures and the lack of water tariffs for industrial consumption. These external factors, at some cases, put stresses on the project in convincing factories to join and finding the balance between environmental and financial benefits of proposed measures. So, they pose threats and had indirect impact on the project but they were not part of its governance context. At such points the SWOT analysis complemented the GAT by adding another lens to it in order to get a more comprehensive analysis for the project. Also, the sequence of using simple and familiar tool such as SWOT in the first part of interviews followed by complicated and precise tool such as GAT was very useful for the process of collecting and formulating data as it made the participants more comfortable in the interview by starting with familiar terminologies from a tool that they already know then deep dive with questions relevant to the next unfamiliar and complicated tool (GAT). This technique was narrowing the focus from the general items about the project's factors that was collected using SWOT at first to move towards more precise data related to GAT that focuses more on governance conditions. Accordingly, using the two tools together is to mix between simplicity and complexity and to move from general to specific. Therefore, the two tools can be considered useful and proper to this study as they addressed important aspects in the PaCT project and highlighted areas for potential enhancements.

6.2 Conclusion

The first research question was about the water management in textile sector in Bangladesh. This question was mainly answered by secondary data however the primary data collected from the interviews had similar and supportive results. The results highlight the fact that the industry has a very negative water footprint as its average water consumption is almost three times the global standard for producing 1 kg of textile. Also, it highly participates in the surface water pollution in the country. Accordingly, the industry has a negative impact on the water quantity and quality in Bangladesh. Then the main organizations responsible for water management in the country were addressed with a brief description about their roles and responsibilities. They were divided into three main categories: governmental organizations, NGOs and national trade organizations.

The second research question was discussing the measures in place for managing/enhancing the current situation. This question was answered by combination of primary and secondary data. The research revealed that the country has some acts and policies in place that address the water issue in industry. All of them are mentioning the topic in general without specifying any measures or tools to achieve water sustainability and efficiency. Moreover, the roles and responsibility of each organization is not clear and they can overlap especially the WARPO and DoE. Also, regulations, acts and policies are more focusing on pollution prevention but not water efficiency. Afterwards, the PaCT project was identified as an example for voluntary project that represents good practices in Bangladesh to enhance the current situation. The main levels and actors involved were described. The project has three main levels (international, national and private); different actors follow under these three levels. The project goals and problem perspectives of different actors were explained. The main difference in opinions come from the fact that the private sector is focusing on the economic perspective with less attention to the environmental perspective while the other actors are more concerned with the environmental perspective. The four strategies of the project were identified (see section 3.5.4) along with the instruments used in the project (social and financial). Finally, the division of responsibilities between the actors was identified: the IFC and BGMEA are the implementers, the international brands are influencers and promoting textile facilities for participation, Solidradid along with other organizations are giving technical support and the Dutch government is one of the sponsors. The resources are technical and financial ones and all the actors participated with the kind of resources that they can provide to the project.

The third question was aiming for analyzing the PaCT project with two different tools to achieve triangulation of methods. The SWOT analysis was used to identify the internal and external factors of the project while the GAT to recognize the governance context conditions. Both tools gave results that supported each other. The PaCt project governance context is neutral to supportive and the weakest part is the intensity quality of problem perceptions, goals and instruments dimensions because the used instruments are not enough to monitor the long term changing in behavior and the goals are absolutely different than the current situation. Although the project is aiming at changing the situation and kind of achieved it to a certain extent, but more actions are needed to really urge changes in the current situation. Also, the SWOT analysis revealed that one of the major weaknesses was the passive role of the national and local public sector in the project along with the low level of awareness between the facilities. The threats found by the analysis are the absence of legal and political support to water sustainability and cleaner production issues. The same output was reflected in the analysis of levels and actors' extent in the GAT.

The fourth and final question was to provide recommendations based on the results and findings of the analysis. Therefore, weaknesses, threats and opportunities were used as a guidance to offer recommendations. Also, the neutral and negative parts in the GAT visualizations were seen as focus areas for improvements to get more supportive governance conditions.

The recommendations (proposed in section 5.1) are about the importance of involving local communities and national government, incentivize smaller facilities to join the project, raise awareness of the local communities and monitoring and observations of the impact from raising awareness workshops to evaluate and adjust them if and when needed to get better results.

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Appendices

Appendix 1-A: Interview guide and questionnaire

Interview guide

<table>
<tr><td colspan="2">Thanks for answering my questions. [Sara Magdy, MSc student, Master of Environmental and Energy Management (MEEM) program/ University of Twente]</td></tr>
<tr><td>Interviewer:
- Sara Magdy</td><td rowspan="2">This interview guide is part of my thesis for the MEEM program. My thesis topic is about water management in textile sector in Bangladesh and to find opportunities for achieving water sustainability in the sector and applying cleaner production concepts. Accordingly, analyzing and the factors and governance conditions of a good practice in the country such as Partnership for Cleaner Textile (PaCT I) is considered a good opportunity. Moreover, it is important to analyze and assess the contexts of this project in order to improve and upscale it. Therefore, I greatly appreciate your participation as a partner of the PaCT I project. Also, I hope that this participation will provide me with insights into the project and its activities.</td></tr>
<tr><td>Research institute: University of Twente
Interviewers' contact:
Sara Magdy;
saramagdymostafaabdelsalam@student.utwente.nl</td></tr>
<tr><td colspan="2">The questionnaire is sectioned into Two parts:
A. Governance context conditions
B. Questions relevant to Pact activities

I estimate that it will take up to 30 minutes to read and fully consider this interview guide.</td></tr>
</table>

A. <u>Governance context conditions</u>

A-1: Were all the levels* included in the project?

