A POLICY ARRANGEMENT ANALYSIS FOR THE GOVERNANCE OF WATER SENSITIVE URBAN DESIGN

BENCHMARKING BEST PRACTICES FROM MELBOURNE AND DHAKA

Andile Moale

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Colophon

Title:	A Policy Arrangement Analysis for the Governance of Water Sensitive Urban Design in Melbourne and Dhaka
Author:	Andile Moale
Student number:	1080802
Institution:	Radboud University
Thesis supervisor:	Dr. N. Anyango-van Zwieten
Internship supervisor:	A. Johannessen
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GLOBAL CENTER ON ADAPTATION

Radboud University

Executive summary

Extreme climatic events such as rainfall and drought have increased by 50% in the last decade, and are occurring more frequently. The population in urban areas has risen and this causes an increase in impermeable surfaces, which are not able to drain water efficiently during such extreme climatic events. This can result in severe economic, social, and environmental problems in the urban areas and surroundings. Water Sensitive Urban Design (WSUD) is a newly developed approach for water planning and its philosophy is to incorporate water supply and demand of users with the needs of the environment. This involves the collection, movement, treatment, and storage of water in an urban environment. Many water-related solutions in the past have been techno centric and this has not been successful, as the management of water involves a wide range of disciplines and sectors. Thus, multidisciplinary policy reform to incorporate WSUD into water governance is crucial.

This research uses the cities of Melbourne and Dhaka to assess what governance components are necessary for best practice and improved water management in an urban space. This is done through extensive research into the policies, plans, acts, frameworks, and several other governance related documents, which are studied in the lens of the Policy Arrangement Approach (PAA). The four contextual dimensions which are used in this approach are actors, resources, rules of the game and discourses.

Best practice benchmarking is the perspective that will be arguing for the framework components for the application of Water Sensitive Urban Design (WSUD) based on the case study findings. The main conclusion was that the biggest barrier to WSUD is implementation, and this shortcoming has been credited to the absence of an applicable framework to guide the steps in implementation.

Preface

Nijmegen, January 2022

One cannot ignore the ever increasingly popular topic of climate change and sustainability management. The news is constantly filled with reports on severe droughts, floods, and extreme weather events. Cape Town, a city in my home country of South Africa experienced a severe drought in 2017/2018 where taps ran dry, and the country was in crisis. This opened my eyes and I started to look into water management and wondered whether the drought was caused by a reduction of rain in the climate of Cape Town or if the drought was induced by a mismanagement of this valuable resource. The causes of the drought were exacerbated by increased population and an increased demand of the water sources. High agricultural acreage as well as changes in land surfaces caused by urbanization also played a big role. This sparked my interest in water resource management, and I knew that I had to learn more about how to better govern water.

In coming across the Global Center on Adaptation (GCA) which is an international solutions broker for adaptation action, I had to get involved in the Water and Urban division, and thus found a way to secure an internship. This thesis is done in collaboration with this UN founded organization and was not only a masters research requirement but was indeed a passion project.

This thesis marks the end of my master's journey and in the same breath, an achievement of one of my most important goals. Besides gaining invaluable knowledge, this research process proved to be a personal challenge and undoubtedly one of the most fulfilling experiences in my academic career. With this thesis, I hope to contribute in a small way to the promotion of integrated water resource management.

Thank you to my supervisors Dr. Nowella Anyango van Zwieten and Ase Johannessen. I appreciate your guidance throughout this process. To my husband, thank you for your support, your patience with me and for all the coffee you had ready when I needed it the most. To the greatest extent, I would like to dedicate this thesis to my mother, who has been an incredible role model to me. This is for you. Thank you for believing in me and encouraging me to go after my dreams.

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List of acronyms

Abbreviation	Meaning
BCSSAP	Bangladesh Climate Change Strategy and Action Plan
BMP	Best Management Practices
CBO	Community Based Organisations
COAG	Council of Australian Governments
CRC	Cooperative Research Center
DELWP	Department of Energy, Environment and Climate Action
DWASA	Dhaka Water Supply and Sewage Authority
GCA	Global Center on Adaptation
IPCC	Intergovernmental Panel on Climate Change
IUWM	Integrated Urban Water Management
IWRM	Integrated Water Resource Management
LIDD	Low Impact Design and Development
NPDM	National Plan for Disaster Management
NWI	National Water Initiative
NWQMS	National Water Quality Management Strategy
OECD	Organisation For Economic Cooperation and Development
PAA	Policy Arrangement Approach
PROSH	Poribesh Rokkha Shopoth
RAJUR	Rajdhani Unnayan Kartripakha
SUDS	Sustainable Urban Drainage Systems
SUWM	Sustainable Urban Water Management
UNFCC	United Nations Framework Concentration on Climate Change
WARPO	Water Resources Planning Organisation
WASH	Water, Sanitation and Hygiene
WELS	Water Efficiency Labelling Scheme
WSUD	Water Sensitive Urban Design

1. Introduction

With rising sea levels, more frequent and extreme weather events such as floods and cyclones as well as a higher frequency of heatwaves, the impacts of climate change are already visible globally (IPCC, 2021). As much as it is important to combat the causes of climate change, it is just as important to adapt to the changes that are already occurring at present as well as those that will occur in the near future (GCA, 2021). Water is a vital resource for maintaining life as well as for the economic growth necessary to maintain a growing population. It is predicted by GCA (2022) that the number of people living with water scarcity will be 3.1 billion by 2050 as water demand increases by 55%. As the hydrological cycle is intensified by climate change, flood risk has the potential to double. Those most affected by this are communities which are already fragile and disadvantaged, particularly in poorer countries and those who reside in the informal settlements of urban areas (GCA, 2021).

Water is a resource through which the impacts of climate change are most acutely expressed, and this should place water adaptation at the heart of rigorous response to climate change on a global scale (GCA, 2022). Resilience building to the effects of climate change, is created through the implementation of adaptation strategies. Water Sensitive Urban Design is a design principle under the larger umbrella of Integrated Water Resource Management (IWRM) and is important for resilience building as it has the potential to reduce vulnerability (Wong & Brown, 2009). This concept encompasses Integrated Urban Water Management (IUWM) by focusing on 'green' urban planning systems (Kuller et al., 2017; Lloyd et al., 2002; Woods-Ballard et al., 2007) and emphasizing on implementing urban designs that are sensitive to environmental sustainability. This is done by incorporating the intrinsic values of the natural water cycle into urban design (Wong & Brown, 2009; Ashley et al., 2004) and integrating the urban water cycle with the environment (Taylor and Wong, 2002; Kuller et al., 2017).

Traditional water management governance approaches have been inadequate in addressing the complex issues of today (Brown & Clarke, 2007) and new thinking, in a multi-disciplinary approach is becoming increasingly popular in the water management space. Best practice studies for WSUD and SUWM (Sustainable Urban Water Management) in general are inter-disciplinary, multi-objective studies which require inclusive and integrative practices (Graupner, 2009). Much of today's research and governance on urban water management is technocentric, and this is not enough to manage an issue of such great complexity. The planning side of urban water management remains underexposed and Kuller et al. (2017) suspect that this may be due to the high complexity of planning required, which is at a level of intricacy that is beyond conventional infrastructure engineering. Policy implementation and governance for such a 'wicked problem' are often hindered by the lack of agreement in causes, and this results in the inability to find cross-beneficial solutions across the different sectors (Graupner, 2009). There is also a high degree of fragmentation in the space of water governance (Haque et al., 2019). Teisman and Edelenbos (2011) argue that in governance, where there is specialization, fragmentation will always exist and although this may be true, they believe that stable boundaries and prioritization can exist in policy making.

The early implementation of WSUD will be beneficial in the long term as resilience-based land use governance and planning is of a lower cost than reconstruction with resilience as an afterthought (GCA, 2021). This study looks at Melbourne in Australia, and Dhaka in Bangladesh as cities that have demonstrated best practice in how urban water systems are managed. This best practice knowledge is conducted with the aim of developing a framework which can be used to better incorporate water sensitive urban design in other cities of the world. The cities were selected based on several other criteria which will be discussed in the following sections of this paper.

1.1. Problem Statement

Through the review of literature on sustainable water management in urban design by authors such as Haque et al. (2019), Weiring and Arts (2006) and Woodhouse and Muller (2017), there is consensus that there is limited information available on the exact governance components that need to come together to successfully implement policies and governance processes which enable WSUD. The perspectives usually assessed in current research are centered around the various technologies which have been developed and can be used for sustainable water use in cities (Wong, 2006), but there is a gap in knowledge pertaining to the exact governance practices and policies needed from multiple sectors in the relevant markets, state and civil society to come together for the successful implementation of WSUD. This research aims to play a role in bridging that gap. Haque et al. (2019) have stated that numerous studies have proved that shifting processes in policy, are influenced by several factors which may include the interests of donors or stakeholders, political considerations, pressure from civil society as well as learning from experience. This means that to make this study applicable and instrumental, it is important to study more than just policy because there are a wider range of aspects that enable the effective implementation of good practice. As mentioned by Biswas (2008), water problems of the world are not consistent or homogenous and can vary across regions as well as from year to year. This makes water management a complex and difficult task even under the best circumstances.

It is important to look at institutions and governance in water because the solutions are not only dependent on the availability of water but very importantly, the processes through which water is managed (Biswas, 2008). This is embodied by the capacities and competencies of the institutions that manage water, the socio-political conditions as well as the implementation (and suitability) of the solutions given in the legal and regulatory frameworks. Water management is affected by the funds available, knowledge acquisition, technology access, international and national attitudes, transparency, corruption, education, and development (Arts & van Tatenhove, 2004). There are endless contributors to water management, and thus necessary to look at water from a wholesome perspective. This research focusses on building a framework which can contribute to the creation of effective implementation of WSUD.

1.2. Research aim and research questions

This research study aims to develop a best practice framework for the governance of effective WSUD in cities. For this to be achieved, case studies of two cities will be assessed and critiqued to gain an overview of how steps to effective water governance implementation are achieved. This is referred to as best practice analysis. By doing this, this study aims to formulate useful governance recommendations to improve water sensitive urban design and assist city managers to transition to more collaborative, integrative and adaptive water management and governance. Therefore, the main research question formulated is:

What framework can be used to achieve the governance elements which are necessary for the effective approach and implementation of Water Sensitive Urban Design in a city?

This question is answered by three sub-questions which will be resolved for both Melbourne and Dhaka:

1. *What is the policy arrangement of Water Sensitive Urban Design in this urban area?*
2. *What are the barriers to the implementation of water sensitive urban management in the city?*
3. *What are the facilitators of water sensitivity governance in this urban area?*

The first sub-research question defines the approach that has been taken by the water authorities in how they pursue water sensitive urban management and allows for an in-depth analysis of the institutional context based on the Policy Arrangement Approach (Arts & van Tatenhove, 2004). Sub-question two allows us to look at what implementation challenges might be expected in the pursuit of applying WSUD, and finally sub-question three allows us to identify what elements are beneficial for the application of WSUD in a city. Answers to these questions will be used to answer the main research question. The background theory of these questions is further discussed in Chapter 3.

1.3. Societal and scientific relevance of the research

This research is in collaboration with the Global Center on Adaptation (GCA) as part of a master's thesis internship per the requirements of Radboud University. The GCA is an international organization recognized as a solutions broker for adaptation action and solutions (GCA, 2022). They work from local to international scales in partnership with the public and private sector to mobilize finance, innovate and act as a solutions broker for sustainable development adaptation. GCA does this through their various programs and action, by accelerating knowledge and providing support and advocacy across several activities for the promotion of a climate resilient world, focusing on the most vulnerable communities. This research is for the GCA's Water and Urban program.

In the next 25 years, the demand for water will increase by 55% and 3.1 billion people will be living with water scarcity (GCA, 2022). The outcomes of this thesis can be used to help achieve the aims of the water and urban program by providing a framework for WSUD. Trends indicate that water issues are increasing and will continue to increase in complexity and become more interlinked with other sectors of development, including energy, industry, agriculture, health and the environment (Asian Development Bank, 2007). Because of this, water can no longer be addressed in isolation.

There have been several theories of governance in the last 15 years and although they are descriptive and analytical, rarely do they provide a prescriptive basis for governance instead, much of the focus is on the technologies (Ward et al., 2012). Francis and Holloway (2007) state that research on environmental governance issues has previously been done either on the prescriptive form or the practical form, with a lack of research on both combined.

In the twenty-first century, climate change is pivotal in redefining development. The way that communities, societies and entire nations respond to its impacts is more than likely to determine their chances of sustainability and growth. With that being known, the knowledge gaps about what role institutions have in adapting to climate change are still large (Agrawal, 2008). Governance from both international and local institutions affects how various groups of people will be affected.

Research by Agrawal (2008) shows that climate change adaptation is inevitably local and by governing adaptation resources and knowledge, institutions influence climate vulnerability. Institutions also shape adaptation outcomes by mediating collective and individual responses to climate change, making them very important actors in water management. The application of WSUD in cities in the developing world is particularly a challenge as social pressure directs the political agenda to achieving short term goals which are more urgent to the livelihoods of the populations. Attempts for WSUD initiatives are often unsuccessful due to poor planning and ad hoc solutions (Salinas Rodriguez et al., 2014). With this knowledge, it becomes important to improve livability in the short and long term and to develop synergies that link the shorter-term goals with the more 'advanced' ideas which will improve water sustainability in the long term; this link can be done through governance.

By governance, this paper refers to the economic, social, political and administrative systems that control decision-making around water resource management and development, formally and informally (Enqvist & Ziervogl, 2019). Governance is an issue that involves private, public as well as nonprofit actors because it requires cooperation from every sphere and high investments on capital. Good governance requires water justice, decision making that is transparent and the correct implementation of policy, among other factors. The Policy Arrangement Approach is used because it links policy and reality by putting into operation the various dimensions of the PAA whereas, although many theoretical frameworks made for the analysis of policy processes briefly acknowledge the importance of all these factors, they do not provide the theoretical tools to explore how perceptions and ideas influence policy (Arts & van Tatenhove, 2004). Best practice methods will enable critical assessment on what it necessary in terms of governance, to incorporate sustainable and resilience centered water management in a city.

1.4. Reading guide

The structure in which the above-described research questions will be answered, is described here. After this introductory chapter one, a literature review will be presented in chapter two, and this will give a detailed foundation and understanding of the research topic by exploring the relevant debates, literature and pertinent arguments on the topic. Chapter three and four are an elaboration of the theoretical framework which underpins the research questions. This framework is a basis for this research as it introduces the conceptual model as well as serving as the groundwork for data collection and analysis. Chapter five is the methodology, and this takes the reader through the process in which the research was conducted. In chapter six, the case-by-case results and overall results of both case studies will be presented before they are critically analyzed in chapter seven which is the concluding chapter. Here, the answers to the research questions are provided and recommendations for policy and future research are given.

2. Literature review

This section will elaborate on the concept of WSUD and its value in sustainable water management. Melbourne and Dhaka as case studies will be introduced and the most important themes which emerge from existing literature are visited to provide a well-rounded understanding on where water sensitive urban management lies in academia as well as in practice. This is necessary for the realization of a well-founded methodological approach to the sub-research questions and the main research question.

2.1. Integrated Water Resources Management

The concept of Integrated Water Resources Management (IWRM) has emerged in the last 30 years as sustainable development gained popularity (Ward et al., 2012). The growing awareness that water needs to be managed comprehensively came from the recognition that water resources are limited and must be divided among the competing needs of society. Recognition also grew that more efficient use of water can increase crop production to feed the growing population. Studies on rainwater harvesting increased and so did those on ground water, surface water and other sources of water regulation as it became clear that regulating only one system alone, may no longer be sufficient (Savenije & Van der Zaag, 2008; Ward et al., 2012). This meant that water management expanded outwards as engineering, social, economic and legal aspects had to be considered. The management cycle for this complicated process had to be developed, as a result more studies were done on the monitoring, planning, operation and maintenance of this subject (Savenije & Van der Zaag, 2008). The term IWRM developed as a term for managing water in a holistic and comprehensive way (Savenije & Van der Zaag, 2008) and it considers the human and natural dimensions of the water cycle.

Water Sensitive Urban Design (WSUD) is a sub domain of IWRM and will be the focus of this research. Although closely linked to the definition of IWRM, WSUD is focused on water sensitive management and design specifically in urban areas (Ward et al., 2012). With that, factors such as engineering, urban planning and high rates of population growth become a focus of this discipline. The significance of looking at cities particularly, is discussed in section 2.2. Water sensitive cities as described by CRC for Water Sensitive Cities (2015) enable water management strategies by contributing to biodiversity, carbon sequestration and urban heat island reduction. While environmental issues have fast emerged and continue to do so, adaptation to climate extremes becomes increasingly critical in resilience building (Ward et al., 2012). This can be done by addressing adaptation needs that include flood or drought risk reduction, efficient management of stressed water resources and water quality improvement (Ward et al., 2012).

WSUD can be understood as a concept that integrates water, stormwater, and wastewater flows, giving prominence to water sensitivity in urban design (Ward et al., 2012). It is sometimes used synonymously with other approaches to water management. This includes Low Impact Design and Development (LIDD), Best Management Practices (BMP), Sustainable Urban Drainage systems (SUDS) and Integrated Water Resource Management (Gain et al., 2015; Biswas, 2008). The concept of Integrated Water Resources Management overarches the concept of WSUD as a design philosophy which was defined in Biswas (2008), as a process which promotes coordination in the management and development of land, water, and related resources, with the goal of maximizing economic and social welfare without compromising the sustainability of ecosystems.

WSUD in not a recent concept but emerged in Australia in the late 1990's. This developed as an alternative approach to the traditional approach to water supply management and was aimed at contributing to better environmental outcomes (Choi & McIlrath, 2017). The concept gained popularity in the rest of the world in the last decade as population growth continues and urban areas experience more frequent extreme weather events. There has been a trend of countries redefining urban design to increase resilience to climate change through the incorporation of the total water cycle into the urban fabrics (Choi & McIlrath, 2017). The example of countries which have decentralized planning systems similar to Australia include the United Kingdom, Israel, the United States of America and Singapore (Choi & McIlrath, 2017). The city of Oslo in Norway is known as the 'Green Capital of Europe' due to their transition into WSUD and storm water management (Sjodahl, 2018).

