From Abundance to Scarcity:
Exploring Narratives and Locked-in Institutions around Desalination in Bahrain

Ahmed Al-Aghbari

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University of Sussex

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Declaration

I hereby declare that this thesis, whether in the same or different form, has not been previously submitted to this or any other University for a degree.

Name: Ahmed Al-Aghbari

Signature:

Dedication

To my beloved Father Soul, with great appreciation

UNIVERSITY OF SUSSEX

AHMED AL-AGHBARI
PHD IN DEVELOPMENT STUDIES

FROM ABUNDANCE TO SCARCITY: EXPLORING NARRATIVES AND LOCKED-IN INSTITUTIONS AROUND DESALINATION IN BAHRAIN

SUMMARY

While most literature on desalination focuses on how a specific technical or managerial concern is addressed, desalination, in its relatively long history in Bahrain, has emerged periodically under different guises and forms. The topic of the changing motivations to desalinate has yet to be analysed. Thus, it is beneficial to understand the changing context and justifications that accompanied the various milestones of desalination adoption; emergence, expansion and dominance. Over four decades, the desalination journey in Bahrain has coincided with the formation of the modern Bahraini state. Not only has desalination dominated hydro-politics, but it has also become the primary source of municipal water, side-lining other water resource management options. I argue that changing state-building policies, scarcity discourse and politics of reforms in the water sector have influenced the position of desalination. Therefore, contextual analysis along development trajectories is central to understanding the position of desalination in Bahrain.

To substantiate this argument, firstly, I situate the research context within the historical development of water and food policies, noting their influence and fluctuation. Specifically, I trace how the general perception around water and resources has shifted from one of abundance to scarcity to advance the interest of particular stakeholder groups and to meet changing national priorities. Since independence, state-building politics, in Bahrain, has influenced the development trajectories of how water and food are perceived and provided. Secondly, despite the water-rich history of Bahrain, there appears a hegemonic discourse of scarcity that has influenced how water policies are shaped. The current limitations of conventional water resources and climate change are presented as signifiers of water scarcity. In part, to legitimise an expansion in desalination, as well as to disengage the Government from any failings in their responsibilities. As such, the mobilisation of desalination in Bahrain denotes a political-fix, primarily to facilitate the evolution of a sanctioned discourse and maintain the Government's political and economic vision.

Finally, this thesis examines the politics of water reforms that have emerged in the last two decades. While the reforms came about to address the spiral of commitments to the path of desalination, the entrenched position of desalination showed little flexibility to change. The dynamics of lock-in were evident in the rejection of the dominance of desalination, on the one hand, and the counter-reaction to the rejection, on the other. As such, viable alternatives were locked-out while the desal-dependent path was maintained. These alternatives represented institutional and demand management options such as infrastructure repairs, an improved water tariff structure, water bylaws and others that were viewed at a disadvantage when compared to the desalination promise. Hence, drawing on development studies, hydro politics and political economy scholarship, this thesis extends our understanding on the dynamics of the large-scale expansion of desalination schemes. Whilst the role of the water scarcity narrative to chart fixed pathways to large-scale hydro-infrastructure is essential in influencing politics of development, path-dependency processes are equally visible, enmeshed in hydro-politics to further favour the desal option. These outlined drivers of influential state-building politics, a totalising discourse of water scarcity, and path-dependency processes provide a unique explanation for the current overreliance on desalination in Bahrain.

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List of Acronyms, Abbreviations and Terms

AGU	Arabian Gulf University
AI	Aridity Index
ALBA	Aluminium Bahrain
BAU	Business As Usual
BAPCO	Bahrain Petroleum Company
BCSR	Bahraini Centre for Studies and Research
BHCWR	Bahrain High Council for Water Resources
BOOT	Build-Own-Operate-Transfer
CEO	Chief Executive Officer
CGPD	Co-Generation Power Desalination
ED	Electrodialysis
EDB	Economic Development Board
EDI	Electrodeinoisation
EP	Evapotranspiration
EPC	Engineering Procurement and Construction
ESC	Environmental Supreme Council
ESCWA	Economic and Social Commission for Western Asia
EWA	Electricity and Water Authority
FAO	Food and Agriculture Organisation
FO	Forward Osmosis
GCC	Gulf Cooperation Council
GCC-UWS	Gulf Cooperation Council Unified Water Strategy
GCM	General Circulation Models
GDC	Groundwater Development Consultants
GDP	Gross Domestic Product
GoB	Government of Bahrain
GWP	Global Water Partnership
ha	Hectare
HPC	Hidd Power Plant
ICDD	International Conference on Development of Drylands
IMF	International Monetary Fund

IWPP	Independent Water and Power Producer
IWRM	Integrated Water Resource Management
KSA	Kingdom of Saudi Arabia
MCM	Million Cubic Meter
MED	Multiple Effect Distillation
MoC&A	Ministry of Commerce and Agriculture
MoE	Ministry of Energy
MoEW	Ministry of Electricity and Water
MoM&A	Ministry of Municipality and Agriculture
MoMUP	Ministry of Municipality and Urban Planning
MoW	Ministry of Work
MoW&M	Ministry of Work and Municipality
MSF	Multi-Stage Flash Distillation
NGO	Non-Government Organisation
NRW	Non-Revenue Water
NWS	National Water Strategy
OPEC	The Organization of the Petroleum Exporting Countries
P	Precipitation
PPP	Public-Private Partnership
RO	Reverse Osmosis
SIDS	Small Island Development States
STS	Science, Technology and Society studies
TAC	Technical Advisory Committee
TINA	There is no alternative
TSE	Treated Sewage Effluent
UN	United Nations
UNDP	United Nations Development Program
UNEP	United Nations Environmental Program
WEAP	Water Evaluation and Planning
WFE	Water-Food-Energy Nexus
WSTA	Water Science and Technology Association
WRC	Water Resources Council

Chapter 1: Introduction

Figure 1.1: A residential swimming pool with Enki, the God of fresh water, in the background (source: Author)

1.1 Background

The Arabian Peninsula countries are classified as drylands[1], characterised by insufficient rainfall and hot and dry climates (Al-Hurban, 2006; Mortimore et al., 2008). However, Gulf Cooperation Council[2] (GCC) countries often makes headlines for having some of the highest water consumption rates in the world, with the UAE and Kuwait consuming over 575 litres per capita per day (Al-Otaibi & Abdel-Jawad, 2007). The endeavours of these countries to meet present and future water demands has been achieved through the exploitation of unconventional water sources, for example, through the use of desalination[3] and, to a lesser extent, treated wastewater effluent. GCC countries now produce half the global capacity of desalinated water (Dawoud & Mulla, 2012). Additionally, these projects are viewed to enhance the state's position and deliver its hydraulic mission[4]. Terms such as "water delivered" and "scarcity overcame" frame the rhetoric, and hydro-projects are celebrated as national trophies (March et al., 2014; Molle & Mollinga, 2009). What at stake here is not just water itself but its ability to influence

[1] Among the Dryland Systems are Hyper-arid, Arid, Semiarid and Dry Subhumid.
[2] The Cooperation Council for the Arab States of the Gulf (GCC) (Arabic: مجلس التعاون لدول الخليج العربي), is a regional intergovernmental political and economic union consisting of all Arab states of the Arabic Gulf except Iraq, namely: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.
[3] The process of converting seawater or brackish water to potable water.
[4] It refers here to iconic and symbolic projects in the form of massive dams, expansion of public irrigation and desalination plants. Also, it refers here to Wester's definition as the "states' strong conviction to utilize every single drop of water by building hydraulic infrastructure" (Ibid, 2009a, p. 396).

development, political goals and state power. Yet, most of the debate has centred on the technical and financial aspects of increased water supply.