*levels are international level, ex. international organizations such as the international brands and IFC, the national level such as BGMEA and the national government, local such as municipalities and the private level such as the factories.

A-2 Were all relevant stakeholders involved? Were there any stakeholders not involved or excluded? If so, why?

A3- What are the different problem perspectives (ex. environmental problem) from the different actors' opinions? Are all problem perspectives taken into consideration? To what extent?

A4- What types of strategies and instruments were used?

A-5 Were all responsibilities allocated clearly between the partners and supported with the needed resources? What is the possibility for combining responsibilities and resources?

A-6 Is there cooperation and trust between the levels?

A-7 What is the level of interactions between actors? Do they have experience in working together before this project?

A-8 To what extent do the various perspectives and goals support each other?

A-9 To what extent are the used strategies and instruments* supplementing each other? What is the potential for combining different instruments to achieve the goals?

* Instruments such as raising awareness workshops and facilitating investment facilitation for the factories

A-10 What is the impact of the assigned responsibilities on the interaction between different institutions?

A-11 What was the possibility of moving between the levels (up and down)?

A-12 What was the possibility of including governmental parties as actors in the project? Do you think that involving any governmental parties in this project will be beneficial? Why?

A-13 Does any level had an impact to promote behavioral changes and better management?

A-14 Was there any actor pushes towards changes in behavior and better management?

A-15 How different were the goal ambitions from the current situation back then?

A-16 What are the implied changes in behavior to deviate from the current situation? To what extent the instruments support and enforce that?

A-17 Were allocated resources sufficient to implement the required measures to achieve the goals and make the change?

B. <u>Questions relevant to Pact activities and results</u>

B-1: What was your role, activities and personal experience in this ended pahse of the project?

B-2: Do you consider the PaCt (phase 1) a successful experience? Why?

B-3: What are the main obstacles that faced the implementation of the project's activities? How has the project been able to overcome them?

B-4: Do you think that the ended pahse of the project has participated in behavioral changes towards cleaner production?

B-5: What are the main threats that this ended pahse of the project posed and faced in Bangladesh?

B-6: Do you think of any part of this ended pahse of the project that can be improved?

B-7: Does the project monitor the factories after the completion of phase 1 of the project to ensure there continuous commitment?

B-8: Are there any experience from phase 1 of this project that should be avoided in the second phase for better results? If so, what is it?

Questionnaire

<table>
<tr><td colspan="2">Thanks for answering my questions. [Sara Magdy, MSc student, Master of Environmental and Energy Management (MEEM) program/ University of Twente]</td></tr>
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<tr><td colspan="2">The questionnaire is sectioned into three parts:
1- General questions
2- Questions relevant to Pact activities
3- Questions related to Pact results and impacts

I estimate that it will take up to 30 minutes to read and fully consider the questionnaire.</td></tr>
</table>

A. General Questions

A-1: From your experience, do you think the country has the potential to adopt cleaner production and water sustainability concepts? If so, what are the most needed factors to achieve it?

A-2: From your point of view, who has the most effective role in water management in the textile sector? Why?

A-3: Do you think that the legal framework and policies such as Bangladesh Water Act 2013 support water sustainability and cleaner production concepts in the sector? If so, why?

A-4: Do you think the country (public and private parties) has the resources to implement water sustainability in textile sector?

B. Questions related to Pact activities

B-1: What is your role, activities and personal experience in this project?

B-2: What are the main obstacles that faced the implementation of the project's activities? How has the project been able to overcome them?

B-3: What is the size of the participating factories: large or small and medium factories? How did the project communicate and choose the factories that participated?

B-4: Which organizations financed the project?

B-5: How did the project raise awareness in the sector? What are the used tools?

C. Questions relevant to Pact results and impacts

C-1: Do you consider the PaCt (phase 1) a successful experience? Why?

C-2: Do you think that the project has a continuous impact and that the level of awareness actually increased between the participated factories?

C-3: What are the main threats that the project poses and faces in Bangladesh?

C-4: Do you think of any part of this project that can be improved?

C-5: Does the project monitor the factories after the completion of phase 1 of the project to ensure there continuous commitment?

C-6: Do you think that involving any governmental parties in this project will be beneficial? Why?

C-7: Are there any experience from phase 1 of this project that will be avoided in the second phase for better results? If so, what is it?

Appendix 1-B: list of organizations that participated in the study

Organizations' type	Name of organization
International organization	IFC
International clothing brands	H&M
Water experts	Water footprint network