Some scholars, such as Biswas (2008) have critiqued IWRM and WSUD concepts because of the broad definition of the concepts. Biswas (2008) has argued that due to this broad definition, many are unsure of what the concepts of WSUD and IWRM mean thus can get away with false branding. He further argues that despite the efforts made to promote the concepts, the results of IWRM have not much improved. The operationalization of this concept becomes difficult when the concept is vague and the interpretation of the concept itself varies. In many definitions, there is no explanation on which parameters should be maximized and what criteria should be used to select these necessary parameters (Biswas, 2008), nor who should select them. This research aims to provide a general framework for WSUD which can serve as a guide that can be further altered to suit each context and scenario.

Hopeful of the potential of these terms, Biswas (2008) concludes that if the definitional problems can be resolved in a way that enables practical implementation, it may be able to be translated into measurable criteria. Water is something that is connected to many sectors thus it is important to understand that concepts of IWRM and in this case, specifically WSUD is a journey and not a destination.

2.2. Why cities are vulnerable

Cities are important locations in water adaptation not only because they host a large proportion of the country's population, but also because cities are always part of a natural system and are built close to a water source to service the need for drinking, agriculture, infrastructural development, and transport (GCA, 2022). Water issues need to be balanced with other priorities for planning – such as public health, transport and energy needs as well as meeting housing demands while facilitating economic growth (Ward et al., 2012).

There is increasing awareness that green infrastructure reaps many societal benefits in urban areas while ecosystem services are also benefited (GCA, 2022). The view that water stress management, flood risk and other uses of water require separate management is now replaced by water sensitive design, however there are not many examples or views of the process for implementing integrated water management in its entirety (Salinas Rodriguez et al., 2014). The WSUD concept used in this research has been derived from trailblazer research and practice developed in Australia and now in several countries around the world. It is mostly driven by the water sector in urban areas but there is a great increase in involvement and interest from the municipal sector as it is in their interest to save on cost and develop synergies (Salinas Rodriguez et al., 2014). As mentioned in the introduction, the cost of sustainable water management systems is more affordable than damages caused by extreme weather conditions or water mismanagement over time (Salinas Rodriguez et al., 2014). Thus, a water sensitive city is approached, in this study as a city that interacts with the hydrological cycle in a way that enhances and protects the health of wetlands and water courses, mitigates flood risk, enables water security for economic prosperity by the utilization of diverse water resources and creates spaces that recycle and clean water (Salinas Rodriguez et al., 2014; COAG, 2004). WSUD is 'seen as an advanced state of urban water management transitions' (Salinas Rodriguez et al., 2014, p.174). Water is the foundation of a city's future and thus requires citizens, governments, and businesses to facilitate behavioral change to that that is water sensitive (Dutch Water Sector, 2021). There needs to be a move from just technical innovations and solutions to solutions that are developed and imbedded in the policy and governance (Loorbach, 2010).

2.3. Water governance

A theme for the UN World Water Assessment Program has repeatedly been about the world water crisis as an issue of governance, rather than that of a lack of knowledge (World Water Assessment Program, 2016) and as a response to this, literature on water governance has grown over the past two decades (Woodhouse & Muller, 2017). The literature has a range of perspectives on approaches to improved governance, but this range also poses a methodological challenge as the broad views make it difficult to develop clear methods (Woodhouse & Muller, 2017). While some believe it is a matter that must be handled by the state, others believe that the private sector needs to take control; with various levels of prioritization and tradeoffs which are valued differently among actors (Woodhouse & Muller, 2017). What there seems to be consensus about, is that there is an urgent need for improved water governance but, there is no clear consensus on what that should look like and how to achieve it (Woodhouse & Muller, 2017). For example, the United Nations has struggled to give defined governance indicators for targets that are water-resource related, such as Sustainable Development Goal 6 – '*to ensure availability and sustainable management of water and sanitation for all'* (UN DESA, 2022). Water is a resource which is transitory and the diversity of circumstances in which it is found, makes it difficult to specify any single policy for its governance (Woodhouse & Muller, 2017). The barriers to integration are due to the complexity of the concept itself as there are varying climates even in a single country (Salem et al., 2007).

This study uses the definition of water governance by the Organisation for Economic Cooperation and Development (OECD) as 'the range of political, institutional and administrative rules, practices and processes (formal and informal) through which decisions are taken and implemented, stakeholders can articulate their interests and have their concerns considered, and decision makers are held accountable for water management' (2015: 5).

Weiring and Arts (2006) have noted that there is a new lexicon that is used by policy makers, environmental scientists, and hydrological engineers regarding water issues. This sector is now framed in similar ways to the concepts which have been used in the past for ecosystem-based perspectives, with 'institutionalization' used as a central concept to examine the transformation processes which (re)produce political interactions (van Tatenhove et al., 2000). This relates to the construction and preservation of patterns which are ongoing and make up the interactions of institutions. These function as semi-autonomous social agents by controlling a wide range of symbols and rituals which modify the preferences of individuals and by doing that, imposing order in a policy area by defining the rules of the game (van Tatenhove et al., 2000). Many authors have used an institutionalization frame of reference and have framed environmental problems as new social problems (van Tatenhove et al., 2000).

From the 1980's, environmental politics took on a macro-context, which resulted in the subject of environmental policy being regarded as a 'perpetual process of construction, deconstruction and reconstruction' (van Tatenhove et al., 2000: 20) as society evolved. Water problems are now expressed in terms such as 'resilient water systems' or 'making room for the river' (van Tatenhove et al., 2000). Weiring and Arts (2006) inquire whether this narrative is a discursive shift which will lead to fundamental changes in the management of water or is it possibly a strategy used by water scientists and managers for the purpose of falsely 'adapting to a changing environment', while the institutions remain unchanged. Although some cases give criticism to the water sector, there is an undeniable shift toward water sensitivity discussions in several sectors (van Tatenhove et al., 2000).

The concept of water sensitive urban management represents the goal of attainment of resilience, and it is grounded by interactions between branches of water science, urban planning, engineering, and politics. In this context, the term resilience is *the ability of a system to retain its original identity or cope and recover from system disturbances* (Salinas Rodriguez et al., 2014). It is important to note that water sensitivity is a state to be aspired toward and no city can go as far as saying that they are fully water sensitive, the aim is to improve resilience. WSUD is 'seen as an advanced state of urban water management transitions' (Salinas Rodriguez et al., 2014: 174).

2.4. Overview of case studies

Dhaka and Melbourne are selected as the two case studies for exploring forward-thinking, sustainable urban water management and the reasons for each city's selection is discussed below. A case study involves an in-depth inquiry of the case, which allows for the understanding of context and thus an acceptance of things which may be subjective and unique (Yin, 2009). This is necessary when studying a complex and intricate subject such as the real-world application of governance. Although accommodating subjectivity, best practice case study research also enables generalizability (Overman & Boyd, 1994) see section 3.1.

2.4.1. Case study 1: Melbourne, Australia

Designing water sensitive cities is one of the goals of the Australian Commonwealth's National Water Initiative (COAG, 2004) and WSUD was used at the end of the 1990's for the first time in Australia (Mouritz, 1996). The country experiences a lot of variability when it comes to water and the many droughts which occurred in the country's history encouraged the water industry to move towards water sensitivity and integrated water planning approaches to make better use of water resources and optimize the social, economic and environmental outcomes of water management in Australia (Frontier Economics, 2017). Melbourne has decentralized supply and treatment solutions because of this, and flooding has made the upgrading of drainage infrastructure necessary. *'The water security pressures caused by Melbourne's recent 13-year drought have fundamentally changed the way we use water – in our homes, offices, and public open spaces, for recreation and for commercial and industrial purposes'* (City of Melbourne, 2014, p. 2).

The vision for water sensitivity emerges in several policies which will be studied throughout this research paper and these policies incorporate WSUD into a vision for Australian cities, specifically Melbourne. With these policies, urban design accommodates water cycle systems. The Living Victoria Ministerial Advisory Report (2011) is a framework for transforming urban water management in the City of Melbourne (Wong et al., 2011).

2.4.2. Case study 2: Dhaka, Bangladesh

Bangladesh is the sixth most vulnerable country in the world to floods and it ranks first for cyclones (Gain et al., 2017; Haque et al, 2019). The severe floods experienced by Bangladesh have been a result of various reasons which are caused by hydro-meteorological and nonlinear geomorphological trends, but deforestation and the large expansion urban sprawl caused by population growth unplanned land-use practices have also contributed greatly (Haque et al., 2019).

Planning for water management during extreme weather events has been happening in Bangladesh since the 1960's (Gain et al., 2017) as they devised the first Master Plan for the management of water. This document was based mainly on flood control and drainage, specifically to produce agriculture. Since the 1980's, policy documents have slowly incorporated integrated management as a focus. After the consecutive floods of 1987 and 1988, more planning was done until 1995 where the Bangladesh Water and Flood Management Strategy was produced – this was the first longer term plan for water management in the country (Gain et al., 2017). It led to the conception of a National Water Policy and a National Water Management Plan (2004). Major reforms in institutions were defined by the National Water Policy of 1999 and this was a milestone for institutionalization of integrated water management in the country. The National Water Management Plan was drawn up in 2004 and is a 25-year plan for better water resource management in the country. Bangladesh has one of the most intricate water integration plans for developing countries (Gain et al., 2017) and to achieve this, the institutions involved have had to work together with the community to implement these goals.

3. Theoretical framework

This study requires theory on 2 domains of governance and sustainability research. One is theory on Best Practice Benchmarking research and the other is theory on the Policy Arrangement Approach as a method to study governance. The theoretical framework section below will provide definitions and clarifications of these frameworks which appear to be appropriate for this research, along with the choices made for the theoretical framework used.

3.1. Best Practice Research for Policy

Benchmarking is the search to find as well as to implement best practice (Trosa & Williams, 1996). The process involves searching for better – or best – performing organisations, in the case of this research, we will be looking at water governance in urban areas (Trosa & Williams, 1996). Benchmarking is used mainly in management, for the purpose of learning practices to improve the performance of business (Yasin, 2002). The first book on benchmarking was published by Robert Camp in 1989 but the development of this method as a tool for management occurred in 1979 when the Xerox Corporation used benchmarking initiatives to gain insights into the methods and materials used by competitors who were Japanese companies that had photocopier machines with lower production costs than Xerox (Yasin, 2002; Salem, 2007). They wanted to learn how they did this so that they could emulate the same practices to improve their business model. This practice made its way into private and then public service (Francis & Holloway, 2007).

Mann (2015) defines two major categories of benchmarking, and these are formal and informal. The informal is an approach which involves learning from the experience of other cases with no defined process. Formal benchmarking has two types which are performance benchmarking and best practice benchmarking. Performance benchmarking describes a comparison of performance data that is obtained by studying other, similar activities. Best practice benchmarking is used in this study and involves using 'performance data obtained from studying similar processes and identifying, adapting and implementing the practices that produced the best performance results.' (Mann, 2015, p. 37).

Kinder (2002) has used best practice case study methodology for the improvement of service innovations of local public administration. Best practice plays a profound role in the process of innovation because it allows the introduction of informal standards, which may be difficult to find using other research methodology. Case studies have also been used by professionals to capture best practice (Easton, 1982; Kinder, 2002). Similar methodology and concepts have been used in studies such as the EU's Fourth Framework Programme (Kinder, 2002) which is a framework and tool to boost research and collaboration at European level. Best practice research is not a strict method of research, but it is rather defined as: '*the selective observation of a set of exemplars across different contexts in order to derive more generalizable principles and theories of management'* (Overman & Boyd, 1994, p. 69). In this, principal outcomes from research in particular cities could be prescribed for other locations, this makes best practice research suitable for this study. Generalizability is the degree to which findings in research are applicable to other samples or populations (Polit & Hugler, 1991). Benchmarking has been described by Butta and Huq (1999) as a process which is used to establish the ground for creative breakthroughs.

There is a lack of models and theoretical frameworks in best practice benchmarking literature (Salem, 2007). Yasin (2002) states that this could be attributed to the lack of interest of public management to adapt to innovation and new approaches. Literature on benchmarking also does not discuss much on costs and benefits of various benchmarking approaches. As mentioned previously, the literature review brought forward an issue that there is research done on either the practical or prescriptive form separately and there is very little research available on the middle ground, which is on both the theoretically underpinned and evidence informed (Francis & Holloway, 2007). This is the gap that needs to be filled, specifically for policy studies as both aspects are necessary for the fulfilment of the demands of policy analysis and reform. There are various complexities in the way that benchmarking is understood. While some understand it for 'results' and others for 'best practice standards', these concepts mainly reflect different emphases rather than techniques. Processes should not be formal rules, but rather be the chain of activities or work practices (Trosa & Williams, 1996). As a contrast to results benchmarking, process benchmarking goes beyond the quantitative information to understand the reasons for various performance levels of best practice.

Both performance and results benchmarking techniques are used by over 70% of the Fortune500 companies such as Ford, IBM and AT&T (Trosa and Williams, 1996). Throughout this literature study, it is identified that there is a gap in literature regarding a unified understanding of the steps for a benchmarking study. There are numerous methods, but they all essentially account for the same thing (Polt et al., 2001), essentially it is the study of learned practices which seem to be effective. This research process will adjust the steps of benchmarking best practice methodology as that would require comparison of one organization or city, to another more successful one so that best practices can be retracted and applied to the one less successful. Here we will simply look at best practices of two case studies, without comparison to a less successful one. Furthermore, the application of the learned practices will not be conducted as part of this research.

It also important to explain that countries are characterized by systematic differences thus, what is best practice in one country or region, may not be suitable for another. Therefore, although the more formal term 'best practice' is used in this study, it is a more adequate aim to develop 'better practice' or 'good practice' through learning (Tomlinson, 2002). The term is formerly known as 'best practice', however when used throughout this research, we simply mean good practice, as defining the best possible practice would be impractical for a study of this level. As mentioned by Salinas Rodriguez et al. (2014), no city is completely water sensitive, the aim is improvement. In this study, the aim is to improve on current practice through providing governance dimensions that facilitate good practices. Benchmarking best practice has some methodological challenges, and one is that it demands a collection and analysis of a wide array of data, which in this case are governance indicators such as policy documents and regulations (Tomlinson, 2002). The generalizability of this method also means that there is no guarantee that what works in one city will work as efficiently in another context, therefore the framework is created as something that can be tweaked and adjusted to fit a particular context (Tomlinson, 2002). In terms of best practice policy-driven framework conditions, the general attempt is to identify the impact of the institutional and regulatory policy framework conditions and how they impact the outcomes of economic and social processes, as well as identify in which direction the framework conditions should improve for the attainment of maximal welfare, economic performance, or any other policy objectives, in this case that is Water Sensitive Urban Design.

3.2. Policy Arrangement Approach

To understand policy arrangements, a few central themes need to be recognized. Firstly, the theoretical notions in policy and politics need to be understood, the most important of these is the advocacy coalition framework (Sabatier & Jenkins-Smith, 1993) which tells us about the intricate process of having various actors coming together to formulate and implement effective policies. Secondly, the role of discourse coalitions and how they affect policy networks is important (van Tatenhove et al., 2000). Thirdly, we need to look at the ontology behind the generation of environmental knowledge in that space, particularly – what beliefs are shared, affecting the way that a problem is approached (van Tatenhove et al., 2000).

The Policy Arrangement Approach (PAA) is the main theoretical framework that guides the methodology of this research and is explained in this section. Healey (2006) explains that the resistance of urban areas is dependent on the governance measures taken against a particular threat. A policy arrangement is the way in which a policy domain is shaped in the context of time and space. This refers to the way in which it is organized and all the underlying substance that comes with that (Arts & van Tatenhove, 2004). The Policy Arrangement Approach fits this objective because it allows for the investigation of substantive and organizational aspects of water management in that case. It will also be important to understand the role of actor constellations and changing framework rules to fulfil the aims of this research.

This approach was developed at the Radboud University of Nijmegen, by the Department of Political Sciences of the Environment and builds on various concepts from sociology and political science (Arts & van Tatenhove, 2004). The PAA builds on several other theories which function at 'meso level' to policy arrangements through their change and stability; these other theories include various approaches on policy network (Kickert et al., 1997), discourse analysis (Hajer, 1995) and the advocacy coalition approach (Sabatier and Jenkins-Smith, 1993). The PAA emphasizes four factors in its methodology: (1) the fact that multi-actor policy processes are institutionally embedded; (2) that structural developments will be manifested in concrete policy processes; (3) that there are different faces of power in policy making and they all have a specific role; and (4) the importance of both organization and substance but also that of change and continuity in policy practices (Arts and van Tatenhove, 2004).

This way of combining the four factors in an analysis looks at policy at a deeper level than just at the meso level, which many policy analysis approaches lack (Arts and van Tatenhove, 2004). The method of analysing all four perspectives, encompasses a more dynamic analysis for policy processes. The below figure 1 is taken from Van Eard et al. (2014, p. 95) and shows the dependent relationship between the dimensions of the PAA approach. It was chosen because it is the most simplified model of the key elements and clearly conveys the congruence between the arrangements. A policy arrangement is the way that a particular domain of policy is shaped and organized (Hegger et al., 2014). It results from the interplay between actors and actor constellations, the power plays and the resources, the rules of the game – which can be formal and informal, and the discourses. These dimensions depend on one another and the changes to one element are likely to affect one or more of the other elements (Hegger et al., 2014). The details of each dimension will be further elaborated on in Chapter 4.