Desalinated water is a manufactured water that is produced by capital and technology intensive processes. The ability to produce water in pre-defined quantities, and with specific chemical properties, is a critically important feature of the desalination promise (Williams & Swyngedouw, 2018a). However, as water demands continues to increase, desalination is likely to enable, and sometimes engender, social, economic and institutional configurations. The pursuit of a lavish lifestyle has been a central feature of the journey to modernisation and development in many GCC countries since the start of oil exploration in the 1930s. The social and economic transformations that have accompanied this period have drastically improved standards of living and access to services (Mitchell, 2010). As illustrated in Figure 1.1, the stark contrast of a residential swimming pool in an arid and water scarce environment is achieved by substantial government investment in desalinating the Gulf water. This contrast, however, is profound, in terms of how desalination has transcended the hyper-aridity of these countries and transformed both landscapes and social structures in ways that diverge from the physical conditions. But how has desalination gained popularity? Is it because water is scarce in these countries? Or is desalination and the promise of water abundance deeply entangled within the political and socio-economic context? For the GCC countries, desalination is a foreign-imported technology that is both capital and energy-intensive. How, then, has desalination been justified and at what cost? How are water discourses constructed and contested in this process? And how have water institutions coped with the rapid expansion in large-scale desalination schemes? These questions form the focus of this thesis.

The work also focuses on the governance decisions that drive the development of desalination that is location and context specific. Therefore, this thesis is an in-depth case study examining the factors that led to the adoption of desalination in Bahrain and the implications associated with it. While its adoption is closely linked to the broader development trajectories in the GCC region, the notion of *sweet water* abundance, from natural springs, was distinct to Bahrain, setting it apart from mainland Arabia in the recent past.

Bahraini Context

Bahrain, translated in Arabic as the "*Land of the Two Seas"*, one salty and one sweet, was famed for its natural springs. A portion of the great Epic of Gilgamesh[5] narrates the historical myth of the land of *Dilmun,* now known as Bahrain. This 4000-year-old myth describes the presence of *Enki*, the God and the Guardian of Water in this land. The conversation, as Enki answers the prayers of the Goddess Ninsikilla:

> *"Let Utu (God of the Sun) stationed in heaven,*
> *Bring you sweet water from the earth, from the water-sources of the earth,*
> *Let him bring up the water into your large reservoirs,*
> *Let him make your city drink from them the water of abundance,*
> *Let him make Dilmun drink from them the water of abundance,*
> *Let your wells of bitter water become wells of sweet water"*
> (Edited script from the Epic of Gilgamesh)

Although the water that fills the swimming pool in Figure 1.1 is supplied from a desalination plant, the presence of Enki in the background provides a strong historical and cultural context of a perceived water abundance in Bahrain. Natural springs were an integral part of the culture, heritage and survivability both on land and off the land (Es'haqi & Al-Khaddar, 2009). Culturally, tales and poems capitalised on natural springs for relevance and distinguished Bahrain, and its water resources, from mainland Arabia. A local poet likens the departure of a lover to the water of the Adhari Spring that spreads wide and far, he narrates:

> "*O Adhari, until when will water flow in this channel without me. The grass is parched: what a shame it is that you abandoned your vegetation. Incredible how you behave unfaithfully! O Kind-hearted souls take me. North of the spring I was, yet it irrigated those who are far away".* (Local poet, Bahrain Heritage Festival 2017)

From an economic point of view, natural springs were considered to be the cornerstones of agriculture and pearl trading. On the one hand, Bahrain had an abundance[6] of natural springs which formed the basis for sustainable agriculture and farming activities inland

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[5] The legend transcript is found on six huge columns, brought by orientalists to University of Pennsylvania Museum and translated in 1958.

[6] Beside agriculture and farming activities, Bahrain was also known for its trading activities and commercial interaction with the rest of Asia and Europe. This took place in the region because of its stability and unique geographical location in the Gulf. Evidence suggests that early Bahraini civilisations were engaged in prosperous economic activities (Rausch et al., 2014).

(Ansari, 2013). On the other hand, pearl divers relied on submarine springs (*Shawasheb*[7]) for freshwater to sustain their month-long journeys into the Gulf (Es'haqi & Al-Khaddar, 2009). Submarine freshwater springs provided important access points to water for divers who could dive and fill a goat-skin sack with sweet water while out at sea. As such, understanding the significance of the historical, cultural and economic value of water resources, in the form of natural springs, is essential in locating discussions around the prominence of water abundance discourse and the emergence of desalination in Bahrain.

However, over the last few decades, and especially since independence in 1971, an accelerated growth in development activities, over-exploitation and changes in economic models and development modalities (Zubari et al., 1993) have eroded the importance of Bahrain's natural springs. This has also led to ever-changing characteristics within the Bahraini water sector. Firstly, Bahrain's original groundwater reservoirs have been lost to salinization because of over extraction (RBAS, 2013). Subsequently, the desalination sector continues to grow to offset any deficit in the groundwater supply as well as any increase in water demand. Therefore, desalination is viewed as a water resource solution to depleting groundwater resources and harsh natural aridity conditions. Secondly, desalination was introduced in Bahrain in 1975, as a modernisation project, and has developed very rapidly to meet domestic water quality requirements. This is clearly illustrated in the supply shift of domestic water, from its reliance on groundwater to that of desalination, currently peaking at over 94% of the domestic water supply (EWA, 2018). The shift in water augmentation, therefore, represents a fundamental change in water resource management. Within this change, there exists a stark contrast in how water is perceived by different, and usually competing, stakeholders. This contestation relates to the distinction made between water for food and water for drinking, as will be covered in later chapters.

Therefore, this thesis examines the evolution of water resource management paradigms and policies in Bahrain, along state-building trajectories, since independence. It examines how discourses and practices, that have influenced the desalination journey in Bahrain, are historically and politically produced and shaped. While desalination dominates the

[7] *Shawasheb* is the local name for submarine springs. The name reflects the strong gushing of sweet water in the middle of the Gulf.

Bahraini domestic water sector to overcome water scarcity, its adoption rate only accelerated in the last few decades. How, then, have the perceptions of water resources changed? What happened between the recent lived memory of water abundance, represented by natural springs, and the contemporary perception of water scarcity? And how have water institutions reacted to the dominance of large-scale desalination schemes? These issues guide the inquiry of this thesis.

1.2 Aim and Research Questions

This study aims to better understand the dynamics of adopting large-scale desalination as a sustainable water augmentation strategy in Bahrain. This research critically engages with policy agendas that promote modernisation through the expansion of large-scale infrastructure. For the water sector, this study examines desalination as a pathway to overcoming water scarcity. The interplay has the potential to work in both directions, politics and policies can influence the expansion of large-scale desalination schemes, and conversely, large-scale desalination schemes can influence politics and policies. In principle, either of these could explain the current overreliance on desalination, but there is a reasonable basis for thinking that both are important.

In light of the above, the principal research question is: *What are the relationships and dynamics between large-scale desalination schemes and changing water management policies in Bahrain?*

To answer this question, the following research sub-questions are formulated to guide my work:

1. How have water policies developed and changed in Bahrain? What are the origins, discourses, and policies associated with the adoption and expansion of desalination? (Chapter 3 & 4)
2. How are the current perceptions of water resources being discursively constructed? How is the discourse of water scarcity constructed in Bahrain? How have these perceptions influenced water sector policies and politics around desalination? (Chapter 5)

3. How does desalination influence water management policies? What are the dynamics between the increasing prominence of large-scale desalination schemes and water institutions? (Chapter 6 & 7)

1.3 Scope and Limitations

There are a number of contradictory features which make Bahrain a highly relevant policy and social environment, to unpack the overreliance on a singular water management option, such as desalination. Firstly, there is a stark contrast between the present perception of Bahraini water resources and that which dominated the recent past. As discussed earlier, Bahrain was known for its water abundance, in the form of natural springs that supported socio-economic activities. In contrast, the current, dominant, perception is one of water scarcity. Therefore, it is imperative to situate desalination within this changing perception of water resources that coincided with Bahrain's journey towards modernisation. In other words, understanding changing water politics, along with the various milestones in the desalination journey, is critical over the ahistorical, and usually technical, approach to examining the large-scale expansion of desalination schemes (Chapter 4). Understanding the evolution of water management paradigms and practices, in their political and historical context, serves to highlight the complexity of technological adaptations, such as desalination, in the water sector.

The second contradictory feature is how water is perceived and provided. While there is a dominant claim of water scarcity in Bahrain, there also exists a water-intensive lifestyle. On the one hand, the ahistorical scarcity discourse dominates public discussion to highlight the ostensible, natural, arid conditions. On the other hand, domestic consumption rates soar above those of similarly arid countries, and even the global average (Zubari, 2014). The constraint of aridity has thus been overcome through the expansion of desalination processes, but what is of interest here is the notion of replacing water scarcity with ideas of lavish abundance. As such, the role of water scarcity discourse, to gain consensus around, and legitimise, hydro-investment is a subject matter for inquiry (Chapter 5). Drivers of water scarcity, such as the limitation of conventional water resources, climate change and other dimensions, are analysed in the context of how they influence the desal-path. More importantly, how the discursive context of "*there is*

no alternative" is critical to the promotion of desalination, as will be reviewed in Section 2.3.1 and analysed in Chapter 5.

Additionally, the water and energy sectors are inextricably linked in the GCC (i.e., the water-energy nexus), probably more so than in any other region of the world, and this has a major impact on the environment. The water-energy nexus would probably be even stronger under the anticipated impact of climate change. Hence, concerns about carbon emissions from desalination plants may attribute to "maladaptation" (Barnett & O'Neill, 2010). Maladapation, here, is undrstood as a situation where carbon emissions increase as a direct result of efforts to tackle impacts of climate change. While there are elitist efforts to improve Bahrain's rankings in international water and environmental indicators (e.g., Sustainable Development Goals (SDGs) 2030 water-related goals and targets), and contribute to the Kingdom's global environmental commitments (e.g., climate change related Intended Nationally Determined Contributions, INDCs), public engagement on the issue is not as prominent (section 5.3).

The third contradictory feature is the cost of water supply infrastructure. In contrast to freshwater, desalinated seawater is inherently a produced product (potable water). The massive hydro-investment, in the form of desalination infrastructure and technologies, sets path dependencies and rigid development trajectories that are increasingly difficult to alter (Berkhout, 2002; Pierson, 2000). While the state's hydraulic mission[8] is a valid conceptual justification for building and expanding desalination schemes, the local Bahraini governance context provides more nuance as to how state-infrastructure-water relations develop (Chapter 6). As such, the dynamics of adopting desalination in Bahrain warrant a contextually sound and empirically founded analysis.

As per the above scope, the majority of this research work engages with politics and policies in Bahrain and the wider GCC context. Both historical and contemporary accounts of the role of water scarcity, desalination and state-building politics are, to a great extent, elitist in nature. Attempts to engage with different social demographics were limited due to time, location, resources and the established boundaries of the fieldwork

[8] Here, the state's hydraulic mission refers to discourse around large-scale infrastructure that plays a central role in strengthening state-building, as well as, the legitimacy of the state.

placement. To address this limitation, the thesis relied on secondary data portraying trends and challenges that are experienced by different stakeholders. These methodological limitations are discussed further in Section 2.6.

1.4 Personal Motivation and Points of Departure

From a young age I was amazed by large-scale infrastructure and how it functions to facilitate movement, water provision and enhance the economic development of a country. Growing up in Yemen and witnessing the significant infrastructure and socio-economic transformations that were experienced by the GCC countries was indeed one of the factors influencing my decision to become an engineer. I chose to become an engineer so that I could participate in the design and building of such marvellous structures. Desalination plants, entrusted to overcome *water scarcity*, were my favourite examples of large-scale infrastructure. As a curious engineer, I wondered why the expansion of new desalination schemes was rapidly unfolding. In Bahrain's case, the country experienced a dramatic shift towards desalination, with the desalinated water ratio rising from 7% in 1980 to 90% in 2014. More recently I have pondered: what motivates and influences the expansive and hard path towards desalination? Are there other options that could lessen the need to commit to massive development projects? How has desalination, as a water policy option, influenced the way water management systems function? Are water sector institutions now better off? Why do the countries in the GCC still utilise older desalination technologies? Why have they never embarked on the development of technologies themselves, as key stakeholders? It appeared to me that the answers, or at least some of them, lie outside the realm of engineering and not in one particular field, but many.

In a professional capacity, I became interested in dryland and water resource development after participating in the 11th International Conference on Development of Drylands (ICDD-11) in Beijing, China on 2013. Soon after the conference, I decided to look for a research opportunity that would enable me to answer some of the questions asked in the previous paragraph. Hence, in doing this PhD, I wanted to contribute to the discussion around politics of water sustainability in the Arabian Peninsula.

Furthermore, as part of the fieldwork placement I co-published a policy-evaluation study on the potential scenarios for water management systems in Bahrain (Al-Aghbari & Al-Zubari, 2016). I evaluated two scenarios that could potentially alleviate the need for the expansion of desalination. These scenarios were i) leakage reduction and ii) per-capita consumption reduction. While attending a regional conference to present the findings that the combined effects of implementing these two recommendations would be favourable, I noticed that there are complexities that go beyond a linear, or even a dynamic, model analysis.

Therefore, in this thesis, I explore the relationships and dynamics of adopting desalination as a viable water option in Bahrain, in relation to changing water management paradigms. Drawing on development studies and political economy scholarship, this qualitative study explores issues of water security, scarcity and abundance and the politics of large-scale development projects in the context of desalination in the Bahraini water resource management system. This research focuses on the political economy within the Bahraini water sector and the national and regional influences that triggered, and allowed, desalination not only to continue to play a vital role in the Bahraini water sector but also to dominate it.

Theoretically, the provision of domestic water through desalination is associated with the state's hydraulic mission, in part to supply higher volumes of water as well as to enhance the state's position and legitimise its action (Molle & Mollinga, 2009; Wester, 2009a). The hydraulic mission of the state is understood as a kind of discourse around large-scale infrastructures that play a central role in strengthening state-building, as well as, the legitimacy of the state (Ibid; Turton, 1999). In the case of desalination in Bahrain, the hydraulic mission of the state is viewed as a water-related discourse, of which, supply management is engineered and technology-oriented, with solution sought to respond to any increase in demand. In other words, as long as the Government is endeavouring to the provision of domestic water sufficiently, the Government is, therefore, reinforcing legitimacy and credibility (Bogardi et al., 2012; Mehta, 2001). What is also reinforced, by the Government's efforts to provide water, is the dominant narrative of *why* there is an apparent scarcity of water and *how* to overcome it (Mehta, 2001).