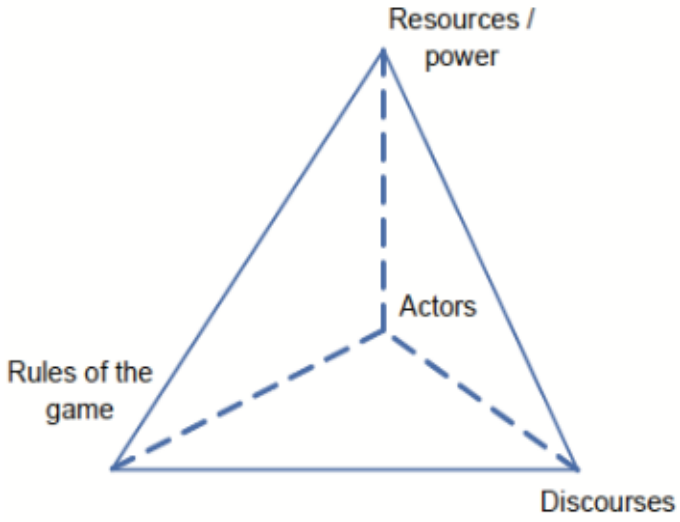

Figure 1: Tetrahedron of the 4 dimensions of the Policy Arrangement Approach (van Eard et al., 2014, p. 95)

4. Conceptual framework

With the theoretical concepts having been identified, in this section they will be further defined into measurable variables and indicators that will enable analysis and attain the goal of this research, which is to develop a framework that facilitates best practice in water sensitive urban design in a city. This is done by using the Policy Arrangement Approach to study the substantive and organizational aspects of efficient water management methodologically. This theory will be used together with Benchmarking Best Practice research methodologies which require an in-depth analysis of the governance processes used to achieve WSUD in Melbourne and Dhaka. The combination of these processes will aim to facilitate the conception and development of a framework which identifies the necessary elements WSUD.

4.1. Operationalization of the theoretical concepts

4.1.1. Best practice operationalization

Regarding the concept of Best Practice, a model by Gillen (2017) has been included as figure 2 below. This model is to be followed for part of the research process however, some steps do not apply and will be left out of the methodology for this research. The necessary steps for the method of this research will be selected and combined with the steps of the Policy Analysis Approach in the coming sections, as will be seen in the conceptual model itself. Figure 2 has the following steps: (1) best performers identification – in the case of this study, two cities are identified. Step (2) is to measure the gap between the best practices and the practices of the organization/city you are trying to improve, which will only be necessary when applying the framework, this is the same for step (3), (5) and (6). Step (3) is to assess the improvement potential between the steps in the framework and those of the urban environment that you are aiming to improve. Step (4) will be used throughout this research and that is to identify the important actions that are undertaken by the selected case studies which led them to best practice, in our case that will be for the cities of Melbourne and Dhaka. Step (5) is consensus building, and (6) is implementation. A framework will not be applied but only created, as part of this research. 'Communication' is written across the diagram as that serves as a crucial factor for transformation using benchmarking.

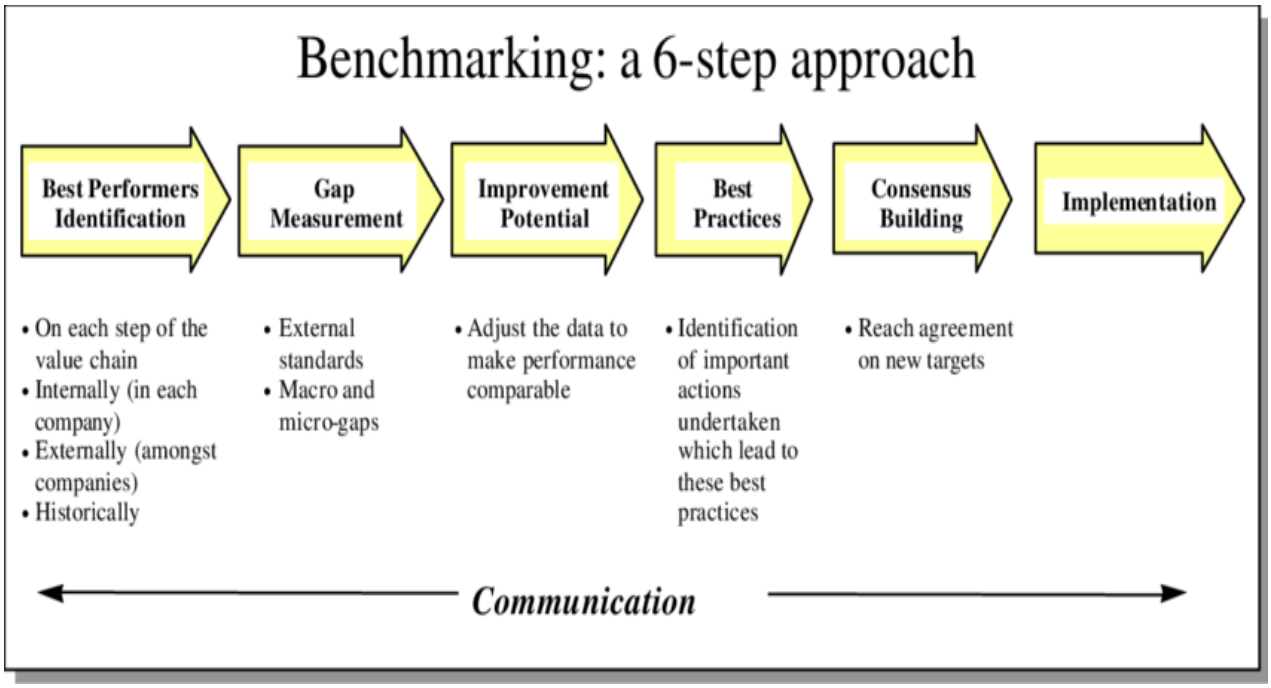

Figure 2: The steps in benchmarking (Gillen, 2017)

4.1.2. Policy Arrangement Approach operationalization

Regarding the Policy Arrangement Approach, the four dimensions need to be operationalized further. Table 1 below summarizes the variables in these dimensions along with their variables and indicators.

Dimensions	***Variables***	***Indicators (examples)***
Actors	Actor constellations (internal and external actors)	Key political actors
	Interaction patters	How actors interact among themselves
	Coalitions and oppositions	Cooperation levels/oppositions
Resources/Power	Knowledge capacity and development	Skills and capabilities of actors
	Financial capacity	Budgets Subsidies
	Technological capacity	Capability to have access to experiment with technology
Rules of the game	Formal Rules	Binding laws, legislation, policy procedures
	Informal rules	Informal procedures: organizational, political culture, routines of action
Discourses	Diagnostic frames	How problems are perceived, how causal factors are perceived
	Objectives	Shared views on problem, leading to coordination and integration
	Motivational frames	Driving factors which lead to action (responsibility and shared political urgency)

Table 1: Operationalization table of the dimensions of the policy arrangement approach (Adapted from Liefferink, 2006; Weiring & Arts, 2006)

Actors

This dimension is analysed through three perspectives which are: 'actor constellations', 'interaction patterns' and 'coalitions and oppositions' (Weiring & Arts, 2006). The actor constellation describes the key actors along with their influence in the policy process. Who is involved in setting the agenda, making decisions, and implementing the policies?

Another aspect of interaction patterns has to do with the dynamics and changes in the way that these actors interact, is there more conflict or co-operation? Questions in this realm can be theoretically inspired by macro theories and changes on relationships between the market, state and civil societies. An example of this could be the role of globalization in the way that WSUD has been governed (Liefferink, 2006). In this instance, a good question to ask would be how policies are created in the face of globalization and how are they implemented in the space of multi-level governance. This notion is an example of how new coalitions and sub-politics may emerge outside of political institutions which are formal; created possibly by private actors, individuals, and social apolitical movements.

The practice-oriented aspect of the actor and coalitions section is about who is involved in the policy that is being considered and what are the institutional power relations between these actors, this is referred to as 'relational power' (Liefferink, 2006). The third aspect has to do with co-operation and is an important aspect of the actor constellation dimension because the existence of cooperation between various arrangements is an indicator that actors are open to collaborate and cooperate with other actors (Liefferink, 2006).

Resources/power

The most important expressions of this dimension are resource constellation, political influence, and power relations (Arts, 1998; Wiering and Arts, 2006). Resource constellations are related to the assets that actors pose or can mobilise, including money, technology, authority, and knowledge. In most cases, these assets are not equal between the actors therefore they are not all able to achieve the same political outcomes (Arts, 1998). It should be acknowledged that these relations and this distribution of power is dynamic through space and time (Wiering and Arts, 2006). As actors may decide not to use their power, or at times fail to achieve their desired outcomes, there is no guaranteed one to one relationship between influence and power.

One of the indicators is *knowledge capacity and development* in policy arrangement and this has to do with the skills and capabilities of the actors involved and the resources that the actors possess. One must ask themselves, what are the capabilities within certain policy arrangements to source and produce new kinds of knowledge. Knowledge development capabilities and willingness are also direct indicators in this aspect. Essentially, more willingness increases knowledge thus is an indicator of potential resources. The second indicator is *financial capacity* – in this study we look at finances available for WSUD and how financial resources are mobilsed. *Technological capacity* is the third indication of capability within a policy arrangement and very directly has to do with what technology can be created or accessed (Wiering and Arts, 2006; Arts & Tatenhove, 2004).

Rules of the game

The indicators of this dimension are legislation, procedures, and political culture. Legislation a discursive indicator is the translation of discourse into binding law (Liefferink, 2006). Deep institutional change in discourse is reflected by changes in legislation (Wiering and Arts, 2006) and these are the formal and informal routines and procedures which have been mutually agreed upon within institutions (Liefferink, 2006). Procedures are the organizational aspect and looking at procedures helps to understand how different courses of action and rules of the game are caused by changes in the policy arrangement, but also how the policy arrangements themselves are reflected in the procedures. This dimension is closely connected to actors. An example would be if there is a participation of new policy actors, this shift in participation can lead to rule changes (Wiering and Arts, 2006). Formal institutional arrangements help to achieve policy coordination (Meijers and Stead, 2004). The political culture is represented by the routines of interaction, and these are not easy to change (Liefferink, 2006).

Discourses

A discourse has to do with ideas and concepts which when combined, give meaning to certain phenomenon in the real world (Wiering and Arts, 2006). The discourse around sustainability is closely connected to the discourse around water management and brings together notions of sustainable development and integration of the economy and ecology. A discourse consists of three layers, and these are strategic, ontological and normative (Wiering and Arts, 2006). How do we define and interpret problems? Do the paradigms in which we deal with certain problems change over time? A big indicator in discourse are the *objectives in policy arrangement*. Objectives must be shared if policy coordination and integration are to take place (Nilsson et al., 2012).

How *problems are defined* in policy arrangements is also important. Having common ideologies, definitions and interests are facilitators to organizational coordination (Meijers and Stead, 2004). This makes it very important to break down certain normative expressions of political actors, understanding what their world views are because that shapes certain belief systems which manifest themselves in the policy proceedings. The acceptance and spread of these ideas through shared *belief systems* causes successful policy coordination and facilitates a shared *approach to the problem*.

4.2. Conceptual Model

The section above gives background to the theory that will serve as a starting point for this research. The below figure 3 is of the conceptual model and takes both the policy analysis approach and best practice theories adjusted. As discussed above, it is assumed that best practice in the WSUD and water management in both Melbourne and Dhaka are carried out by governance, which is also defined by the institutional milieu/framework as can be seen by the outermost shape of the model below. The best practice approach is represented by the lighter blue shape, which relates to sub question 3, 'what are the facilitators of water sensitivity governance in this urban area?' The answer to this is built up by looking at the policy arrangement of water sensitive design in both cities – as represented by the larger green square.

The four dimensions of the PAA are represented by the four smaller blue shapes and are used to analyze this institutional arrangement of urban water management and will answer sub-questions 1 and 2 of the research questions. The four arrows above the squares show that there is a relation between the 4 dimensions of the PAA and the approach to best practice of WSUD in both Melbourne and Dhaka. As described in the above sections of the PAA, these dimensions are interrelated (Liefferink, 2006), which means that at times it may be difficult to come to solid conclusions on the concrete individual links. With that, the purpose of this model is not to prove that there is direct causality between each of the factors, but it aims to merely identify the complex relationships in the pursuit of getting an overall view of the policy arrangement that can lead to improved WSUD.

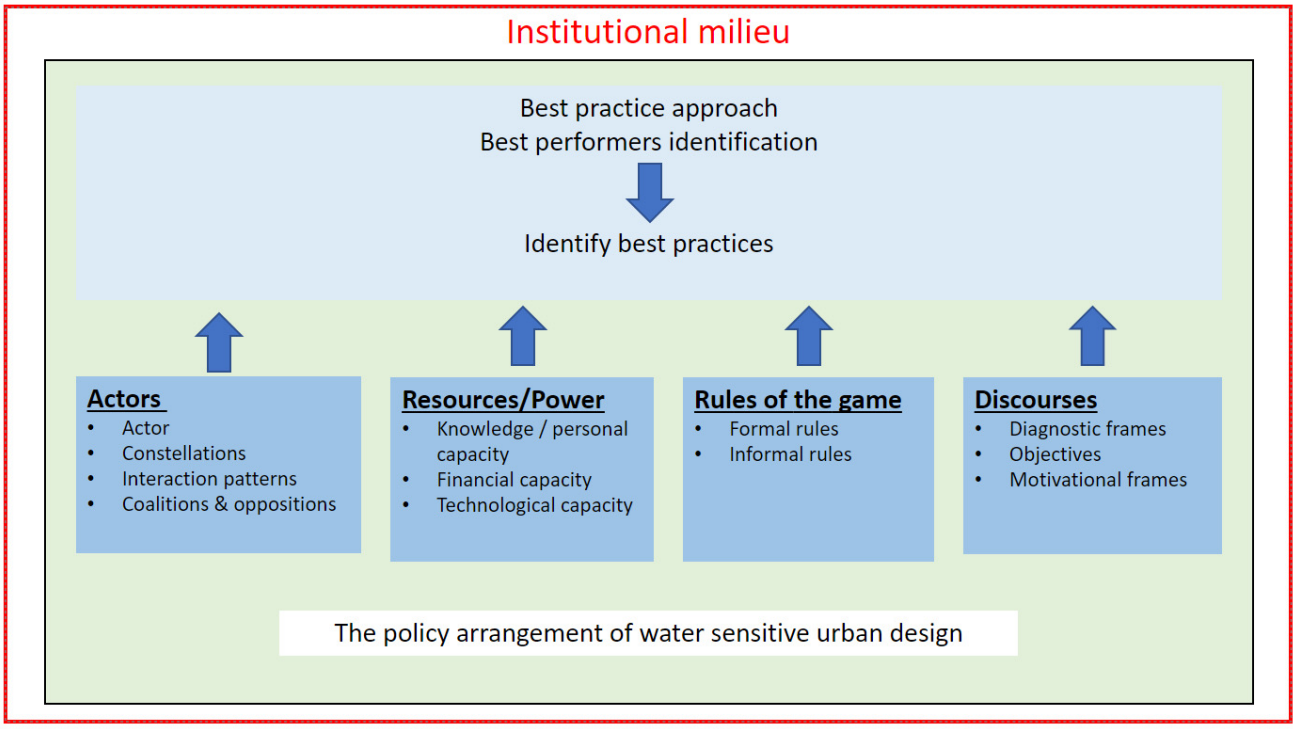

Figure 3: Conceptual Model

5. Methodology

The below section explains the methods used to conduct this research. Paradigms of research are based on epistemological assumptions (Guba & Lincoln, 1994) which are not factual but rather subjective; these can only be accepted as the basis of belief but bare no proven truth. These personal assumptions have a big impact in how research is approached and makes it important that the researcher discloses their research paradigm so that the reader can understand the choices made in methodology and the entire meaning of the results of the research.

5.1. Research paradigm

The way that an individual views the world is defined by certain paradigms or basic belief systems which in turn shape their research (Guba & Lincoln, 1994). This research is shaped by two research paradigms. First is best practice research which is pragmatic and requires both a utilitarian and pragmatic outlook. The word 'inquiry' is used to explain the process of conducting research in this approach and suggests a social and open process of problem solving (Bardach, 1987) as best practice is a process of looking in and inquiring into the principles and possibilities (Overman and Boyd, 1994; James, 1975).

Pragmatism is also relevant as a philosophy for best practice research because it requires research using 'common sense', as actions are assessed through practical consequences (Shields, 1998). This is suitable for best practice research because the best governance practices identified as most important for the successful implementation of water sensitive urban design are going to be deduced through practical understanding and critical reasoning (Shields, 1998). This perspective is suitable for this study since case studies which have their own context are used, and these findings will be collated for the purpose of corroborating a general framework which can be applied for other cases. The pragmatic approach can decipher theories out of observations, and assess those theories through action (Morgan, 2007). This approach is suitable in that it rejects the idea that a researcher must choose his position between extremes of either designing their research with generalized principles (positivist) or locating their research findings in a context which is specific (constructivist).

This way, pragmatism does not focus on generality or context but rather examines whether an empirical issue can be applied through the things that are learned from one context - transferability is the strength of this perspective (Creswell, 2009; Tran, 2016). When looking at creating a framework for water policy and governance, we aim to find what is meaningful from both a positivist and constructivist approach and to investigate whether knowledge can be transferred. The advantage of the pragmatic approach in this research allows the researcher to get a complex understanding of the intricate world of policy and this would have been difficult if using only a single approach. The challenge with this approach, however, lies in balancing between subjectivity and objectivity (Tran, 2016). Analysing qualitative data requires time and careful design, which is time consuming. Despite these factors, the careful design of the research methodology used aided in overcoming the challenges posed and provided the opportunity for an in depth understanding of policy and governance issues and challenges in water sensitive urban management. The aim of this research has components of explanatory and descriptive inquiry as it involves finding a transferable success formula but also involves the analysis of existing research principles and best practices.

5.2. Research method and design

The details of the methods of data collection and data analysis that will be used in this research will be visited in this subsection. Qualitative research will be conducted for this study and the research processes adopted consists of four main stages: identification of research objectives, data acquisition, data interpretation and analysis and finally, the creation of a framework. The details of these steps are discussed below. In comparison to a quantitative analysis, the qualitative analysis approach can focus on an unlimited number of variables and can take the contextual factors into account. Qualitative methods reduce the risk of uncertainties due to the relation to contextual factors (Guba & Lincoln, 1994).