Science, Technology and Society (STS) studies typically trace the social conditions that shape the adoption of certain policies and technologies (Mehta et al., 2019; Sultana, 2013). Similarly, critics of the nature, origin and implications of particular natural resource scarcity narratives analyse the socio-political tensions and implications of the selection and distortion of data to assert certain imperatives and forward specific agendas (Mehta et al., 2019; Mehta, 2001; Bakker, 2000). As those discursive constructs are usually deployed to highlight the obvious and what people can relate to, they typically operationalise certain development pathways. In essence, concepts of *scarcity* and *abundance* are usually deployed as discourses that function to neutralise and legitimise certain human endeavours. Furthermore, the extent to which particular actors deploy scientific language and discourse represents ideas and arguments with a certain level of evidence, educational resource and access to current information (Alatout, 2008; Bakker, 2000). As such, they potentially produce and reproduce a particular representation of reality and focus. A reality that is perceived technically and scientifically, and as a triumph of science and engineering over nature (Williams & Swyngedouw, 2018a). The rise to power and prominence of the techno-managerial class in Bahrain is examined in Chapter 5.

Most publications about desalination in Bahrain and the GCC tends to present desalination as the only option needed to overcome a perceived *scarcity* (Darwish et al., 2014; Lattemann & Höpner, 2008; Dawoud, 2005; Al-Zubari, 1998). Mainly, they analyse physical constraints to water resources, and when conventional water resources are compared to the existing water demand, desalination is then presented as a valid and necessary endeavour. As such, the Government's economic model (projecting abundance), high consumption rates and state of infrastructure are considered as constants in any analysis. A critical angle in STS studies is the contested knowledge around scientific facts and social construction (Mehta et al., 2019; Sultana, 2013; Teschner et al., 2013). The physical limits, in this instance water resource, are socially and politically constructed by means of emphasising the relationship between the natural limitations and available technological solutions.

While scientific discourse is usually deployed to affirm certainty, technological intervention is positioned to suppress marginalised narratives (Dreizin et al., 2008; Kim

et al., 2009). In a Foucauldian understanding of power, hegemonic discourses have the ability to structure domains and produce an effect on the behaviour of actors and institutions (Chhotray & Stoker, 2010; McEvoy & Wilder, 2012). Thus, discourse analysis literature is a useful reference to unpack the broader, complex and contested nature of hydro-politics around water allocation and power relationships.

Other literature on desalination and water security focuses on forecasting scenarios: computing and quantifying the financial and environmental cost associated with choosing, and expanding, the desalination option (Al-Otaibi & Abdel-Jawad, 2007). However, aspects of path dependency and the lock-in dynamics that desalination may bring into hydro-politics are not considered in the current debates in the region. In this respect, the interdependencies between institutions and infrastructures are an important dimension to help unpack the interplay between water politics and desalination.

Against these conceptual understandings, this research argues that there is a critical gulf between the Government's vision of overcoming water scarcity through desalination and the trickle-down effects that desalination has on reconfiguring social, economic and political relationships with water resources. The glamorous promotion of desalination as a viable and sustainable water resource option in Bahrain may obscure significant threats to the sustainability of the institutions that support it and hence undermine its sustainability. Furthermore, the interplay of technology, politics and policies are viewed in this research as dynamic processes.

1.5 An Interdisciplinary Analysis of a Changing Water Management Paradigm

Overcoming water scarcity in Bahrain, through desalination, is the principal subject matter of this research. This focus is examined in the interplay of technology, politics and discourse. To substantiate this analysis, two positions underpin the focus of my research. Firstly, I approach "large-scale desalination" as a development intervention where the agenda is influenced by external and internal factors. Subsequently, I seek to investigate the drivers of the water scarcity discourse and their role in mobilising consensus around the issue. Secondly, I seek to understand the influence of this development intervention on the politics and policies of the water sector, as well as the implications for water management system institutions. Considering the above, the role of desalination in water

politics and policies in Bahrain warrants an inquiry that traces and assess critical junctures in the journey of desalination.

The study's significance is in providing a new and better understanding of the dynamics between desalination and water politics in Bahrain. The theoretical and empirical contributions are as follows: theoretically, it adds to the literature of water scarcity in the GCC by providing a unique perspective on the evolution of hydro-politics and dominance of desalination in Bahrain. While existing studies focus on the apparent natural scarcity as a justification for the adoption of desalination in any particular setting, this study contests the scarcity narrative by examining Bahraini hydro-politics through historical milestones of desalination adoption. Specifically, the study enhances our understanding of the factors that influenced the rapid expansion of the desalination sector by tracing the historical projection of the sector's development through the identification of discourses and narratives that are still under-researched. Moreover, this thesis contributes to development theory and practice by deconstructing the notion that desalination is *the only option* to counter the apparent water shortage in Bahrain. To do this, I examine the persistent perception of water scarcity and the underpinning assumptions along the desalination development pathway.

Empirically, this study contributes to understanding the hydro-trap that the Bahraini municipal water sector experiences through the dominance of desalination. Present discussions focus on the persistence of desalination in the policy arena and argue that development in the desalination sector prescribes a path dependency, technical lock-in (Teschner et al., 2013), and sunk cost (Barnett & O'Neill, 2010). These discussions also analyse the implications of desalination technology in the water system as an inherent side-effect of industrial, social, economic and institutional transformation, and one that also reduces the space for policy-makers to navigate the long-term selection of policies. In essence, this study explores whether the persistence of desalination is a technological choice or politically inevitable.

1.6 Structure of the Thesis

In the following chapters, I build a case to illustrate the extent to which state-building policies, the context of modernity, scarcity discourse and the politics of water reforms have influenced the uptake of desalination processes in Bahrain.

In addition to this chapter, the thesis consists of five further chapters, within two main parts, before the conclusion. In Part One (Chapters 2 & 3), I situate the current study in the related literature, present the research design details and then provide general background information about the case study. In Chapter 2, I outline the multiplicity of forms that desalination could emerge through: the hydraulic mission of the state, as a means to overcome water scarcity and as and an example of climate change adaptation. I examine how the use of desalination is justified depending on specific water resource management paradigms. I also review the role of discourse in influencing perceptions of water resources, of which water, and control of water, is viewed in the realm of competing for knowledge and power. After that, I propose an analytical framework to understand the expansion of the desalination industry in Bahrain. The factors are derived from the existing literature, and the framework is intended to guide the approach of the study. Additionally, I present the design method which justifies adopting a qualitative case study for this research. I explain how the analysis is implemented, going from data collection to data analysis, to answering the main research question. Towards the end of Chapter 2, I also discuss my positionality and various ethical considerations. In Chapter 3, I unpack the Bahraini case by providing a historical and contemporary overview of water, society and ruling strategies. Additionally, I present an overview of Bahraini water resources, from natural water to manufactured water. The water sector information focuses mainly on the institutional setup, stakeholder relationships and the unique position of desalination in the composition. Later on, I present a historical narrative of the development of desalination technology globally and then provide an account of where the local Bahraini market stands. This data provides an essential background to the unique position of water in Bahrain past and present, and paves the way for the analysis of the empirical data.