The strategy used in this research is case study analysis. This is suitable because the aim is to analyze, explore and explain a particular situation (Yin, 1981), in this case that is the governance of water sensitivity in a particular city. Yin (1981) also mentions that case study research is suitable for an empirical inquiry used to examine a phenomenon in its real-life context, despite the criticism that case study research has for ‘relying too much on logic’ (Poulis et al., 2013).

Having multiple data sources also makes analysis using a case study possible and suitable (Poulis et al., 2013). An abductive method of data analysis was used to collect and analyze the data, this methodology is corroborated by the techniques of the pragmatic approach and connects the theory by shifting between inductive and deductive reasoning (Morgan, 2007). 'Abductive reasoning involves the conception of new rules or types of relationships to explain an intended outcome' (Cramer-Peterson et al., 2019, p. 41). Pragmatism agrees with the policy analysis approach in that they both emphasis that how we act and who we are, are inherently part of our politics. The identification of research objectives was the first stage of this research. This includes desk research of the background knowledge of the topic and related theory as well as gaining an understanding of what was required to fulfil the requirements of this study. The second stage was data acquisition, and this required a further review of literature from the chosen case studies as well as in-depth analysis of policies and documentation related to the research objectives. Stage three was data interpretation and analysis. The methods used were best practice and the policy arrangement approach and will be discussed below. Stage four was to create a framework using best practice methodology based on the findings in the analysis.

With the abductive approach used, room is given for new insights to emerge, and the occasional analysis beyond variables in the conceptual model if this information is important for the research findings (Cramer-Peterson et al., 2019). Tunnel vision can be avoided, and in that way, a more wholesome view can be achieved.

5.2. Case selection

An approach that is contextualized such as a case study, allows one to assess the effectiveness of a phenomenon more meaningfully (Poulis et al., 2012). The GCA works on various projects in different countries and Bangladesh was identified as the most vulnerable country to climate change (Ministry of Environment and Forest, 2013). From information received during a team meeting with the GCA, it was important to the organization that a developing country and a developed country be selected for study. Melbourne in Australia was selected as the second case study. The reason for the selection of both was to demonstrate that WSUD principles could be attained even in a country that may not have many resources, although these principles may be applied differently than in a developed country. The policy documents of Bangladesh have shown additions and improvements in water management since the 1980's with IWRM and WSUD being recently incorporated (Gain et al., 2013). The principles of a water sensitive city were described by Wong and Brown (2009) and affected the case studies chosen, both cities had to fit into the three principles of a water sensitive city which are described below. It was also important to select cities that have water policies and governance principles which are water sensitive and accessible for the researcher, as an intensive desk analysis would be the primary method of research. A site visit would have brought more richness to the study but was not possible due to travel costs and time limitations. The three pillars of the water sensitive city served as a means of case identification and are described by Wong and Brown (2009) as:

Cities as water supply catchments

The conditions of water patterns are unpredictable and will become even more unpredictable in the future (GCA, 2022). Temporary, reactive solutions to water problems are no longer sufficient and cities need to break the dependency on favorable soil moisture and regular rainfall patterns for the security of water supply (Wong & Brown, 2009). For a city to be resilient, it needs to have a diverse range of water sources. This can include stormwater, groundwater, and recycled water among others. Building water sources in a diverse way allows the city to withstand environmental risk and have more reliable access to water (Wong & Brown, 2009). Water sources should be optimized dynamically, even on a short-term basis through various water harvesting infrastructures, treatments, and storage, including centralized as well as decentralized ways (Wong & Brown, 2009). Decentralized water sources lower environmental risk and reduce the cost of overall water management in that area, especially when looking at smaller scale communities (Wong & Brown, 2009). Large, government-built infrastructure may take longer to construct and requires increased cost, not always being reliable during a short-term water crisis (Wong & Brown, 2009). Decentralization improves resilience (Wong & Brown, 2009).

Cities providing ecosystem services

With high rates of population growth and the increased effects of climate change, urban areas have various design challenges that they are faced with. Landscapes need to include technologies which are resilient and can face future uncertainties (Wong & Brown, 2009). It is important that spaces in the public domain of urban areas function have an ecological as more than just aesthetic or spatial purposes, they need to have an ecological function, working with the environment to improve sustainability in that urban space. They must serve as positive microclimate influences which are also useful for food production and act as carbon sinks. The rehabilitation of degraded urban water ways is also a big priority of WSUD as this can impact water health and efficiency without having to build completely new infrastructure.

Cities comprising of water sensitive communities

Technology alone will not deliver the desired outcomes of WSUD, these technologies must be socially embedded into the institutional context. This area of technology and policy infusion is still an underdeveloped area of research (Wong & Brown, 2009). It is an expectation that throughout this research process, other factors which have enabled good practice in these cities, which may have not been recognized during case selection will emerge from the data. The possible shortcoming that some factors may be missed during case selection must be acknowledged.

Australia

The concept of WSUD emerged in Australia and there has been a drastic evolution to WSUD philosophy in Australian cities over the last 25 years (Ward et al., 2012) and the concept of the 'water sensitive city' is one of the major goals of the Australian Commonwealth's National Water Initiative (COAG, 2004). WSUD research done in Australia shows that the interplay between various change agents and local actors has played a big role in the success (Wong & Brown, 2009), along with the social rise of environmentalism over the last 20 years. Community acceptance and political support for water sensitivity in Australia were important factors for this transition. Melbourne was selected as a case study because it is identified as a city that leads in WSUD nationally and internationally (Wong & Brown, 2009). 'WSUD is widely recognized across Australia, but the component priorities vary in response to local environments. Planners now look beyond engineering solutions as they progress toward water sensitive cities' (Radcliffe, 2018, p. 38). Melbourne Water outlines methods to apply WSUD for stormwater management as an alternative to the traditional conveyance approach.

Bangladesh

'Globally, Bangladesh is widely regarded as the "Role Model" for disaster and climate risk management' (Ministry of Disaster Management and Relief, 2020, p. 3). Among the developing countries, this country faces multiple challenges in climate change impacts, water demand and supply, flood management as well as managing the natural ecosystems such as fisheries and wetlands. Dhaka is one of the world's most densely populated megacities and this results in a reduced environment for rainwater to permeate the ground (Ahmed et al., 2019). As mentioned above, Bangladesh is one of the most vulnerable countries for floods and the most vulnerable for tropical cyclones, however it also faces droughts in the dry season (Gain et al., 2014; Gain et al., 2015). In the 1960's, one big step towards water management was made in Bangladesh and this was the introduction of the First Master Plan for water management. This plan was aimed as a strategy for massive flood control (Gain et al., 2017). IWRM is reflected well in project documents, policies and legislation in Dhaka (Gain et al., 2017). In 2009, it was calculated that within the 35 years prior, the Bangladesh Government had already invested 10 billion dollars to reduce the country's vulnerability to natural disasters (Ministry of Environment and Forests, 2009). 75% of Dhaka city was put under water by the 1988 flood (Ahmed et al., 2019). With the city of Dhaka being surrounded by a network of rivers, it requires transboundary water governance and has improved these policies over the last 50 years (Gain et al., 2017).

5.3. Data collection and research methods

This study makes use of triangulation as a process of conducting research. Triangulation is the process of using several different methods, data sources and theories for research and this has been asserted in science as a way of increasing reliability and validity in the results and findings of research (Farquhar et al., 2020). Triangulation also provides qualitatively acquired richness which increases the fullness of the study (Farquhar et al., 2020). Van Thiel (2014) mentions that triangulation increases validity of the findings because if the same conclusion can be drawn from different methods of research, the accuracy of the results will increase. This also counteracts the notion that case studies are based on a methodological view that is one-sided (Van Thiel, 2014).

The sources used in this research are primary and secondary, including extensive document analysis and joining a team meeting of the Urban Water Program at the GCA. Casual interviews with these actors took place, informally – to get a well-rounded understanding of water sensitive city governance from the viewpoint of a solutions broker. One formal interview was held with a resilience specialist (Van Thiel, 2014). Interviewing actors who work in different roles of the water sector further improves triangulation. The interviews in this study were not a primary source of answering the research question but were used to support and enhance the results. The open-structured nature of these interviews also made it possible to get more insight and allow the researcher and interviewee to go into various topics that may add unanticipated content (Van Thiel, 2014).

Document studies as desk research

The literature study of this research reviews, books, reports, government documents, websites, scientific articles, and policy documents to gain an understanding of the practices and governance of water sensitive urban design techniques in Melbourne and Dhaka. The commencement of the data collection part of the research was a document analysis of secondary research to gain an understanding of the governance of water in both Bangladesh and Australia. The sources which were used most extensively were policy documents, reports, city plans and general government publications which contained the details of the processes involved and actions which take place in the countries and cities themselves. These sources were found online and were selected according to how they fulfil the requirements of the research questions. Mainly government documents were used, however other sources were included if they contained useful information on how water is governed in that city. See Appendix A for a list of documents used. Once documents were selected, they were studied through the lens of the PAA.

Interviews

Interviews with 6 members who work as part of the Urban Water team of the Global Center on Adaptation were conducted to gain an understanding of the world of water governance from the perspective of an international organization, see Table 2 under observations below. These interviewees were members in the field of urban water management and had an in depth understanding of water management as well as policy and the governance of water in today's context, see Appendix B. Interviews were of an open structure and conducted during a team meeting, except for one which was more formal and conducted separately, via Microsoft Teams. All were recorded only if permission was given. The benefit in using open-structured interviews is that it allows the interviewee to answer questions necessary for the study, but also gives room for additional discussions (Brantlinger et al., 2005).

Appendix C is the meeting outline of the meeting held with the Urban Water team, and Appendix D is the interview guide for the formal interview carried out. This guide was based on the indicators which were presented in the analytical framework. The interviewees were told that they did not have to answer questions if they did not want to. None skipped any questions. They were also told that they would remain anonymous if that was preferred.

Interview with the resilience specialist: A Microsoft Teams meeting was held to interview a resilience specialist. He describes himself as a freelance consultant in international development, with a focus on resilience, urban development, and infrastructure, currently working as Senior Urban Specialist with the Global Center on Adaptation (GCA). An in-depth individual interview was held with him as he specialized in resilience and that role could give great insight into the discourses of resilience management in water. Although this interview was formal, it was still not used as a primary source of answering the research questions because there was only one formal interview conducted.

All interviews, formal and open were used to support and enhance the results. Using interviews as part of formal, primary sources, for a complex case such as devising a generalizable framework would require enough interviews to have a comparison of opinions, which would require more than one interview. A minimum of four interviews would be required, preferably from members of different hierarchical levels and at different organizations (Perry, 1998). As the researcher, it felt best that this research would benefit most from desk research as direct access to the actors involved in water management in Dhaka or Melbourne for formal interviewing was not possible within the geographical and time constraints.

Observations

Through sitting in on a meeting with the team of the Urban Water Program and having an opportunity to ask questions, it is observed how water governance takes place. This step helps to enhance the understanding of water governance from the perspective of a solutions broker, the GCA.

Event	***Date***	***Relevance***	***Observation product***	***Validated***
Meeting among the water and urban team. Participants: senior program officer, chief resilience officer, the lead of locally lead adaptation, lead of water adaptation specialist and the resilience specialist, and results monitoring consultant. Agenda: weekly team meeting for updates and so that discussion could be had with the researcher for this thesis.	25 May 2022	Get an understanding of what projects the organization is involved, how funding is sourced and how drought is managed by the government of Bangladesh. What case studies to select. How to source documents.	Minutes and paraphrased notes	Yes

Table 2: An overview of the observation events

5.4. Data analysis

The careful selection of indicators is a crucial aspect of best practice (Trosa and Williams, 1996) and the quality of performance indicators selected for benchmarking help to develop the criteria on which assessment is based. An important aspect of the PAA theoretical framework is the operationalization of the concepts into measurable indicators (Arts and van Tatenhove, 2004). As a result, the indicators are used to analyze findings which are then compared to the concepts of the theoretical framework.

5.5.1. Research steps

The first step was to conduct a literature review. This allowed the discovery of the appropriate analytical framework for analysis. Two theories were selected and studied in detail, this included best practice research and the PAA. In this research phase, extensive desk research was done on the case studies. This included reading reports, city plans and several policy documents. An analytical framework and conceptual model were devised using the information gathered throughout these phases of research.

The second step was to input the data into Atlas.ti. and code the data into information. This software allows the researcher to track the analytical process and identify patterns (Hwang, 2008). Several indicators are necessary for the complete picture of performance thus one indicator cannot be used to determine performance. Methods of the policy arrangement were used for detailed data analysis, and this includes looking at relationships between actors, resources, rules and of the game and discourses involved in the governance of water in the cities (Arts and van Tatenhove, 2004). The interrelationships were studied through document analysis and coding groups were created. Data from the documents were coded using Atlas.ti (Smit, 2002). The information from interviews was used to guide research steps. This helped in the selection of case studies and highlighted various areas for document analysis. This included capacity building, decentralized methods and the challenges in financing, among others.

Although these interviews did not form part of the formal results, they were helpful in steering this research and assisting in the approach to take when looking at the most important issues of water governance. The steps of the coding process enable the researcher to look at the information in more detail and see which factors affect effective water sensitive urban management practices in cities. Coding processes included converting data to information, sorting, organizing, and monitoring the information, removal of irregular factors, detection of best practices, and identification of processes which can be improved (Trosa and Williams, 1996). As this thesis utilizes a variety of data sources, the quality of each source will be verified in reference, sufficiently cited and described, stored well and have their relevance established.

The final stage was to devise a framework as part of the recommendations and develop conclusions. This was done by drawing deductions from the analyzed data after analyzing it through conceptual framework thereafter identifying what works and what do not in both case studies. Finally, reflections were given and recommendations for future research are suggested.

5.5.2. Validity, reliability, and ethics of research

Internal and external validity

Validity is tested by assessing whether the data that has been analysed effectively answers the research question. One way that this is done is by mapping out the project through the processes of a conceptual model and through the operationalization of theoretical concepts. Applying triangulation allows the cross-checking of data from various sources (Bryman, 2016).

Preliminary results were discussed with those interviewed to see if statements were correctly interpreted, here feedback was considered. The downfall of case study research is mostly acclaimed to the difficulty to ensure external validity (Yin, 2009). This means that it is challenging to generalize the results as institutional contexts may greatly differ. It is difficult, however, to conduct an in-depth analysis or include more case studies as there was limited time for this master's research but, the main goal of this research was to serve as a guideline, with the flexibility of contextual adaptation for users and to serve as a guidance for further research. With that, the interpretation of the results must be used conscientiously.

Reliability

This factor is difficult to measure in qualitative research as it requires personal interpretation from the researcher (Roberts & Priest, 2006). Reliability refers to the degree to which replication can be done for this study (Roberts & Priest, 2006). The phases of the research process have been recorded to increase transparency and thus reliability, and these are accessible for peers (see research steps of records such as the observation notes and coded transcripts from Atlas t.i.). Interview questionnaires, a list of documents used for consultation and a description of interviewees are all included along with the codebook so that the coding process can be followed and conducted by another researcher (Roberts & Priest, 2006).

Research ethics

Governance as a subject involves politically driven institutions and possible public scrutiny thus it was important to let those interviewees know that they will remain anonymous if they wish. Privacy issues like recording and anonymity were spoken through. The interviewees were given information and were informed on the purpose of this research, for the formal interview, a list of interview questions was sent out prior to the interview itself so that they could prepare beforehand if desired. When questions were written, they were deliberately made not to be suggestive in order to avoid steering. Interview transcripts and quotes used within the thesis are anonymized.

6. Results

The findings of the research are presented in this chapter. Important contextual factors and their impact on water management and WSUD governance in the cities of Melbourne and Dhaka are given. By looking through the lenses of the PAA for each of the cases, the first research question answered is 'what is the policy arrangement of water sensitive urban design in this area?'. Through doing this, we also come to identify what barriers and conditions have evolved and existed for the application of WSUD in Melbourne and Dhaka. This answers sub question two and three. This section is based mostly on desk research thus policy documents will be heavily referred to throughout.

6.1. Characteristics of case studies

When analysing the case studies, it is important to acknowledge the differences in demographics, geography, politics, and history as these contextual factors are to be considered when drawing calculated conclusions which are used for the development of a framework, see table 3.

Contextual factor	***Melbourne***	***Dhaka***
Population	5,150,766 (WPR, 2022)	22,478,116 (WPR, 2022)
Population density	9,992.5 people per square kilometer (WPR, 2022)	23,234 people per square kilometer (WPR, 2022)
Population growth rate	1,76% (WPR, 2022)	3.39% (WPR, 2022)
Main resource of GDP	Industry (Statista, 2022)	Agriculture
Risk of flooding (by country)	High Floods occurred in: 1956, 1983, 1990,1998 2007, 2008, 2011, 2012, 2013, 2015, 2016, 2017, 2019, 2020, 2021, 2022 (Australian Geographic, 2022)	High Floods occurred in: 1954, 1955, 1962, 1966, 1970, 1974, 1987, 1988, 1998, 2004, 2009 (World Bank, 2015).
Main water supply	Dams and rivers (Choi and McIlrath, 2017)	Groundwater (Iftekhar & Islam, 2022)

Table 3: Contextual factors of case studies

6.2. Case study 1: Melbourne

6.2.1. Policy Arrangement of Melbourne

Actors

Actor constellations

The key actor in Australia's water management has been the state, as water is constitutionally a state responsibility (Choi and McIlrath, 2017). The various territories do not have the legislation to self-create laws, but instead these laws are created by the federal government. However, in the smaller branch of WSUD, there is a more localized style of governance (Choi and McIlrath, 2017).

The infrastructure of Melbourne's water system is managed by many stakeholders who work both independently and together to manage the system and policy direction (City of Melbourne, 2014). The National Water Commission is the independent expert panel for knowledge and research for water, while Melbourne Water is the authority that is responsible for the management of the major drainage systems (Choi and McIlrath, 2017). The National Water Commission carried out a great deal of progress in Australia's WSUD but was abolished in 2014 on the account that they had made substantial progress in Water Reform, thus there was no longer a need to have a stand-alone agency to manage Australia's water reform (Choi and McIlrath, 2017). Infrastructure Australia provides advice and advocates for reforms to improve the financing, delivery and operation of water related infrastructure (Frontier Economics, 2017). The city of Melbourne works together with various stake holders and partners in the private sector, to achieve certain goals for the improvement of water sensitivity and management, see table 4 below for the main organizations responsible for water management. IWRM has dedicated plans and one of the main ones are the Municipal Integrated Water Management Plan July 2017 (City of Melbourne, 2017).

The research, planning and application of WSUD has also involved various stakeholders, members of the public, universities, and the private sector over time (Radcliffe, 2018) and since 2014, there has been a shift from centralized management to local management for WSUD. WSUD policies are carried out by the local governments, despite much of the legislation being created by the state. Total Watermark is a strategy designed for the achievement of WSUD in Melbourne (City of Melbourne, 2014) and was designed through a process of collaboration from partners and organizations in the water sector, property developers, universities, research bodies and members of the community. Over 15 organisations were consulted on water challenges, and aimed to find solutions (City of Melbourne, 2014). This collaboration has been a facilitator of WSUD in the city but has had its challenges. Throughout the years, there has been a blurring of division of responsibilities in water management as transitions have taken place (Choi and McIlrath, 2017).

To achieve clarity in responsibilities, it needs to be made clearer, who is responsible for which aspects of WSUD. The challenge with the status quo is that despite the collaboration on paper, there is limited interaction between various actors and sectors, making it difficult to coordinate and divide responsibilities (Choi and McIlrath, 2017).

Interaction patterns

Interactions have developed among the various state and territory governments as they have made the joint decision to improve water management in Australia and in their individual territories, such as Melbourne (Choi and McIlrath, 2017). The achievements that have been made as well as ongoing assessments on what needs to be improved, have been conducted through reports such as the Australian Environmental Water Management: 2014 Review (National Water Commission, 2014) by independent expert panels who have experience in water policy and planning. Through assessing various documents in Melbourne's water management, the concept of Integrated Water Management comes as a recurring topic and one way that this is achieved is through collaborations from many sectors, community, and government. For the 2017 Municipal Integrated Water Management Plan, the main organizations responsible for these roles are listed in table 4 below along with other organisations involved in water management.

This integration has improved the interaction patterns but the need to collaborate has brought up some confusion as to who has responsibility for what (Choi and McIlrath, 2017). This unclear actor constellation has been caused by a lack of state policy framework for WSUD and has caused vague and unclear interaction patterns.

Another barrier to WSUD is that there is a lack of sharing of responsibilities among the different organisations, and this results in uncoordinated patterns of interaction. The local government lacks direction from the state (Choi and McIlrath, 2017) and this lack of leadership may affect the overall coordination process negatively. Appropriate steering is necessary to facilitate WSUD. The application of WSUD being reliant on the development of local planning responses but having to be within limits of the state regulations, causes a lack of clarity in the actor constellations, especially worsened by limited communication.

Organization	**Role in achieving Integrated Water Management**	**Actor**
Victorian Planning Authority	Precinct Planning for Arden-Macualay	State Government
City of Melbourne	Carries out WSUD at a local scale	Local government
National Water Commission (2004 – 2014)	Implementation of National Water Reform	State government
Resilient Melbourne	Integrated Water Management Framework	Local government
CRC Water Sensitive Cities	Latest Research on Water Sensitive Cities	Market and state, with public participation
DELWP (Department of Energy, Environment and Climate Action)	Water for Victoria/Integrated Water Management Forums Action Plans case by case Climate Change Adaptation Plan Taskforce for Fishermans Bend	State government
Melbourne Water	Flood Strategy Healthy Waterways Strategy Moonee Ponds Creek collaboration	Local government
City West Water/Southeast Water	Water retailers Integrated Water Management Plans Precinct based projects	Local government

Table 4: Main organisations involved in Melbourne's Water Management

Coalitions and oppositions

Total Watermark is a strategy (City of Melbourne, 2014) which has had a positive impact in the uptake of WSUD in Melbourne and was designed through collaboration with a range of partners and organizations in the water sector, this includes regulators, property developers, water authorities, universities, research bodies, international city networks and the community of Victoria. Throughout the conception of the strategy, over 15 organizations were consulted on what water challenges they identified, and they were consulted further on the actions needed to improve on the solutions (City of Melbourne, 2014). Community members were able to view a draft of the document and a 6-week community consultation opportunity was given for feedback on the draft.

Various strategies and plans have been products of collaborative processes. For example, the Urban Forest Strategy 2012 – 2032 was developed over a two-year period, with several stakeholders including international and local academics, the broader Melbourne community as well as various interest groups (City of Melbourne, 2014). However, when assessing the wider legislation, it does not clearly show that the WSUD elements are included in every policy. Cooperation is an important aspect of policy coordination (Stead & Meijers, 2009) thus, must exist if WSUD governance is to be achieved.

There is still some fragmentation in the different sectors, for example, the water sector and the engineering sector are managed separately (City of Melbourne, 2014). Although coalitions exist at various scales there are barriers which interfere with this. One of those are the limited interactions. For WSUD to thrive, it is important to have coalitions through collaborations between the various interest groups and industries, including members of society, the state, and the private sector (Stead and Meijers, 2009). The conditions and barriers to each dimension are mentioned at the end of the dimension analysis in table 5.

Resources/Power

Knowledge capacity and development

For knowledge generation at state level, the National Water Commission is the independent expert panel for knowledge and research for water (Choi and McIlrath, 2017) while Cooperative Research Centers (CRCs) have been developed by the Commonwealth government together with universities, industry, and members of state governments for knowledge generation at a smaller scale (Radcliffe, 2018). Here it is a requirement that training opportunities are given at various degrees. More than five CRC's have water as a focus of research.

In Melbourne, Radcliffe (2018) mentions that WSUD is now recognized as an alternative to the traditional conveyance approach to stormwater management, and how to apply it has been comprehensively outlined by Melbourne Water (2016). One notices that knowledge capacity and development is sufficient in Melbourne. Here, no barriers were identified. The conditions that could result in more knowledge creation and exchange are further research development by various organizations. Collaboration in this remains important. The parties of the COAG who signed the Intergovernmental Agreement on a National Water Initiative agreed on two main points regarding innovation and the future of water management in Australia: (1) to develop environmental guidelines for water sensitive urban designs and (2) to look at best practice scenarios for water sensitive urban developments for the purpose of identifying knowledge gaps and lessons for future developments (Choi and Mcllrath, 2017). This is an example of some of the ways identified that the parties took to create innovation and build capacity for the creation of Water Sensitive Australian Cities. A major goal was to 'review the institutional and regulatory models for achieving integrated urban water cycle planning and management, followed by preparation of best practice guidelines'. (Choi and Mcllrath, 2017, p. 115). The National Water Commission (2014) have included information sharing between jurisdictions as a goal to produce various project reports.

Financial capacity

In 2016, the stormwater offset service operated by Melbourne Water had a financial contribution of AUD $6,645 per kilogram of annual total nitrogen loan (Radcliffe, 2018). This contribution was done by residential developers and was for the purpose of undertaking stormwater management works in a different location, outside the development. Melbourne Water Offsets Scheme allows for some developers to pay money rather than providing the physical works to achieve good practice standards on their private land. The council determines who is eligible and variable rates apply based on calculations by Melbourne Water. Essentially, this scheme allows for developers to pay money as a substitute to delivering water quality treatment within that subdivision. In the Victoria area, councils need to rely on general rates and grant funding to cover any cost of WSUD in the public realm not covered under the developer contributions (Choi & McIlrath, 2017). There are independent economic regulators who determine the price of water that is charged by water businesses. They have an independent price-setting process where a binding price is determined (Frontier Economics, 2017).

In Melbourne, the delivery and funding of WSUD projects is dispersed across developers, water utilities and the local government (Fogarty & van Bueren, 2020). There is an issue around the uncertainty around public funding because in some instances, governments may agree to compensate water utilities if there is a legislative obligation for service to the broader community. However, there is often some uncertainty regarding what is eligible for public funding as well as the duration of that funding (Fogarty & van Bueren, 2020). Economic regulators in Melbourne have the responsibility of ensuring that the capital put forward for cost recovery through pricing, are efficient. Financial security could be improved by encouraging investments. This can be done through developing knowledge and budget research and strengthening policies thus creating good business models and incentives for the market and people to invest.

Technological capacity

No lack in technological spend or access was identified in Melbourne. Knowledge sharing and best practice studies are important as ways to address climate change issues, as mentioned by Choi and Mcllrath (2017). On the City of Melbourne website (City of Melbourne, 2022)., you can find dedicated initiatives for WSUD. One can also learn about various ongoing greening projects or urban water projects – interactive maps are included. The current categories for the projects are raingardens, wetlands, water capture and reuse, permeability and infiltration and recycled water. When clicking on permeability and infiltration for example, it shows the location of permeable pavement project. Project details such as the benefits to the environment, completion date, size and cost of the project are included. There is also information on how members of the community can contribute to achieving WSUD in the city, through information on water saving and reuse. This website as a technical tool can improve transparency and education on WSUD in the city.

Rules of the game

Legislation

There is a richness in binding laws related to water management in Melbourne. One of these are the Intergovernmental Agreement on a National Water Initiative (NWI) which states that 'the objective of the Parties in implementing this agreement is to provide greater certainty for the investment and the environment and underpin the capacity of Australia's water management regimes to deal with change responsively and fairly' (COAG, 2014, p. 1). All states and territory governments in Australia, including Melbourne are signatories to the NWI (COAG, 2004) and this is the blueprint document for water management in the country. The commitments made in this initiative are to provide healthy and reliable water supplies, encourage innovation in water sourcing, discharge, and storage, encourage recycling and reuse, increase water use efficiency (domestically and commercially). All parties have agreed to have independent bodies to set and review pricing for water storage and delivery. Melbourne has made progress to this goal (Fogarty & Bueren, 2020).

Other Agreements such as the Urban Water Reform signed by members of the COAG, accommodates WSUD in the following areas: to provide safe, healthy, and reliable water supplies, increase the efficiency of water and water use, achieve improved water pricing, facilitate water trading within the urban rural sectors and encourage innovation in water supply sourcing, treatment, storage and discharge (Choi & McIlrath, 2017). The actions taken to achieve these goals are described in various legislation such as the Water Efficiency Labelling Scheme (WELS). Having formal agreements is a condition for WSUD. However, there is no consistent national policy framework that applies to WSUD (Choi and McIlrath, 2017). The local governments in Melbourne have tried to combat this by developing local solutions but as a result, a diverse array of policy obligations was created. This causes a lack of clarity and reduced coordination from municipality to municipality. This diverse array of policies at different scales can be seen as a barrier to coordination as planners find that it makes it difficult to navigate the WSUD framework (Choi & McIlrath, 2017). Clear performance-based standards are yet to be developed.

From 2012 to 2014, there was an office established for Melbourne, with the goal to integrate the water system into the wider network of planning in the city and by that, moving from centralized management to a more integrated style of managing the water cycle in Melbourne (Radcliffe, 2018). This did not last long, and a change of government meant that a state-wide water commodity approach was taken on. This was entitled 'Integrated Catchment Management' and included biodiversity, climate change and catchment management. With this, councils have extended the principles of the Victorian Planning Provisions (Clause 56.07-4) and implemented their own local policies for WSUD as they were not addressed specifically at state level. These plans are led by regional water corporations who collaborate with the local community, other partners, and the local government. This change in government meant that the procedures also evolved from a centralised style of management, to a more localized one. Fragmentation grew as a barrier as there was no clear statewide policy for WSUD (Choi & McIlrath, 2017).

Procedures

In terms of the procedures related to Melbourne, each jurisdiction's planning system in Australia has evolved independently and thus all states individually adopt different approaches, however they share some common elements which include planning and implementing legislation which establishes authorities and statutory instruments (Choi & McIlrath, 2017). Public consultation and participation are also enabled through this legislation (Choi & McIlrath, 2017).

Although WSUD has become a big part of Australian water governance, there is still a fragmentation along various agreements and policies (Choi & McIlrath, 2017). There have been very few joint policy documents which clearly discuss WSUD as such or at least incorporate the urban planning aspect into water management. Between December 2015 and May 2016, consultations were done in Melbourne across several jurisdictions to obtain feedback on the water reform. There was participation from a range of professionals in the urban sector to ensure input from a cross sectoral perspective which included planners in councils, urban water management professionals in councils, civil engineers, urban and water policy advisors in state agencies, industry partners and water authorities (Choi & McIlrath, 2017). Their feedback was mainly targeted at a lack of state-wide policy on WSUD as the lack of direction and clarity impeded on the city's advancement. While some believed that smaller scale jurisdictional legislation is beneficial, most believed that a statewide legislation and targets would improve control and implementation. This barrier on practical guidance on a statewide level reduces the potential for coordination.

The progress of governments in achieving the commitments in the National Water Initiative was reviewed by the Productivity Commission in 2017 and concluded that good progress has been made in Melbourne, for the delivery of these commitments (COAG, 2004). The National Urban Water Planning Principles are also reviewed, with those that are useful being incorporated into future and areas of improvement were also identified. 'In all jurisdictions, there is a need to harmonize, consolidate, review, streamline, and simplify WSUD guidance so that planners and developers can easily apply it' (Choi and Mcllrath, 2017, p. 4). Monitoring is a condition for WSUD.

Political culture

As mentioned above, there is a correlation between the formal and informal procedures in Melbourne in that, similarly to the formal legislation, many households have adopted the principles of WSUD into their daily routines (Choi & McIlrath, 2017). Knowledge sharing and technology can improve political culture by informing the community on what they can do at the household scale. The National Urban Water Planning Principles are also reviewed, with those that are useful being incorporated into future plans and areas of improvement were also identified. The application requirements for WSUD were introduced in the Melbourne Planning Scheme Clauses as an aim to improve water management in urban planning (City of Melbourne, 2017). The Intergovernmental Agreement on a National Water Initiative (Australian Government, 2004) states that governments have a responsibility to make sure that water is used to achieve outcomes which are economically and socially beneficial, and in a manner that is environmentally friendly. WSUD has become mandatory in several architecture schemes of Australia in the present, however regarding urban developments, there are no mandatory requirements for developers, and this can be seen as a barrier (Sharma et al., 2016).

Discourses

Problem definitions and belief systems

The problem definitions between the various actors seem to be at consensus, in that addressing and implementing WSUD is a priority across the board in Melbourne. The millennial drought of 2000-2011 is one of the major encouragers of water reform in Australia hastened processes to the development of national guidelines and principles by the states, through the council of Australian Governments (COAG's). General guidelines for water quality, pollution, ground water and water recycling are stated in the National Water Quality Management Strategy (NWQMS). More specifically for WSUD, the National Water Initiative (NWI 2004) was committed to by all territory governments, and this stated guidelines for WSUD with the goal of integrating components of the water cycle into urban water management (Radcliffe, 2018). The problem definitions are also alike. The localised adoption of WSUD solutions means that there is more liberty, as smaller governments are able to adapt the methods of reaching goals in their own ways. The localization allows in freedom, reducing the need for extensive collaboration with other governments. This can be viewed as a condition for WSUD governance although, statewide policy can still assist in this. This will be elaborated upon in the discussion chapter.

There are goals set out clearly in various municipal plans, which have been agreed upon by various governments however, the challenge of this is that WSUD elements require multi-functionality which has resulted in competing objectives and thus lagging in action. Multifunctionality is difficult to achieve as various objectives need to be weighed and prioritized. This is the nature of environmental problems and less of an issue of the local governments themselves. This requirement to fulfil multi-functionality in solutions is difficult and must be seen as a barrier.

Regarding public funding for WSUD in Melbourne, there is a clash in belief systems around what constitutes as 'service to the broader community' when granting or denying public funding for certain water utilities (Choi & McIlrath, 2017). There is often uncertainty about that definition as well as the duration of the funding, this causes clashes in definitions and thus reduces action (Stead & Meijers, 2009). This can be seen as a barrier.

Objectives

In Melbourne, objectives are nationally determined, and local governments have the freedom to regulate procedures themselves. As mentioned above, some feel that smaller scale jurisdictional legislation is beneficial, most believe that a statewide legislation and targets would improve control and implementation (Choi & McIlrath, 2017). This will be discussed in chapter 7. The conditions that could facilitate future shared objectives are collaboration with the local community, the state and the market.

Approaches to problem

Approaches to various water problems in Australia have evolved over time and through experimentation (Choi & McIlrath, 2017). Environmental problems are complex and require some level of risk to solve. The lack of steering by the government has been viewed by some as a barrier to coordination, however, this has forced local governments to set up their own direction and look into various approaches. There is a method of problem analysis on a case-by-case basis in Australia and then creating solutions which are practical for the individual case. The Australia environmental water management review 2014 (National Water Commission, 2014) is an assessment of the environmental water management practices in each of the jurisdictions against the framework criteria that have been created. The report recognized that the jurisdictions were at different stages in their development cycles and have differing experiences and needs thus it assessed them on a case-by-case basis and a roadmap for improvement was created for each jurisdiction. The way that policies of WSUD are adopted and implemented varies among the development industry and across jurisdictions, this makes for patchy policy adoption.