In Part Two (Chapters 4, 5 & 6), I present the analysis of the empirical data gathered. Chapter 4 provides historical and archival accounts of the dominant and competing

discourses that have accompanied the desalination journey and the formation of the modern Bahraini State. This chapter explains the phenomenon of *Desal Fever* and how the regional and national policy climate paved the way for large-scale desalination expansion. The chapter charts the different milestones in the adoption of desalination in Bahrain, and discursively analyses them along regional and national development trajectories. The emphasis is on how these milestones correspond to a broader policy discussion around food and water, and the evolution of their securities. Chapter 5 is an in-depth investigation into the narratives of scarcity associated with the promotion of desalination as *the only option*. This chapter aims to analyse and interrogate the prominent narratives associated with the expansion of desalination. Specifically, how the discourse is constructed around water issues and why desalination remains a strong policy option. Chapter 6 extends the analysis and examines the *hydro-trap* as an interplay between the projection of abundance and a hydraulic mission that is engineered and technically oriented. It highlights how the water institutions evolved, in response to the expansion of desalination, reinforcing greater dependency on this option, one that is difficult to change. Subsequently, how these responses to a specific path of development within the water sector have reinforced the position and dominance of desalination.

Finally, Chapter 7 provides a synthesis and the concluding remarks of the thesis. It briefly recapitulates the purpose of this study, the main thematic concepts and the research design. It, then, presents a broader view of understanding the emergence of large-scale desalination schemes by providing an account of how desalination was initiated, expanded and then came to dominate the domestic water supply. The principal research question and sub-questions are reviewed, and the chapter concludes by critiquing the single contemporaneous presentation on desalination and showing how it could be justified and emerge through various guises and forms.

Chapter 2: Literature Review, Concepts and Methodology

2.1 Introduction

As introduced in the previous chapter, this thesis examines the large-scale expansion in desalination schemes and its justification in Bahrain, often in the name of "scarcity". This work locates politics and discourses that promote desalination as an innovative, and sometimes necessary, tool that i) promises the end of scarcity; ii) projects abundance and iii) represents the triumph of science and technology over nature. It interrogates the diffusion of an expensive technology and energy-intensive water supply option to supplement, augment, and in some cases replace the water supply of cities. The emergence of desalination has been widely acknowledged as location-specific and an option that addresses specific hydro-managerial concerns (Dawoud & Mulla, 2012). Yet, for countries that have utilised desalination for several decades, desalination could emerge periodically under various guises and forms (Williams, 2018). As such, concepts pertaining to the changing water management paradigm, discourses of scarcity and abundance, the hydraulic mission of the state and infrastructure-politics could provide unique dimensions to understand the desalination-fix.

In Section 2.2, I explore the desal-fix in a changing water resource management paradigm. I argue that the justification for the adoption of desalination could be realigned to suit developments in local and global water resource norms and practices. Then, in Section 2.3, I examine the role of discourse in influencing perceptions of water resources, of which water, and the control of water, is viewed in terms of the competition for knowledge and power. Next, in Section 2.4, I situate desalination in the realm of infrastructure-politics and path-dependency. Section 2.5 offers a critique of the literature on desalination and the motivation for the proposed analytical framework. The chapter concludes in Section 2.6 with an outline of the methodology and research design for the enquiry.

2.2 The Desal-Fix in a Changing Water Resource Management Paradigm

> *"The present water policy debate is dominated by the 30 year old mission to secure water supply and sanitation to all people"*
> (Falkenmark, 2007, p.3)

In this section, I review how the emergence of particular framings of water resource management, in any local context, associates with specific global approaches to tackling the water crisis issue. Given the centrality of water in enabling development objectives, a host of stakeholders have influenced how water and water resources are perceived and appropriated. In other words, my focus is on how institutions and processes have shaped water narratives and paradigms. As per the above quotation, water resource management has been under the spotlight since the second half of the twentieth century. Likewise, water policies have been adapted according to changing perceptions, the favoured wisdom and knowledge of the time and, to some extent, to particular water dimensions (environment, social, economic and political). The supply-led, control-based approach, which includes dam building and water transfer, has shifted to consider more diverse methods of water management (Nicol & Slaymaker, 2002). For instance, in the 1960s, discourse around water for the environment and protecting rural livelihoods stood in contrast to both the hydraulic-mission and aims of maximising water utility (White, 1998).

The social and environmental costs of large-scale infrastructure, dams being a prime example, were contested through the highlighting of issues such as involuntary resettlement and ecological damage (Mehta, 2001). For instance, in 1956 the Economic and Social Council requested its staff and a panel of experts to prepare a review of the administrative, economic and social implications of integrated river basin development. Water allocation to the environment underscored principles of the hydraulic-cycle and the multi-dimensional value of water.

Towards the end of the 1970s, increasing emphasis was placed on the health and social aspects of water resources. The culmination of several seminars and conferences on water resource management saw the 1980s declared the International Decade for Water Supply and Sanitation. International campaigns demanded water and sanitation for all, especially for the poor, and saw this as central to achieving global justice (Nicol et al., 2012). The

World Health Organization took a leading role in the organisation of the International Decade for Water Supply and Sanitation (1980-1990). However, while health and social concerns continued to hold weight, albeit with signs of inertia, financial sustainability issues gained more attention. The 1990s saw the emergence of The Dublin Principles[9] and their emphasis on the economic value of water, paving the way for neoliberal logic in dealing with water issues (Savenije & Van der Zaag, 2002). Of particular importance was the general acceptance, among water resources managers, that water should be considered an economic good, which includes the process of integrating decision making on the allocation of scarce resources. The Dublin Principles herald a turning point in the perception of water, whereby supplies are considered scarce, necessitating a shift to demand management (Mehta, 2000).

At the beginning of the century, however, consolidation around a holistic and integrated water management paradigm emerged. The 2nd World Water Forum at the Hague in 2000, conceptualised Good Water Governance in its declaration, as a managerial paradigm to water resources (Century, 2000). In 2003, the Johannesburg Summit promoted components of Integrated Water Resource Management (IWRM) as another [effective] paradigm to address water issues (Pahl-Wostl et al., 2008). Although the IWRM concept has been around for a long time, it gained momentum, in its current form, at the International Conference on Water and the Environment in Dublin during January 1992 and subsequently at the Johannesburg Summit in 2003 (Mehta et al., 2004). This global diffusion of IWRM has been through a hegemonic process propelled by supranational global bodies such as the Global Water Partnership (GWP) (Allouche, 2016). The integrative aspirations of the IWRM paradigm were therefore seen as an attempt to prioritise allocations to maximise yield.

While the relatively fast paced changes in water management paradigms occurred internationally, not all countries and regions were adhering to their application. Allan (2003) indicated that the Global South remained partially entrapped in the hydraulic

[9] The Dublin Principles recognise:
(1) The finite nature of water and its key role in sustaining life, development and the environment.
(2) The importance of participatory approaches in water development and management.
(3) The central role played by women in the provision, management and safeguarding of water.
(4) The economic and competing values of water and the need to recognise water as an economic good. (United Nations, 1992)

mission, while the Global North transitioned to a more reflexive modernity, Figure 2.1[10]. Therefore, in the last few decades, the gap between the two paradigms has manifested a contentious discourse. The standard explanation for the difference focuses on the contrasting financial and institutional climates of developed and developing countries. Nonetheless, every country has its own development trajectory and complexities. Notwithstanding this explanation, detailed case studies show complex factors and actors involved in shaping the policies and agendas that are applicable in a particular geographic location (Xie 2006; Pahl-Wostl et al., 2007; Dawadi & Ahmad, 2013; England & Haines, 2018).