The conditions and barriers to WSUD in Melbourne, are summarised in the PAA dimensions below

Dimension	*Indicator*	*Conditions*	*Barriers*
Actors	Actor constellations	Clear division of responsibility	Blurred division of responsibility Vague patterns of interaction
	Interaction patterns	Coordination	Lack of coordination Low levels of autonomy
	Coalitions and oppositions	Can be strengthened by collaboration	Similar to barriers in interaction patterns
Resources/power	Knowledge capacity and development	Collaboration Continued research and knowledge creation innovation	None
	Financial capacity	Water quality offset schemes Dispersed funding responsibility Economic regulators Encouraging investment	Lack of clarity in regulation definitions
	Technological capacity	Research and innovation Best practice studies	None
Rules of the game	Legislation	Acts and legally binding agreements Formal institutional agreements	Lack of statewide policy
	Procedures	Coordination essential Need to simplify procedures	Similar to barriers in legislation Fragmentation due to changing procedures
	Political culture	Correlation between formal and informal procedures Creation of unity through information sharing	No mandatory inclusion of WSUD in urban developments Political fragmentation
Discourses	Problem definitions and belief systems	Same problem definitions among actors Localised policies	Competing functions and objectives Clashes in definitions for funding
	Objectives	Nationally determined objectives	Localised objectives leading to reduced implementation
	Approaches to problem	Creativity and experimentation in approaches	Lack of governmental steering Patchy policy adoption

Table 5: The conditions and barriers to WSUD in Melbourne

6.2.2. Case study summary

The discourses of WSUD in Melbourne are well developed with problem definitions and principles generally aligning with the goals of WSUD among the various actors. The barriers here are caused by some clashes in problem definitions among various actors. The change from central to local governance of WSUD has been successful at large but has in some instances, created a blurred division of responsibilities among state and local actors. Furthermore, in the case of Melbourne, the publication of documents at state levels and then at local levels has resulted in a diverse array of policies, which have made it difficult for planners to navigate the WSUD framework (Choi & McIlrath, 2017). This is worsened by the absence of a hierarchical statutory policy framework. Policies at state level are necessary for coherence and to enable the planners to have guidelines, hierarchically. State policies will also support mainstreaming of WSUD and remove the notion that it is unconventional. Thus, a major clash in WSUD management comes in the form of the question: should there be a mandatory framework for every state or should it be maintained that each of the jurisdictions maintain their individual framework and management of this sector. Both sides of this coin have their challenges as statewide targets may not be appropriate for every context, thus many be difficult to enforce (Choi & McIlrath, 2017). This will be further discussed in the discussion sections below.

Collaborations and coalitions in drawing up strategies have improved greatly over time as members of the state and local government bring in market actors and local communities to participate – the Total Watermark Strategy is an example of this collaboration. Resources such as technology are sufficient and have been a condition for WSUD in Melbourne, however the subject of water offset schemes is one that comes with its own challenges, which will be discussed in the coming sections. There are also unclear definitions around what projects must be funded by the state and for how long, this lack of clear definitions for eligibility must be seen as a barrier. At large, legislation is well developed, and this has been a condition for WSUD, but procedures have been disturbed in instances, by the fragmentation that exists along various policies and agreements, with WSUD not always being included in urban planning or not being applied effectively.

Looking at the way that WSUD is handled in Melbourne, it appears that the frameworks which are outlined and created for water quality regulation and improved water sensitivity are strong and well developed, the successful implementation of these plans and policies are, however jeopardized by the insufficient and inconsistent approaches to the implementation (National Water Commission, 2014). 'In all jurisdictions, infrastructure planning by water agencies and councils is often not well aligned to facilitate the provision of WSUD infrastructure in the public realm' (Choi and Mcllrath, 2017, p. 13). Another barrier to effectively achieving water-sensitive cities is the absence of adequate frameworks for measuring and valuing the full benefits and costs of water-related measures designed to improve livability (City of Melbourne, 2014).

Melbourne's water system is complex, involving several authorities and government bodies with responsibilities that overlap in some areas (City of Melbourne,2014), and this overlapping can cause some tension and lack of effectiveness. Capacity building through the involvement of the community can be implemented further to encourage the uptake WSUD at household/community level. The application of the National Water Initiative as the main frame of legislation in water management in Australia has enabled different states to be held to the same standard but has allowed flexibility regarding how these obligations will be reached, through having separate jurisdictional targets and practices which are drawn up and managed at a smaller scale.

The research carried out by CRC is a form of progress monitoring and looks at the best practices from international cases as well as past experiences of Melbourne, and this has improved planning and policy making in this city. A unique aspect of WSUD management in Melbourne is the role of economic regulators. Here, economic regulators have a direct bearing on the uptake of WSUD they influence the funding of WSUD projects. They thoroughly examine proposed expenditures to ensure that monopoly's do not abuse their power. In these evaluations, non-market valuation is considered (Fogarty & Bueren, 2020), which is important in WSUD projects because of the 'public good' nature of many of the benefits generated. This has improved regulation over time.

6.3. Case study 2: Dhaka

6.3.1. Policy Arrangement of Dhaka

Actors

Actor constellations

The actor constellations of water governance in the country were linear and simple until the period of the merger with Pakistan (Yasmin et al., 2018). During this period (1948 – 1971) the focus of water governance was to align with political visions that would secure agricultural production. With that, the priority was not water supply and sanitation, but to source and use cheaper technology for more irrigation activities. After this period, it grew in complexity as general water supply and sanitation were also prioritised (Yasmin et al., 2018). This change resulted in an increased diversity of actors and a higher density and more complexity within the actor constellations. With this, there was an evolution from having the government as the sole service provider and having the public as a consumer, to a system where other actors like NGO's and civil society were involved in water provision and consumption.

After Bangladesh became independent from colonial rule in 1948, the government sought international support (Yasmin et al., 2018). Organizations such as the World Bank and UN stepped in to help move away from the short term and impromptu solutions that were used for water management (Salinas Rodriguez et al., 2014). Long term planning as a tool was introduced by the UN technical assistance team. By 1964, a 20-year plan was drawn up for Water Resource Management with several organizations set up to achieve this goal (Yasmin et al., 2018). The international support has grown as donors respond positively to the forward-thinking development policies in the country, especially the BCSSAP (Bangladesh Climate Change Strategy and Action Plan). Dhaka also receives major loans from organizations such as the Asian Development Bank (Yasmin et al., 2018). The involvement of these external agencies has been a condition for WSUD as they have provided knowledge and resources.

Dhaka Water Supply and Sewerage Authority (DWASA) has been an example of a commercially viable service utility in Dhaka, and this can be seen in several projects that they led (Sharma & Alipalo, 2017). They introduced closed hydrological systems in the city which resulted more manageable, serviceable zones. Through this, networks and connections have been rehabilitated and these can detect leaks and deliver water all over the city.

The Asian Development Bank financed Dhaka Water Supply Sector Development Program and this provided technology and management approaches which improved water management in the city, including in slum areas. Water Resources Planning Organization (WARPO) is the leading organization responsible for water management implementation in the country, and a major achievement of WARPO has been the preparation of National Water Management Plan in 2004, which reflects a shift from agricultural focus of water management to its more holistic purpose that exists today (Ministry of Environment and Forest, 2009). The National Water Resources Council is the highest national body for the formulation of water policy and in this, they are responsible for facilitating coordination among different water sectors while the Ministry of Environment and Forest has the main responsibility to carry out adaptation activities (Ministry of Environment and Forest, 2009).

The city is administered by an agency called the Dhaka Municipality, and in 2011 Dhaka was divided into North and South City Corporations which are individually responsible for the provision of urban services, including water (Iftekhar & Islam, 2022). A unique organization in Dhaka's water management is the Dhaka Water Supply and Sewerage Authority (DWASA) which is an autonomous commercial origination that provides services for drainage facilities (Iftekhar & Islam, 2022). There are separate state boards which cover the three cantonment areas of the city, and these have limited coordination with the North and South City Corporations. The broadened responsibility of carrying out various projects has also caused overlap in priorities and as a result, a lack of clarity and responsibilities (Iftekhar & Islam, 2022). An example of this is that Rajdhani Unnayan Kartripakha (RAJUK) has the important role of planning and regulating development in Dhaka but has been known to be unproductive as an agency as they have multiple roles and interests which at times have conflicted with interests of WSUD (Iftekhar & Islam, 2022). This clash of interests is a barrier.

Community-Based Organizations (CBOs) in Dhaka are a very active and vibrant group when it comes to water issues and climate (Iftekhar & Islam, 2022). Some of these are the Poribesh Rokkha Shopoth (PROSH) which campaign for the protection of Dhaka's green spaces, water bodies and air. Bangladesh Nodi Bachao Andolon (Save Bangladesh Rivers Movement), and Bangladesh Paribesh Bachao Andolon (Save Bangladesh Environment Movement). 'It can be safely assumed that Bangladesh has conscious community groups that understand the long-term benefits of implementing WSC concepts and could play a significant role in achieving this goal' (Iftekhar & Islam, 2022, p. 8).

Interaction patterns

Due to the unclear distribution of responsibilities, the interaction patterns of Dhaka WSUD management are at large, vague, and uncoordinated. Like Australia, there has been a lack of steering by the state government, and this has led NGOs to take responsibility and tack water management themselves (Iftekhar & Islam, 2022). This lack of steering could be identified as a barrier, although this has resulted in some innovation and community responsibility (Iftekhar & Islam, 2022). Many of the roles and responsibilities that are formally known as that of the state, have been taken over by NGOs (Iftekhar & Islam, 2022). Due to the separation of management by geography into North and South City Corporations, there are often differences in actor constellations (Iftekhar & Islam, 2022), causing reduced coordination and unclear patterns of interaction. This reduces coordination and is a barrier to WSUD. Various agencies in Dhaka are responsible for the maintenance of open spaces and augmenting city open space (Ministry of Housing and Public Works, 2015). However, because of difficulty in classification of open spaces, thus uncertainty on which agencies are responsible, there are weakened processes of planning. There is a similar problem for water bodies. Classification needs to be established so that roles and responsibilities can be improved and thus improved patterns of interaction.

The below table 9 is a summary of the main organizations involved in water management in the city of Dhaka.

Organisation	*Role in Water Management*	*Actor*
Ministry of Water Resources	Executive body for water management	National government
Water Resources Planning Organisation (WARPO)	Lead organization for water management in Dhaka	Local government
National Water Resources Council	Highest national body for water policy	National government
Ministry of Environment and Forest	Adaptation	National government
Dhaka Water Supply and Sewage Authority (DWASA)	Commercial organization providing drainage services	Market
Dhaka Municipality	Provision of urban services in Dhaka	Local government
WASH Alliance	Group of various NGOs involved in integrated water management and WSUD in Dhaka	NGO
Department of Environment	Protection of river water quality	National government
Poribesh Rokkha Shopoth (PROSH)	Campaign for the protection of Dhaka's green spaces, water bodies and air quality	Community based organisation
Institute of Water and Flood Management	Pursues research and capacity development in the field of water and flood management	NGO

Table 6: Main organizations involved in Dhaka's Water Management.

Coalitions and oppositions

There are over 39 organizations who are responsible for water resource management in Bangladesh (Iftekhar & Islam, 2022). Similar to Melbourne, this has often resulted in a lack of clarification in regard to division of responsibility as well as clashes in responsibility and WSUD prioritization as mentioned above. This can be improved by coordination and a clearer division of responsibility. The inclusion of public and private organisations in working on the same projects, can also improve coalitions, one of the ways to do this is for the government to work together with the NGOs to develop better coalitions. There has been cooperation and coalitions forming among different actors in improving WSUD. An example is that of several DWASA projects. For programs like those carried out by DWASA, reform had to be made in policy thus water management had to be decentralized and the local government had to approve of certain plans and allow for an independent regulator to be assigned (Sharma & Alipalo, 2017).

See table 7 at the end of this section for a summary of the conditions and barriers to WSUD in Dhaka, through the elements of the PAA.

Resources/Power

Knowledge capacity and development

Knowledge generation around WSUD is growing in capacity. The Institute of Water and Flood Management conducts research on a large scale and reviews on policies are also conducted so that adjustments can be made from what failed in the past (Ministry of Planning, 2012). There is also an agency called the Climate Public Expenditure and Institutional Review which reviews the financial management of the agencies involved in the activities of Climate Change in Bangladesh (Ministry of Planning, 2012). In 2012, the Ministry of Planning (2012), calculated that the government typically spends around 7% of its annual combined development and non-development budget on climate change. There are at least 37 ministries that have at least one climate sensitive program (Ministry of Planning, 2012). Collaboration and knowledge sharing has been a condition to knowledge development (Stead & Meijers, 2009). The Institute of Flood Management is an institute of the Bangladesh University of Engineering and Technology and is vital for research development in the water sector, especially the management of floods (Gain et al., 2017). They are not only dedicated to engineering solutions, but also in the promotion of WSUD and flood management.

Financial capacity

As mentioned previously, the largest funder of water matters has been the state. In Dhaka, the investment of the private sector is very limited and water resources investment and infrastructure has been mostly made by the government (Iftekhar & Islam, 2022). However, Iftekhar & Islam (2022) have predicted that an effort towards the attraction of private sector investment will be necessary to develop WSUD goals as the condition of Bangladesh's economy will not be able to fund WSUD projects sufficiently. A study by the Government of Bangladesh (GoB, 2017) have estimated that investments to fulfil the Vision 2041 financing needs for Managing the Urban Transition, cannot be met solely by tax mobilization. Multilateral donors that have been involved in investing in sustainable water management in Dhaka, such as the Asian Development Bank, the International Finance Center and the World Bank (Ministry of Finance, 2017) for many years. This developing international involvement also got some European donors involved and interested. There is a large dependency on donors and investors for WSUD in Dhaka (Gain et al., 2017).

Technological capacity

NGOs have occupied the local-scale innovation space by bringing awareness, providing service as well as developing and introducing technologies, still the coverage remains low as the modern water system is new and still evolving (Ministry of Planning, 2012).

Dhaka has relied on technology from NGO's, international organizations and aid from more developed countries. Prime Minister Sheikh Hasina mentioned in the foreword of the 2009 Climate Change Strategy and Action Plan that '*both adaptation and mitigation, however, will need very substantial funds and transfer of technology which must be the firm political commitment of the developed world and those large developing countries who are in a position to help us'* (Ministry of Environment and Forests, 2009, p. xi). Collaboration has aided in technological capacity as the government gave DWASA, the legal right to connect various areas in water supply in Dhaka and approved several other projects such as the Environmentally Sustainable Water Supply Project 2013 (Ministry of Housing and Public Works, 2015).

Rules of the game

Legislation

Gain et al. (2017) has mentioned that the institutional transition that has occurred in Bangladesh towards more integrated water management has been encouraged by several challenges like climate change induced extreme events, environmental degradation and poverty. International agencies and donors have also played an important role. The government of Bangladesh has made their intentions clear in that they are fully committed to tackling climate change and improve on sustainability, specifically in the subject of water management. This is reflected by the efforts to attend and participate in international conferences such as the UN Framework Convention on Climate Change (UNFCCC) in 2007, COP14 in 2009 and more. 'Adaptation is the priority for Bangladesh in the short to medium term. The country is already a world leader in the research, design and implementation of adaptation strategies' (Ministry of Environment and Forests, 2009, p. 3). Laws and policies are a condition for WSUD governance. The National Water Policy of 1999 is seen as a major milestone to IWRM institutionalization in the country as it was the first to define roles for the private sector, government, and civil society (Gain et al., 2017).

Various plans are written specifically to combat the effects of climate change impact. One of these are the National Adaptation Program of Action (NAPA) which was launched in 2005 and focusses on adaptation, including IWRM and WSUD (Ministry of Environment and Forests, 2009). Another such document is the Bangladesh Climate Change Strategy and Action Plan 2009 (Ministry of Environment and Forests, 2009). Outlined in this document are the implications and likely impacts of climate change, thereafter, is a section on the adaptation strategies discussed. The last section provides a detailed 10-year program to build resilience in the country over 20-25 years. Bangladesh Delta Plan 2100 (BDP2100) is the plan which integrates water management with other disciplines like agriculture, biodiversity and environmental management (General Economics Division, 2018). Dhaka has worked its way up and is on the journey to decentralized management (Bangladesh Planning Commission, 2020) and the involvement of multiple sectors and ministries has improved coordination and this is a condition to WSUD.

The Dhaka Structure Plan 2016-2035 has been a Plan Prepared under the Regional Development Planning Project funded by the Asian Development Bank is a project that is supported by consultants of a national and international scale and one of the main purposes was building resilience to climate change (Ministry of Housing and Public Works, 2015).

The main action targets of the National Water Management Plan which were set in 2013, were the decentralization of the administrative system and an increase in funding for allocated governments (Yasmin et al., 2018). Despite changes in policy, these failed to translate on ground. Some attain this failure to the complexity of actor networks which were not considered during planning. Complex policy networks led to inaction as there was reduced coordination. Due to this, organizational responsibilities were not clearly defined and there was insufficient funding. This was a barrier to WSUD. NGOs decided to self-manage this matter and introduced plans such as the Community-Led Sanitation movement. By 2009, NGOs were providing 50% of all sanitation services in the country and this resulted in them becoming powerful lobbyists who could influence government. Still with many shortcomings in other aspects of water management, more policies framed around adaptation and IWRM were created (Yasmin et al., 2018).

The agencies mentioned above are guided by various policies and acts such as the Bangladesh Water Act (2013) and the Bangladesh Environment Conservation Act (1995) among others. Several short-term plans have been put together and are relevant until the years 2035 – 2040. The Detailed Area Plan (2016 – 2023) includes the allocation of water retention areas, green spaces and blue spaces to protect, improve, and expand the natural elements in the city.

Procedures

There has been a culture which has developed among most of the institutions to have an interdisciplinary approach to problem solving as well as working together with other departments to find solutions rather than working in isolation (Yasmin et al., 2018). Coordination among different sectors has improved on paper but is lacking in practice. The government has most of the control, but they are also limited by funding, which they may also outsource from international agencies. As described above, NGOs have taken on managerial roles in WSUD due to lack of action by the government.

The locals were also excluded from processes of decision making at first and mentioned that there was a lack of accountability and transparency by the government (Yasmin et al., 2018). This has improved over the years and now public participation is a central part of Bangladesh's policy making process and always takes priority. An example of this is the drafting process of the 2021 – 2025 National Plan for Disaster Management (Ministry of Disaster Management and Relief, 2020). A national workshop was held at the very beginning of the process where members from different ministries, NGOs, research institutions and people of the private sector were informed about the preparation of the NPDM, here their insights and suggestions were taken into account. Thereafter, a workshop was conducted to draw up the draft and divide the responsibilities of the thematic sections among the experts so that a plan could be drafted.

One of the major challenges in Dhaka is that the policies and infrastructure are not upheld by maintenance (Iftekhar & Islam, 2022). An example of this is the stormwater management infrastructure. Solid waste gets disposed of in the drains and that causes blockages which are not addressed for longer time periods. Thus, implementation of policies is a barrier for WSUD.

Political culture

Lessons from previous plans are learned and applied to the improvement of newer plans (Iftekhar & Islam, 2022). It is safe to say that the political culture in Dhaka and Bangladesh in general is to tackle climate change with whatever resources that it can, domestic and international (Ministry of Finance, 2017). A condition to improve the conditions for a political culture that facilitates WSUD in Dhaka, is more involvement and participation from the local community. Involving the local community has resulted in smoother implementation and stronger commitment (Sharma & Alipalo, 2017). Because of the limited space in Dhaka, it is important to encourage WSUD in the private sector and developers through sharing information, providing incentives, and engaging the industries. There have been levels of institutional transition towards water management in Dhaka and this can be seen in the mandates of several organisations over time. An example of this is the Ministry of Water Resources which originally had the responsibility for irrigation, water development and flood control and then transitioned to responsibility for all aspects of water management including expansion of irrigated areas, water conservation, surface and groundwater use and river management (Gain et al., 2017).

Discourses

Problem definitions and belief systems

There have been several transformations in much of Dhaka's key water management institutions and problem definitions, and there is a change in discourse towards a focus on integrating water throughout the years (Gain et al., 2017). These clear changes can be seen in the transitions of the mandates of the institutions. An example of this is WARPO which originally had a mandate that focused on agriculture. WARPO now has a holistic focus with a multidisciplinary team of experts (Gain et al., 2017). These sectors coordinate with various ministries which are different to them to facilitate water management that is more integrated (Gain et al., 2017). This brings us to deduce that a mutual definition to the problem has been noted among sectors and they are working on improving on the issues, one of the main issues being fragmentation in application among the various institutions and actors. A condition for cooperation is having the same problem definition (Stead & Meijers, 2009).

Objectives

The objectives of WSUD in Dhaka are not only from top-down level (state to local), but the NGOs and local communities have defined their own objectives and have taken responsibility themselves. This could be said to be influenced by international companies who carry out small- and large-scale community projects in Dhaka. Projects have a higher likelihood of success if they have community support (Iftekhar & Islam, 2022).

The vision for WSUD is reflected by the policies. One of these are the Vision 2041 document which stipulate the goal for achieving an urban environment which balances ecology with the service industry and the natural environment (Iftekhar & Islam, 2022). The Bangladesh Delta Plan 2100 also sets out goals for water management improvement and adaptation strategies. The commitments made to international agreements have the potential to influence the local vision and improve political will on a national scale (Iftekhar & Islam, 2022). Objectives towards WSUD have been driven by the socio-political and physical factors such as events induced by climate change (Gain et al., 2017).

Approaches to problem

The approaches to problems are different between the state and local community. The people of Dhaka have adapted to generations of floods, cyclones and other natural disasters to a point where they have taken adaptation into their own hands (Ministry of Environment and Forests, 2009) and do this is several ways. For example, they have adjusted their patterns of cropping and raise their informal roads and houses on mounds above normal levels of flooding when building. Farmers also grow a range of high yielding crop varieties to adapt to floods or drought patterns.

The Asian Development Bank funded projects which applied a bottom-up approach to IWRM and required participation. Involving locals in projects make the operations more effective and transparent (Gain et al., 2017). This is also good for maintenance and sustainability as it encourages responsibility. Dhaka city itself was particularly hit by severe floods in 1988 and 1998. Over half the city being inundated during the 1998 flood. Over 60% of area in the city is deemed a flood risk zone. All sides of the city are bounded by rivers thus they have had to adapt through formal policies as well as informal habits, across all sectors.

The conditions and barriers to WSUD in Dhaka, are summarised in the PAA dimensions below

Dimension	*Indicator*	*Conditions*	*Barriers*
Actors	Actor constellations	Introduction of external actors	Blurred division of responsibility Clash of interests from responsible agencies
	Interaction patterns	Innovation and community responsibility	Lack of steering by government Reduced coordination Vague patterns of interaction
	Coalitions and oppositions	Can be strengthened by clearer division of responsibilities and coordination Different actors working together on the same projects (state, market and civil society)	Unclear division of responsibilities Varied priorities by different organisations
Resources/power	Knowledge capacity and development	Collaboration Continued research and knowledge creation	None
	Financial capacity	Donors and international investment	Limited state funds
	Technological capacity	Research and innovation Technology from NGOs and international agencies	Limited technological access due to lack of financing
Rules of the game	Legislation	Acts and legally binding agreements Formal institutional agreements	Complex actor networks leading to reduced application of legislation
	Procedures	Interdisciplinary approach Public participation	Lack of accountability and transparency from government Lack of maintenance
	Political culture	Creation of unity through participation and community involvement Engage development sector	Mistrust of government by local community
Discourses	Problem definitions and belief systems	Same problem definitions among actors	Fragmentation in applying solutions
	Objectives	Policies with clearly defined objectives Commitment to international agreements	Varied objectives among actors
	Approaches to problem	Creativity and experimentation in approaches	Lack of governmental steering Patchy policy adoption by government

Table 7: The conditions and barriers to WSUD in Dhaka

6.4.2. Case study summary

The water management sector of Bangladesh has become more complex over the years as many different actors have been introduced overtime. Although this diversification has been beneficial in some realms, such as knowledge sharing and financing – there have also been challenges. One of these are difficulties in a clarification of responsibilities and a diverse array of interests must be served. The complication of these actor constellations is a factor that makes water management a wicked problem (Stead & Meijers, 2009).

Knowledge and resources from international organizations have been a major condition for WSUD in Dhaka as they have received resources in the form of knowledge, technology and financial aid from the Asian Development Bank, World Bank and governments of several developed countries (Ministry of Finance, 2017). There seems to be well developed legislation and plans at different levels and actors for WSUD in Dhaka and this has been a condition, however, an integrated approach is still necessary, thus their needs to be a stronger political will to develop a shared vision between communities, the government, and the private sector of Dhaka. Policies relating to WSUD must be integrated within other sectors to facilitate resilience. There is sufficient policy on water management, however there are shortcomings in the lack of implementation and a dependence in funding. This lack of implementation could be attained to a lack of a framework on how exactly to achieve WSUD at different scales. One of the big accomplishments and conditions that exist for WSUD in Dhaka is a shared vision and this can be seen in plans such as the Vision 2041 and community organization's such as 'Save Bangladesh Environment (Ministry of Environment and Forests, 2009). The separation of Dhaka's water management across North and South city corporations has led to difficulties in actor constellations and this is a barrier for WSUD. Overall, the policies still lack the institutional framing to translate into on ground implementation. Maintenance is also a procedural issue in Dhaka. NGO's and community Based Organizations have been paramount actors and enablers of WSUD as they have taken over where the government falls short and have also generated knowledge and technology (Ministry of Housing and Public Works, 2015).

Learning by doing has been the way that transition toward WSUD has occurred in Dhaka (Gain et al., 2017) and a lot of transitions have taken place at project level. This has been facilitated by international organisations and actors outside of the government, DWASA has funded WSUD and is an example of how commercial actors, through collaboration can work together with the state to facilitate WSUD (Sharma & Alipalo, 2017). Similar to Melbourne, institutional transition in Dhaka has been driven by climate change induced extreme events (Gain et al., 2017) but due to the adoption of WSUD in Dhaka following mainly a top-down approach, it has been slow, and time is needed to see how it will develop at various levels, especially with the involvement of private actors and community groups.

7. Discussion, recommendations, and conclusion

To create a framework which indicates the necessary government elements for the effective approach and implementation of Water Sensitive Urban Design in a city, the organization of the policy arrangement must be looked at to understand what measures are pursued by water management authorities to tackle this subject. A discussion of the results from Melbourne and Dhaka will be conducted in the coming section and the considerations will be used to build a framework as part of the recommendations for praxis.

7.1. Discussion

In the two case studies, activities related to fragmentation, the presence or lack of collaboration and public participation are identified as the main drivers or barriers for governing WSUD. Although WSUD has become a big part of Melbourne's water governance, there is still fragmentation along various agreements and policies (Choi & McIlrath, 2017). There have been very few joint policy documents that clearly discuss WSUD, and very few which incorporate WSUD into urban planning (Choi & McIlrath, 2017). Between December 2015 and May 2016, consultations were done in Melbourne across several jurisdictions to obtain feedback on the water reform. There was participation from a range of professionals in the urban sector to ensure input from a cross sectoral perspective which included planners, urban water management professionals, civil engineers, urban and water policy advisors in state agencies, industry partners and water authorities (Choi & McIlrath, 2017). Their feedback was mainly pointing at a lack of state-wide policy in WSUD as something that impeded on the city's advancement in this realm.

While some felt that smaller scale jurisdictional legislation is beneficial, most believed that a statewide legislation and targets would improve control and implementation. This along with the lack of flexibility in funding mechanisms for smaller scale WSUD maintenance and implementation are challenging. There is a need for better integration overall.

Furthermore, in the case of Melbourne, the publication of documents at state and local levels has resulted in a diverse array of policies, meaning that a planner's job to navigate the WSUD framework is difficult. This is worsened by the absence of a hierarchical statutory policy framework. Policies at state level are necessary for coherence and to enable the planners to have guidelines, hierarchically (Kuller et al., 2017). It is important to consider all scales at which the problem must be addressed. State policies will also support mainstreaming of WSUD and remove the notion that it is unconventional. Thus, as mentioned earlier, a major clash in WSUD management comes in the form of the question whether there should there be a mandatory framework for every state or should it be maintained that each of the jurisdictions maintain their individual framework and management of this sector. Both sides of this coin have their challenges as statewide targets may not be appropriate for every context, thus many be difficult to enforce (Choi & McIlrath, 2017). Although the implementation of WSUD is advanced in Melbourne, the reasons for an effective overarching state policy is there and the purpose of that is to address catchment issues and improve opportunities for the strategic identification and exploration of WSUD. The solution for this would be to provide policy for WSUD that is targeted at different scales, beginning at catchment level.

Similar to stormwater targets, the subject of unwanted side effects of water quality offset schemes is still of concern. Market-based instruments are increasingly gaining acceptance as mechanisms for facilitating environmental goals internationally (Whitten et al., 2003). There are debates on whether these instruments are justified in the cost of their potential practical challenges. However, their premise is more successful when they are performance based and not overly prescriptive in their policy (Whitten et al., 2003). They also require a lot of detail in their planning and application (Whitten et al., 2003). The improved environmental outcomes of this have not been achieved in Melbourne but rather exchanged for regulatory efficiency. With this considered, offset schemes do not directly address environmental problems, but funds generated from them can be used to develop infrastructure on public land and be used for public benefits.

In the case of Dhaka, DWASA is a demonstration of how collaboration and public participation can improve water management. They have been an impactful commercial service utility in the city and have made big changes which contributed to WSUD. Their collaboration with the Asian Development Bank was a way to source financing for the application of WSUD in Dhaka. This is an example of NGOs as facilitators of WSUD, even in a country where management in water has mostly been from a top-down application. Smaller scale community projects have also demonstrated a progression from isolated management to more inclusive management as the community increasingly transfers local-level management functions from just government agencies to private entities and local communities (Sharma & Alipalo, 2017). A move from top down to more bottom-up management is on the increase in Dhaka. The effect of this, is that the diversity of knowledge for water management is growing increasingly in complexity. The growth of these differing perspectives introduces resources in the form of knowledge, technology and financing. These increases in actor constellations introduce multiple and at times, contrasting assumptions and objectives in several subjects related. Balancing all these ideas remains a challenge in both cases. Effective communication and cooperation with the relevant stakeholders and members of the community from the early processes of planning is mandatory as a condition for WSUD (Kuller et al., 2017; Choi & McIlrath, 2017).

In the past, 87% of the supplied water in Dhaka has been extracted from groundwater sources (Wahab & Islam, 2016). With the failure of traditional drainage and more waterlogging, other sources such as stormwater have increased. This diversification has improved resilience and adaptation at times where ground water has been insufficient or polluted (Wahab & Islam, 2016). The commitment to international policies for environmental protection and sustainability improvement has resulted in positive collaboration in Dhaka as it has lured investors into assisting with WSUD.

The participation of local people is highly promoted in various recent projects in Bangladesh. However, equity and social issues have received less attention at project level, although it has significant potential for supporting some of the key determinants of adaptive capacity (Gain & Guipponi, 2014). Thus, the WSUD applications are reflected in recent policies, institutional reforms and project formulation however, to solve the complex water-problems, basin scale management through transboundary cooperation and equity and social issues need to be implemented at institutional and project levels. Failures in the past have mainly been attributed to poor maintenance once structures for flood control and salinity intrusion had been put up (Gain & Guipponi, 2014). Issues of maintenance still exist in Dhaka, and these can be addressed by getting communities involved in the entire process of WSUD, from conception to application and maintenance. Challenges during implementation are also caused by the lack of cooperation among different agencies, inadequate funds, lack of trade off attitude or compromising between stakeholders.

What makes WSUD unique and in some way sets it apart from other more conventional water subjects, is that often many parties need to be involved, which means that collaboration is crucial (Stead & Meijers, 2009). WSUD projects may require access to infrastructure that may be owned by a monopoly or a private entity which then brings into play the need to access pricing and negotiate arrangements on that. Here, priorities and tradeoffs tend to cause friction. Furthermore, the benefits of WSUD are spread out through space and time and may be hard to identify and price, making it hard to show direct and immediate incentives which are what investors sought after (Gain & Guipponi, 2014). Most importantly, and one way to address the above discussed problem, planning in urban areas needs to be strategic and adaptive to the changing climate rather than solely focused on development control. For WSUD to be applied, environmental protection must be included in the early stages of urban planning and not seen as an afterthought (Kuller et al., 2017; GCA, 2022).

7.2. WSUD Framework: Recommendation for Praxis

In this section, the main research question is answered by creating a framework for best practice in Water Sensitive Urban Design. The main research question of this thesis is '*what framework can be used to achieve the governance elements which are necessary for the effective approach and implementation of Water Sensitive Urban Design in a city?'*. The process of creating a framework involves looking at various aspects of policy, governance, implementation and assessing the tradeoffs. The best practices which facilitated WSUD as well as the barriers to this way of urban water management are identified. The framework created is figure 4 below.

It is important to note that, although there are similarities and things that can be looked at to start applying a framework for WSUD, there is variability across contexts and WSUD can be improved upon in various ways. Biswas (2008) quotes Voltaire in saying that 'best is the enemy of good'. He believes that the 'best approaches' for water management do not exist if you are trying to have a collaborative, multi-industry solution because there will have to be tradeoffs and there is variability within contexts (Woodhouse & Muller, 2017). In saying this, what should be stived for, are good solutions which can result in improved and acceptable management practices, as the situation can never be perfect. No city is completely water sensitive, the aim is to improve resilience (Salinas Rodrigues et al., 2014). Seeing as experimentation is required and solutions vary across conditions of different cities, it is important to be creative and try multiple solutions, on a case-by case basis. The main principles identified are connected to implementation capacity, financial viability, shared vision, multi-level network potential, management ambition and knowledge and awareness creation. This framework provides principles for the incorporation of WSUD. It is to be used flexibly and incorporate contextual differences rather than to be an inflexible blueprint.

7.2.1. Framework principles

Implementation capacity

The subcategories under this include assigning *prescriptive rules* and regulations at a national standard, applying *performance-based standards*, and committing to *international goals.* Having prescriptive rules at a national standard makes the opportunity of enforcement more direct due to the rules being clearly set out. Legislation and law binding policies are an effective way to improve cooperation (Stead & Meijers, 2009). This requires high levels of administration. Having performance-based standards provides the opportunity for continuous review and achievement, while allowing for flexibility on a case-by-case basis. The disadvantage of having smaller scale standards is the possibility of having a lack in uniformity in the standards, which can lead to non-compliance. This is something that must be managed closely. The Victorian Guide to Regulation suggests that industries like urban water management and WSUD which are subject to changing circumstances, should be based on performance standards because these offer greater flexibility when dealing with matters which are more technical, and that they encourage least-cost means for achieving a certain outcome (City of Melbourne, 2014). There needs to be consistent and clear regulatory obligations for WSUD if it is to grow as an urban design methodology. Performance based code can be used to limit variability, stating clear and mandatory requirements. This will also accommodate local variations, also encouraging innovation. In this way, WSUD should be incorporated into all residential codes and building regulations. *Committing to international goals* like the governments of Dhaka and Australia have, influences national political vison and will, as well as improves accountability.

Financial viability

Market-based instruments should be incorporated into WSUD as they come in beneficial in areas where opportunities to alter infrastructure may be limited or where there is a lack of action by the state (Whitten et al., 2003). The basis of this approach is that it can redirect investment to a location where the most impact can be achieved. These schemes can be seen as a funding mechanism that can be used along with other levies. Securing land to deliver WSUD outcomes is an important planning consideration, especially for funding outcomes. In 2011, the Productivity Commission of Australia set fourth some leading principles for raising developer contributions. One way to do this is to use upfront charges for the financing of major shared infrastructure for new developments where costs can be established (Choi and McIlrath, 2017). Secondly, where upgrades or infill development is needed, this should be funded by borrowings which are then recovered through taxes or rates. The Productivity Commission enumerated that for social infrastructure where services are dispersed in a broader way, they should be funded with general revenue because it is so difficult to allocate costs (Choi and McIlrath, 2017). In instances where the economics do not allow for the construction of permanent drainage infrastructure by public authorities, the development contribution schemes must be flexible and accommodate to those particular sub-catchment conditions and allow for temporary drainage.

Sourcing funding through external organisations such as the World Bank, DWASA and the Asian Development Bank has been a major factor in Dhaka's application of WSUD and has enabled them to make progress in ways that they would not have been able to do at the time and scale that they have, if they were solely reliant on government funding (Gain et al., 2017). There is a need for multiple sources of funding if WSUD is to be implemented. *Incorporating WSUD into early stages of planning* and not as an afterthought reduces adaptation costs in the long run (GCA, 2021).