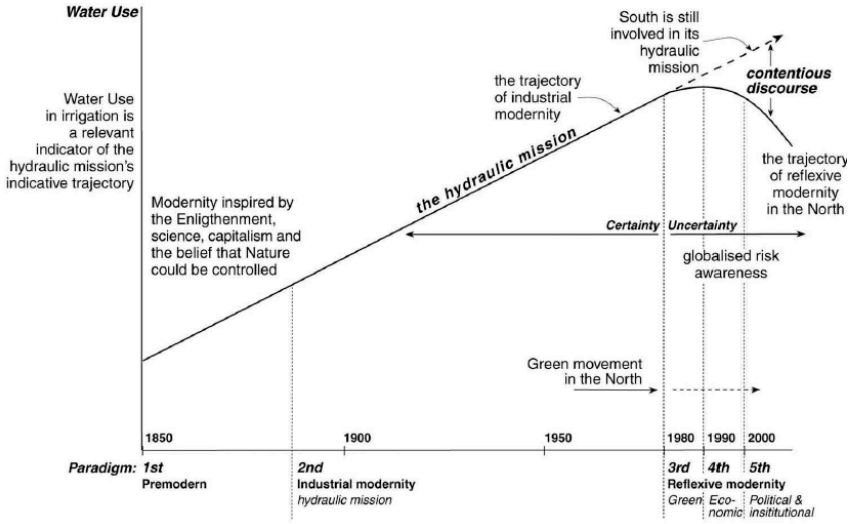

Figure 2. 1: Evolution of water management paradigms
(Allan, 2003, p.10)

Networks of actors emerged to champion the different dimensions of water and articulate linkages and relationships that sought to emphasise potential solutions to the *water crisis.* For instance, international actors such as the World Bank, International Monetary Fund (IMF), Global Water Partnership (GWP) and others, championed the importance of ensuring the financial sustainability of water projects, asserting efficiency as a tool and water as a scarce resource. Water, in all its dimensions, was then visualised in the Integrated Water Resource Management (IWRM) approach (Allan, 2003). In an operational sense, in 2001, the GWP introduced an IWRM toolkit to help developing countries manage water resources and efficiency. Other conceptualisations such as the

[10] In this figure, Allan presents a conceptual framework of the paradigmatic shifts in water management policy. The vertical axis represents water use and the horizontal axis represents time.

Water Security and Water-Food-Energy (WFE) nexus emerged through the global initiatives of the GWP and World Economic Forum in 2000 and 2011, respectively. While the concept of water security is abstract and general in its meaning, the WFE nexus emphasises the interlinkages between the three policy elements and decision making (Cook & Bakker, 2012; Allouche et al., 2015; Middleton et al., 2015).

Therefore, each episode in the evolution of water resource management stems from a unique conceptualisation of water. Each management paradigm charts solutions and political support to forward a particular understanding of water resource appropriation and utilisation. Of particular interest is how a specific water solution could have multiple guises and adaptations to satisfy often contradictory water management practices. For desalination, I refer to its deployment to fix specific management problems. The notion of a *desal-fix* is referenced, although the term is not specifically used, in a review by Williams & Swyngedouw (2018a) on "Mobilising the oceans to quench our thirst". I continue to situate the emergence of the *desal-fix* in changing water resource management policies and practices, and discuss how desalination could be deployed to suit different managerial paradigms.

2.2.1 Desalination as a Fix for the Woes of the Hydraulic Mission

The hydraulic mission of the state is an important concept that denotes the control of nature in order to achieve the best possible outcome for humanity. Wester defines the hydraulic mission as "a strong conviction…that the state should develop hydraulic infrastructure to capture as much water as possible for human uses" (2009a, p.396). In other words, the hydraulic mission discourse is compelling because it postulates the solution of infrastructure to overcome the narrowly defined scarcity for good (Scheba, 2014). Whilst promising water abundance, the discourse around large-scale water infrastructure, engineered and technology-oriented, plays a central role in strengthening supply-management, state-building, and the legitimacy of the state (Molle & Mollinga, 2009).

The hydraulic mission discourse is articulated by a specific breed of technocrats, or "*Hydrocracies"* (Wester, 2009a; Molle and Mollinga, 2009), strongly attached to the mission and the formation of the state, and frequently led by civil engineers (Ibid). Large-

scale hydraulic work, such as the construction of dams and desalination plants, are therefore attributable to centralised forms of state power. For instance, Wester (2009b, p. 398) explains that "the 50 years after the Mexican revolution in 1920 witnessed a large increase in the irrigated area in the Lerma–Chapala Basin, intertwined with the formation and expansion of a strong hydrocracy with a keen sense of its hydraulic mission". Even in a contemporary setting, he argues that "the legacy of the hydraulic mission continues to inform water reforms in Mexico, and largely explains the strong resilience of the Mexican hydrocracy to "deep" institutional change and political transitions" (Ibid, p. 395). In this light, the state's hydraulic mission could be attributed to the dynamics of power and control inherited from institutions and practices.

To understand the dynamic between state power and control, and development trajectories, England and Haines (2018) examined the various spatial and temporal transitions of water management in Nepal. While the developments in water management manifested in the augmentation of water in different topographies in Nepal, it still reflected and contributed to "how the state initiated and subsequently consolidated its control of water through infrastructure development in pursuit of the hydraulic mission" (Ibid, p. 2). As will be discussed in Chapter 4 (desal-fever), state power and water control are historically reproduced and change with time.

While some hydro-scholars herald efforts to maximise every single drop of water for the benefit of man as the moment when "the hydraulic mission was born" (Molle & Mollinga, 2009; Wester, 2009a, p. 334), others have criticised the lack of social and environmental consideration given to the unfolding of large-scale projects (Mehta, 2001). As a result, "the collapse of the hydraulic paradigm" was predicted and the emergence of desalination charted as a potential cure to 21st century water issues (March, 2015, p.231). Seawater desalination is presented as a unique water management option because it offers a seemingly unlimited, steady supply of high-quality water without impairing natural freshwater ecosystems.

The utilisation of desalination has often been presented as a "silver bullet" or a *panacea* (March et al., 2014; Williams & Swyngedouw, 2018a). March et al. (2014) examined the

shift in Spanish water policies towards desalination, over other water supply options, from the beginning of the 21st century. They stated that:

> *"desalination has been seen as the cure for everything that dams and inter-basin water transfers were unable to solve, including droughts, scarcities, social conflicts, environmental impacts and political rivalries among the different Spanish regions"* (Ibid)

This positive outlook of what desalination can achieve extends into the future. For instance, desalination has substituted water transfers as a sort of new "*cornucopia"*, a symbol of water abundance, able in principle, to solve the future water needs of urban expansion. Swyngedouw (2013) observes how the 2004 change of government in Spain, saw a planned, controversial, river diversion scheme scrapped and desalination presented as a hydro-social fix. Nonetheless, such cornucopia was only scoped to solve the water shortage for the high-end tourist sector and for irrigated cash-crops (Ibid). As such, while desalination is promoted as an innovative solution, offering an unlimited supply of water, that is often pushed by governments seeking to circumvent difficult national political decisions (Feitelson, 2018), the question remains for whom and to address what? In this regard, desalination can be seen as closely linked to [strengthening] the state's hydraulic paradigm, as will be discussed in Chapter 6.

Furthermore, the ability of the desal-fix to be deployed as a custom-fit solution to address specific concerns is evident in its promise to counter droughts in various locations. Scheba and Scheba (2018) study the construction of desalination as an emergency drought-fix in South Africa. They observed that considerable urgency (emergency) was needed to legitimise the hard path approach to water augmentation via desalination (Ibid). Desalination was also introduced in other geographical locations, such as Mexico and Australia, to address recurrent droughts. Yet, in the case of Rio Santiago, Mexico, the use of desalination was frequently halted as the intensity of draught subsided, whilst in Victoria, Australia it remained an ideal solution (Wester, 2009b). In other words, despite the "sunk cost", desalination plants can function as an insurance policy when drought occurs (Barnett & O'Neill, 2010). Despite the reduction in production capacity, the promise of water abundance via desalination is an integral part of any desalination policy agenda. The next sub-section examines how desalination adapts to IWRM's principles.