Shared vision

One way that shared vision could be achieved is through *collaboration* (Stead & Meijers, 2009). Including water infrastructure planning in general infrastructure planning is one way to do this. The scope of standard infrastructure planning and funding is usually seen as a separate area of management. This creates unclear division of responsibilities. There needs to be synergy between planning and water infrastructure. Continued research and knowledge sharing also improves coordination by creating shared objectives. *Steering from the government* is a condition to achieve WSUD. Greater coordination of policy development and delivery can be facilitated by aligning planning processes and infrastructure delivery by water authorities and local government where there is a synergy to be achieved. At the same time, local governments need a fair and equitable funding capacity to deliver, maintain, and repair infrastructure. States need to facilitate this and create accountability.

Multi-level network potential

In Melbourne, there is a concern among local governments that state governments are shifting management obligations to local government, while at the same time constraining the local government's ability to raise revenue (Choi & McIlrath, 2017). Stormwater projects are often contingent on grant funding by the water sector or the state government. If funding is not assured, the potential for WSUD engineering capacity within local government to grow consistently cannot be assured in a constrained revenue environment. Governments should consider how local government can better fund stormwater planning and services. One way that this could be done is through the promotion of centralized regional planning and *de-centralized* delivery which is appropriately supported by funding mechanisms. Another way to increase the network potential at multiple levels is to *engage the private sector*. This allows for the opportunity to bring in capital and other resources where the government falls short and should be done in a way that is ethical and still promotes a wider social benefit. What attracts the private sector to invest is public support of policies and adequate legal frameworks which protects the private entity's interests also in the form of taxing and fiscal means. Competent state authorities are important to draw the private sector to want to invest, also because the correct pricing must be set, just as is done in Australia.

Management ambition

A lead agency for coordination needs to be created to effectively embed water sensitive discourse and coordinate realistic and ambitious management. WSUD cannot be easily carried out without management cohesion, as demonstrated by the results, the biggest challenge is implementation, even in cities which have shown improved capacity, there are still challenges with this aspect.

Knowledge and awareness creation

The level of community engagement that was created in Dhaka is said to be one of the defining and crucial aspects in their improved water management success. By engaging the community, you give them autonomy and *improve behavioral internalization*. Community knowledge creates a *local sense of urgency.*

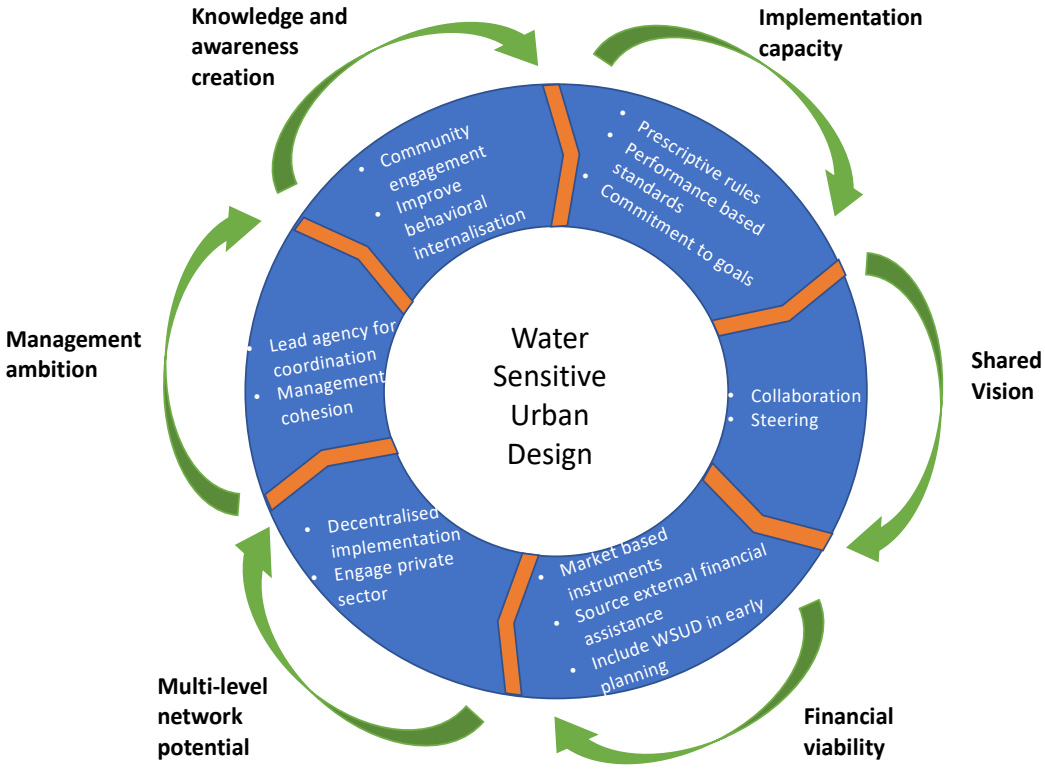

Figure 4: A framework for Water Sensitive Urban Design

7.3. Conclusion

The conclusions made in this research suggest that implementation is a challenging factor in WSUD and can be improved through a good regulatory approach which offers and must consist of binding policy, which also offers consistency but allows room for flexibility to accommodate various changing, local contexts. Due to a high likelihood of uncertainty, regulation of this kind must also offer a high level of guidance and that should be done through a lead agency for coordination. Assessment tools along with clear and detailed guidelines on implementation can achieve broader livability objectives. Frameworks for policies tend to be complex and this makes it hard to create a one-size-fits all approach. Frameworks need to be structured in a way that is supported by implementation tools, without which the policy framework may not be effective. Perhaps the development of websites with clear guidelines for each state, explaining policy hierarchy will be useful. Economic drivers for WSUD are yet to be seen as strong policy drivers for WSUD despite the knowledge that they do exist. There is also an increase in research for the development of a business case for WSUD. It is a wonder whether WSUD infrastructure will be conceptualized as part of essential and basic infrastructure in the future. At this point, it is growing as many are coming to terms with climate change as a reality that will affect water, and thus should be considered in water management but in many cases, WSUD is seen as an optional extra.

All jurisdictions in Australia have, or are in the process of developing, capacity building programs to encourage implementation of WSUD. Such programs would be more effective if they were supported by harmonization of policy and technical guidance for construction and design of WSUD infrastructure. Differences in Bangladesh and Australia are that in Australia, the adaptation strategies follow the direct and modern definition of WSUD whereas in Dhaka, the adaptation strategies still follow the principles of WSUD but not in the same, technocentric way. These solutions are centered around smaller community projects that are not as technically advanced yet have had great impact. Dhaka as a case study shows how water sensitivity can be incorporated in a lower-middle income country, through the engagement of communities and NGOs.

The challenges faced by the urban water sector in fully embracing the concept of WSUD are still many. One of the biggest of these are defining the concepts and their application as it is difficult for jurisdictions to agree on objectives and determine the trade-offs between costs and benefits that are difficult to measure. It is also a challenge to agree on how far urban water policymakers and businesses in the water industry are responsible for broader livability outcomes. Addressing institutional and regulatory barriers must be done on a case-by-case basis. In both cases, the transformation process has not been smooth, and a lot of trial and error occurred at project level and progress was achieved by constant evaluation.

7.4. Reflections and limitations

Theoretical

This study was based on a logical combination of best practice theory and the PAA. Throughout the literature review, it was apparent that studies in integrated water resource management have by large concluded that the subject must be managed in an interdisciplinary manner entailing that the approach must be collaborative and integrative for the achievement of effective results in WSUD. The research conducted, agrees with this. There is, as stated early in this research, a scarcity of research on a framework on how to govern WSUD (Salem, 2007). Much of the information available provides technical solutions (Ward et al., 2012) without direction on what principles are needed to effectively manage and apply WSUD. With both case studies, it stands out that there is no 'one size fits all' solution and WSUD must be looked at on a case-by-case basis, within the guidelines provided in this framework. The conceptual model used enabled a full study of the components of policy analysis although, the parameters of best practice as a method of research was hard to define. This gave flexibility but also meant that there was no clear, grounded methodological approach on how to identify best practices, this was by large, left at the discretion of the researcher. The risk of generalizing a framework generated through a best practice approach is that there is no guarantee that it will work for all cases (Tomlinson, 2002). However, this method was still the most suitable method to fulfil the requirements of these research questions.

The PAA was successful in that it allowed for the exploration of governance from many different angles, as all dimensions of this approach proved to have some effect on governing WSUD. It was also evident in the results, that the four dimensions are dependent to one another (van Eard et al., 2014; Liefferink, 2006). The PAA allowed the researcher to see those links. The barriers and conditions found in each of the dimensions were often connected. An example of this is when there is a blurred division of responsibility in the actor dimension, it affects the patterns of interaction by reducing coordination which then affects the procedures in rules of the game. When the procedures are fragmented and uncoordinated, there can be patchy policy adoption in the discourses dimension.

This research has an exploratory nature thus the absence of order of importance in the governance elements identified is not an issue, a different approach would be needed for that. One other shortcoming in the used theory is that the current policy arrangement assessed, did not directly consider past developments, however in this thesis, this was overcome by including the policy trends over several years in water management. This is important because decisions made in the past influence the approaches used today. As mentioned in the early chapters, pragmatism emphasizes on joint actions and shared meanings and bases itself on the notion that theories can be both contextual and generalizable by analyzing them for transferability to another situation (Creswell, 2009), using this conceptual model achieved that.

Methodological

Due to this research being performed from a pragmatic point of view, it has a strong focus on the case study context. The risk of the pragmatic approach is reduced generalizability, however – generalizability was not the aim of this research. The aim of this research was transferability, through applying knowledge learned from other contexts (Creswell, 2009). Best practice research requires a commonsense approach (Shields, 1998) applied through critical reasoning; this is what was done throughout this research process. An abductive approach was used, which is a mixed method theory approach combining the deductive and inductive approach. Specifically, using the PAA as the first part of the results was deduction and generating conditions and barriers as the second part of the results was induction. This method worked well in combining best practice and PAA methodology. There were no barriers and conditions identified outside of the PAA elements.

The word ‘best’ practice was used as part of the theoretical framework on the basis that the formal concept itself is titled that way, however once conducting the research process, it was identified that the term ‘good’ practice represented the study better as no urban area was fully water sensitive, but rather there are practices which are good for the pursuit of WSUD. Defining ‘best’ was going to be difficult, thus it was made clear in section 3.1 that despite using the term ‘best practice’ in its formal sense, this research ultimately uses it to describe ‘good’ practice or ‘better practice’. These terms are more correct for best practice research; however, it is difficult to find them used under those words, and as their own theories (Tomlinson, 2002), thus best practice is used. Best practice is the study of learned practices which seem to produce an effective result (Polt et al., 2001).

Another reflective remark can be made pertaining to the interviews. This study may have benefited more from interviews of those involved in water management in Dhaka or Melbourne, however accessing those members proved to be difficult despite an attempt to reach out digitally. For that reason, interviews could not be included as part of the results but rather manifested as helpful conversations which helped to build an understanding on the discourse in water governance today, from the perspective of a solutions broker.

7.5. Recommendations for further research

The discourses on water issues have changed in the last few years and are constantly evolving. With climate change induced weather events, water management has become a subject of high attention and focus. A study on how water related discourse evolution has influenced WSUD, would contribute positively to the theoretical development of this subject.

Frameworks for WSUD are still very new in academia and can benefit greatly from theoretical contributions. These frameworks should be applied to real life cases and results should be compared to determine which factors enable or impede on the implementation and overall governance of WSUD. However, for this to be possible, a clearer definition on WSUD which consists of measurable factors/improvement on the framework must be carried out. Due to the pragmatic nature of this framework making it highly contextual, it should be applied to other cases and in urban environments in different countries. Barriers and conditions to WSUD in these various contexts could be looked it for differences and similarities.

Another recommendation would be to take the tetrahedron into consideration and conduct an in-depth study on the independence or interrelatedness between the governance aspects identified in the framework. As mentioned in the framework, as a recommendation for praxis, creating management ambition by means of a lead agency for coordination is a way to improve WSUD. The Netherlands has in place, a water board (*Waterschap*), which is a governing body which manages surface water at a regional scale (Government of the Netherlands, 2023). Their policy areas as described by the European Committee of the Regions are overseeing and monitoring water quantity and quality, developing water management plans for water quality, working with municipalities and regional offices, congregating and balancing views and interests of various stakeholders and finally, having the responsibility for water infrastructure that is not managed at national level (European Committee of the Regions, 2023). This authority is one which has been applied in the Netherlands since the 12th century and has placed the Netherlands as one of the countries with the most advanced water management in the world (Ritzema & Van Loon-Steensma). Putting in place a water board as a lead agency for WSUD is something to be explored as it has the potential to improve coordination and collaboration among various sectors. Having a lead agency may also improve implementation in that decisions can be made by a single authority. Experimentation is crucial for multisectoral issues as complex as WSUD and must be tacked in an exploratory, case-by-case approach.

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Appendices

Appendix A: List of consulted policy/strategy documents

Policy documents used for Melbourne case study

Document Title	***Publisher***	***Year***	***Level***
Municipal Integrated Water Management Plan July 2017	City of Melbourne	2017	Municipality
Total Watermark – City as a catchment	City of Melbourne	2014	Municipality
Australian Environmental Water Management Review	National Water Commission	2014	State
Climate Change Mitigation Strategy to 2050 – Melbourne together for 1,5 degrees	City of Melbourne	2018	Municipality
Urban Forest Strategy 2012-2032	City of Melbourne	2011	Municipality
Intergovernmental Agreement on a National Water Initiative	Commonwealth of Australia	2004	National
Green Our City Strategic Action Plan	City of Melbourne	2017	Municipality
Nature in the City – Thriving Biodiversity and healthy ecosystems	City of Melbourne	2017	Municipality
Open Space opportunity in North and West Melbourne	City of Melbourne	2010	Municipality
Quantifying the benefits of green infrastructure in Melbourne	City of Melbourne	2019	Municipality
City of Melbourne annual report 2020-2021	City of Melbourne	2021	Municipality
Melbourne Water System Strategy	Melbourne Water	2017	Municipality
Reforming Urban Water: a national pathway for change	National Water Commission	2017	National
A Guide to green roofs, walls and facades	State of Victoria	2014	State
Urban Water in Australia: future directions	Commonwealth of Australia	2011	National

Policy documents used for Dhaka case study

Document Title	*Publisher*	*Year*	*Level*
National Water Act	Ministry of Law, Justice and Parliamentary Affairs	2013	National
National Water Policy	Ministry of Water Resources	1999	National
National Water Management Plan	Ministry of Water Resources	2004	National
National Adaptation Program of Action	Ministry of Environment and Forests	2005	National
Bangladesh Climate Change Strategy and Action Plan (BCCSAP)	Ministry of Environment and Forests	2009	National
Sixth Five Year Plan	Ministry of Planning	2011	National
Bangladesh Water Act	Ministry of Law, Justice and Parliamentary Affairs	2013	National
Bangladesh Delta Plan 2100	Bangladesh Planning Commission	2018	National
Dhaka Structure Plan 2016 - 2035	Ministry of Housing and Public Works	2015	Local
Bangladesh Environment Conservation Act	Ministry of Law, Justice and Parliamentary Affairs	1995	National
National Plan for Disaster Management 2021 - 2025	Ministry of Disaster Management and Relief	2020	National
Bangladesh Climate Public Expenditure and Institutional Review	Ministry of Planning	2012	National
Climate Change Trust Act	Ministry of Environment and Forests	2010	National
Climate Fiscal Framework	Ministry of Finance	2014	National
8th Five Year Plan July 2020 – June 2025	Bangladesh Planning Commission	2020	National

Appendix B: Schematic overview of interviews

Organization	*Job title*	*Date of interview*
Global Center on Adaptation	Senior Program Officer	25 May 2022
Global Center on Adaptation	Chief Resilience officer	25 May 2022
Global Center on Adaptation	Lead of locally lead adaptation	25 May 2022
Global Center on Adaptation	Lead Water Adaptation Specialist	25 May 2022
Global Center on Adaptation	Resilience Specialist and results monitoring consultant	25 May 2022
Global Center on Adaptation	Resilience specialist and results monitoring consultant	13 July 2022

Appendix C: Water and Urban team meeting outline

Water and Urban team meeting

A meeting of the Water and Urban Team of the Global Center on Adaptation was held via Microsoft Teams on the 25th of May 2022.

Attendees

Senior Program Officer

Chief Resilience Officer

Lead of locally lead adaptation

Lead Water Adaptation Specialist

Resilience Specialist and results Monitoring Consultant

Old business

Team spoke about decisions and meetings from the last meeting

New business

Weekly team meeting for updates

Time set at the end so that I could ask questions as the researcher/intern

Paraphrased notes and research advice given (relevant to research)

- Look into Rotterdam for an example of a water management framework that works
- Australia should be included in this research because the concept of WSUD originated there, and it is a world leader in this subject
- The team of Locally Lead Adaptation was working on projects in Bangladesh at the time and gave the following information on Dhaka
    - Policy in Dhaka focused on early warning systems as floods aren't avoidable
    - Most of the population of country is poor thus adaptation is centered around community measures and decentralized methods

- Locally lead adaptation in Bangladesh has been at the forefront in comparison to most developing countries
- Policies like the National Adaptation Plan have a community-based approach which she believes is the reason for its success
- Top-down national plans that also allow for the investment of decentralized planning systems which can make smaller scale improvements
- Financing water management is one of the biggest challenges in adaptation

Appendix D: Interview Guide for formal interview

Interview questions for Water Sensitive Urban Design framework

1. In your opinion, is it a preference that the obligations of WSUD be set by the state, rather at a local level or a combination of both?
2. How does this assist with the implementation of WSUD?
3. Do you believe that the planning policy framework for WSUD should be based on mandatory or discretionary policy framework?
4. Do you believe that mandatory stormwater targets which are at a statewide scale would assist in the implementation of WSUD? If yes, which classes/scales do you believe that the targets should apply?
5. What gaps do you see for planning or development of WSUD implementation?
6. Do you believe that there is an economic benefit for the application of WSUD for governments and for the private sector?
7. Would you support the expansion of market-based approaches for WSUD components like stormwater e.g., water quality offset schemes? Why or why not.
8. What changes, if any would you like to see in the current governance structure relating to WSUD? Why?
9. Do you believe that WSUD is a concept that can realistically be applied to lower income countries?
10. Do you think that a general framework can be created for the application of WSUD? Justify