2.2.2 Desalination as a Prudent Component of Integrated Water Resource Management (IWRM)

During the 1990s, a new management paradigm of IWRM emerged to provide holistic management approaches to the water sector. The popularity of the IWRM concept has been under constant study and evaluation. For instance, Allouche argues that the global diffusion of IWRM has been through coercion, cooperation and constant learning (Allouche, 2016). Whereas, Molle attests that "IWRM is a moving target since new problems emerge and evolve over time, which require considerable flexibility and regular attention… , in addition - just as with *nirvana*- the objective is always just beyond reach" (Molle, 2008, p. 132-133).

Additionally, the IWRM framework illustrates a shift towards demand management that provides explicit consideration of water management and water policies, water legislation, institutional frameworks, participatory planning, and trans-boundary issues (Dziegielewski, 2003). Within the international water policy network, the IWRM concept has emerged to replace the state-led, supply-focused hydraulic paradigm. Whilst the IWRM narrative is posed as a techno-managerial solution, politics of allocation comes to the forefront in contestations over water power and control. As such, the conventional mandate of the state to invest in the development of water infrastructure and enlarging access to the resource is modified to managing and allocating. In light of that, IWRM is articulated as a framework that seeks to incorporate all potential water supplies and match them with the most economically beneficial users. What is overlooked, as argued by Mehta et al. (2014) is "the power of the state …. to facilitate the allocation of water to powerful users and render some users more visible than more marginal ones" (p. 539).

Furthermore, the process of integrating and implementing IWRM was found to be a non-linear task. Even within the same geographical context, countries that were tasked to experiment with IWRM showed inconsistencies in implementation. Mehta et al. (2014) examined the spread and uptake of IWRM in South Africa, Zimbabwe and Mozambique, concluding that these cases highlight "the importance of interrogating the relevance of IWRM against the backdrop of the prevailing socio-historical dynamics" (p. 538). An example of the problematic price of integration can be found in the Fischhendler and Heikkila (2010) study, which asserts that IWRM prevented institutional change and

reduced the adaptation capacities of the Israeli water regime. According to their research, serious efforts to implement physical, organisational and inter-sectoral integration led to institutional lock-in and stagnation (Ibid). Hence, the way in which IWRM impedes institutional change could be viewed as a form of institutional path dependency, of which historically benefitted interests become entrenched. Additionally, Scrase and Sheate emphasise that "it is essential not to view integration unreflectively as a panacea or shortcut to sustainable development" (2002, p. 288).

In essence, while IWRM continues to be a ubiquitous concept promoted by supranational bodies such as the World Bank, GWP and others, the uncontroversial local acceptance of IWRM may obscure the aim of integration: how, why, and most importantly, into what? As Conca (2006) notes, IWRM continues to be "the discursive framework of international water policy" (p.126). At the core of this market-led approach to water management is the aspiration of achieving neoliberal[11] efficiency (Ibid). McEvoy (2018), examined the interplay of the adoption of desalination and the international water policy principles on Mexico's water reforms. The study found that the adoption of desalination facilitated some key policy principles, such as decentralisation and privatisation, and deviated from others in significant ways, such as public participation. In light of this, it is suggested that the adoption of desalination as a water policy could function more as a prudent part of the IWRM realm than as a tool of the hydraulic mission. This is relevant to how large-scale desalination schemes are viewed in driving profit and luring international companies into production, examined further in Chapter 6.

However, while the hydraulic mission is usually attributed to firm and state centric control of resources, the recent embracement of the neoliberal agenda could be attributed to water management transformation. Abdullaev and Rakhmatullaev (2015) analysed changes in water management in Uzbekistan, Central Asia. They argued that the recent adoption of the IWRM paradigm should not be understood in stark contrast to the traditional state centric management system. The rather careful analysis highlighted that signs of state

[11] The 20th century notion of neoliberalism is the revival of 19th century liberal free-market capitalism. In his 1951 essay, "Neo-Liberalism and its Prospects", Milton Friedman described a set of economic beliefs that included the prioritisation of the price mechanism, free enterprise, the system of competition, and a strong and impartial state. Proponents of this philosophy subsequently emphasised and encouraged state-market relations, the removal of price control, decentralisation and the downsizing of the role of the state.

control were still manifest in socio-political forms, of which "the state centric model of water management still persist[ed]" (Ibid, p. 849). As such, conflict and contestation between different actors within the process of decision making could be seen between the two factions, as will be explored in the empirical chapters.

In general terms, whilst the role of the state in operating water infrastructure services subsided, in favour of more private sector involvement, the state's regulatory functions did not keep up (Mortimore et al., 2009). Most GCC countries have made efforts to develop the institutional and legislative framework for water management (Ghaffour et al., 2013), however, whilst they have formally adopted IWRM, they still lack the legislative instruments to support its implementation. There exist challenges, such as water tariffs and cost recovery, centralisation, building local authorities, technical and financial capacities, ensuring effective enforcement and compliance and strengthening water institution performance (RBAS, 2013). Yet, proponents of desalination argue that its adoption is a crucial factor within IWRM, producing the highest value water for drinking and industrial uses. While desalination is, logically, assigned to domestic users in the GCC countries, difficulties remain in assigning a usage price for cost recovery.

To this end, Allan (2001) argues that there are political imperatives in the selection and distortion of information on water in the Middle East. These imperatives drive the countries of the GCC to assert that their economies have not run out of water. Consequently, the water question is answered through the introduction of desalination to sustain and ensure the municipal water supply during all seasons. The lack of flexibility within the water management institutions of the Arabian Peninsula is noted as a missing element by many observers (Dawoud, 2005; Cook & Bakker, 2012; Darwish et al., 2014). Expansion in the desalination sector is perceived as inevitable, and remains a primary water policy, dictating future plans to respond to increasing water demands. Services, in particular food and water, are then provided at a very subsidised rate to consumers. As such, the conceptualisation of comprehensive welfare is supported for, by *rentier state*[12]

[12] A rentier state is considered to be one whose national income is pre-dominantly derived from the export (external rent) of a natural resource, such as metals, oil and gas (Beblawi, 1987; Mahdavy, 1970; McDonnell, 2013b).

advocates (Beblawi, 1987) and others who believe it is simply a modern extension of the tribal heritage that existed before oil exploration in the region (McDonnell, 2013).

Additionally, the expectation of the public remains another obstacle to overcome. The system nourishes a mentality of dependency on government hand-outs that hinder any potential for significant change. Therefore, any suggestion of removing or subsiding such entitlement is considered a sensitive issue and highly unfavourable (Sgouridis et al., 2013). Beblawi (1987) analyses the social effects of the rentier state on society by conceptualising "second-order rent" and highlights that citizens generate income without the need to engage in economic activities. An example of second-order rent is the legal requirement for any non-local business to be registered under national ownership, giving locals a privileged earning position without taking a risk. In summary, the residual impact of a rentier state can be viewed in how the public approaches rights, entitlement and access to services, of relevance here are water services.

I anchor the analysis in the work of "*Later Rentierism"*, especially the thinking of Gray (2011) who highlights how the typical rentier states, viewed as centrally strong, evolved on several fronts that were significantly different to the original conceptualisation of the theory. These fronts can be summarised as those relating to foreign policies, the diversification of economic activities or even the legitimisation of parliamentary elections, labelled by Gray as "Quasi-Rentier State" or "Later Rentierism" (Ibid). These modifications can be attributed to both global actors and local aspirations, and access to information, warning of a "resource curse" and "rent-seeking" as a growth strategy (Nem Singh, 2014). In light of that, concepts such as the state's hydraulic mission can be aligned to the rentier's state approach to centralisation.

While most of the literature associates desalination with the state's hydraulic mission, desal-fixes exist to satisfy other forms of water management practices (Williams & Swyngedouw, 2018b). Specifically, how the *desal-fix* is viewed within the context of the supply-driven paradigm represented by the state's hydraulic mission and the more reflexive paradigm represented by the Integrated Water Resource Management (IWRM) approach. However, while these two divergent paradigms are influential in how water politics and policies are shaped, there are important interlinkages between them. In light

of that, I argue that the emergence of the *desal-fix* transcends the hydraulic mission paradigm and adapts to changes in water resource practices and norms, both locally and globally. As discussed in Section 2.2, desalination emerges through multiple forms and adapts to suit changes in global managerial paradigms. In 2.2.1, I examined how desalination is deployed as a solution to the problems associated with the hydraulic mission. In 2.2.2, I describe how desalination is deployed as a prudent component aligned to IWRM principles. As such, the multiplicity in presenting how desalination could adapt to suit global water thinking and practices provides a useful framework to examine the journey of desalination in any particular context, as will be explored in Chapter 4 & 5. In the next section, the role of discourse in shaping water policies is examined.

2.3 Discourse as Knowledge and Power

Given the crucial role that language and discourse play in shaping views and paradigms (Hajer, 2006), it is essential to understand the discursive nature in which desalination is proposed in the Bahraini context. Here, discourse is defined as "a specific ensemble of ideas, concepts and categorisation that is produced, reproduced and transformed in a particular set of practices and through which meaning is given to physical and social realities" (Ibid, p.44). However, it is important to note that reducing the complexity of reality to a simpler framing is not only an exercise of knowledge, but also of power. As such, discourses and their associated narratives, are framed according to power-knowledge configurations that are politically motivated, within historical contexts, and require close-up examination. These framings are contingent on historical events, social forces and ideologies as the sources for the emergence of "facts" and "problems" (Hacking, 1999). Relevant to this thesis are discourses on water scarcity and abundance.

Additionally, discourses and ideas are powerful constraints of action, framing and setting the limits of what can be perceived as possible solutions to societal problems (Arts and Buizer, 2009). On the one hand, discourses can explain lock-in alongside infrastructural networks and vested interests, they do maintain the specific "rules of the game". Hajer (1995) has also suggested that discourses are passed from one generation of policy-makers to the next. Thus, discourse can contribute to path dependencies, exclude alternatives during strategic decision-making processes, and mask unconventional future pathways because they constrain ways of thinking and acting. But on the other hand,

discourses can also foster change by realigning actors into discourse coalitions or policy networks that "can be used to undermine and disrupt existing policy practices and generate and legitimise new approaches" (Smith & Kern, 2009, p. 79).

Studies of water resource scarcity have typically interrogated the socio-political context, institutional processes and implications (Mehta, 2001; Kaika, 2003; Cook & Bakker, 2012). However, Alatout (2009) advocates for examining abundance as a "constructed category by itself, rather than the hidden, other side of scarcity" (Ibid, p.366). More importantly, as Chapter 4 examines, there are critical historical junctures around which discourses could gather converge or swipe to justify different, often contradictory, settings and policies (Kaika, 2003; Alatout, 2008). In light of this, discourses on scarcity and abundance are understood as "discursive vehicles" to exercise authority and build political consensus in efforts to legitimise specific political endeavours (Kaika, 2003). As such, central questions emerge of how, why and by whom discourses are produced in the forms they are at any particular historical moment? Underpinning this discursive context is the Foucauldian notion of "knowledge and power", and how the manufacture and representation of narratives by different actors becomes an exercise of their political power (Wagenaar & Cook, 2003). Foucault's equivocal phrase "internal relation" is used to describe the relation of discourse to power:

> *"Knowledge and power are integrated with one another, and there is no point in dreaming of a time when knowledge will cease to depend on power [….] It is not possible for power to be exercised without knowledge, it is impossible for knowledge not to engender power"* (Foucault, 1980, p. 52)

Hence, the central message in what Foucault is articulating is the need to understand "how" the representation of knowledge, whether scientific or normative, is linked to power and authority, and "how" the proximity of power and knowledge is used to assert legitimacy. Yet, there is still a need to unpack the themes and processes that engage, and are relevant to, the water resource management debate. The next two sub-sections explore the role of discourses on abundance and scarcity in framing the perception of water, constructing reality and how they lead to the closure of options and alternatives. In particular, how knowledge and power are intertwined in framing and representation.

2.3.1 From Abundance to Scarcity

The emerging debates around abundance and scarcity started, as Xenos (1989) states, in the relatively affluent societies of the modern West, as a consequence of the specific attributes of modernity that emphasise the importance of material objects as a signifier of relative social status. The mainstream theory elucidates *wants* to be unlimited relative to resources, so that universal scarcity is a chronic and inevitable feature of economic life (Daoud, 2011). However, if *wants* are subject to relative human perception, it becomes possible for people to achieve relative abundance by deflating their material desires (Ibid). In essence, concepts of *scarcity* and *abundance* are usually deployed as discourses that function to neutralise and legitimise certain human endeavours. Furthermore, resource scarcity can become a totalising discourse that obscures social, economic and political forces, while focusing on natural attributes (Mehta et al., 2019). Therefore, critiques of the scarcity discourse encourage unpacking and understanding various framings and dimensions of the concept (Xenos, 1987; Mehta, 2001; Bakker, 2000; Barbier, 2013).

Alatout (2008) traced the changes in the perception of water potential in Israel. He points out that most water and political experts believed water to be abundant from the mid-1930s through to late-1950s when a total reversal took place. Prior to the establishment of the Israeli State, in 1948, abundance was a scientific and political discourse that justified the Zionist colonial project. Abundance was used to justify the "ingathering" of the world's Jewry in Palestine to assure that Jewish immigration would not pose an economic threat to the original inhabitants of Palestine. However, post-settlement, there emerged a consolidated, hegemonic, discourse on water scarcity that charted the Israeli style of governance on water resources (Ibid). Alatout, therefore, argues:

> *"While water scarcity is an extremely important narrative for understanding contemporary water politics in Israel, it is not the only one…Contrary to common beliefs, the prevailing narrative of water resources before 1948, especially among Zionist practitioners, was one of abundance."* (Ibid, 2009, p.365)

Although the discourse around water availability changed dramatically from one of abundance to scarcity, Alatout (2009) traced the key actors' motives for advocating each position. While the firm belief in abundance, before the formation of the State in 1948,

was necessary for attracting Jewish migrants to Israel, the subsequent perception of scarcity was also politically motivated. As such, the shift to constructing water resource scarcity, in the newly formed Israeli State, legitimised the Government's apparatus towards a centralised and robust regime (Ibid). As will be elaborated upon in Chapter 4 *(Desal-Fever)*, ideas of scarcity and abundance remain powerful concepts, deployed by strong actors and stakeholders to satisfy political and economic forces.

Daoud (2010) argues that scarcity and abundance are concepts that concern human activity or social provision, therefore, the social construction of either of them is a function of relativity rather than of absolute settings. It is possible that limited resources may not always equate with scarcity (Barbier, 2013). In this regard, discourses of abundance and scarcity are potentially politically constructed to define which methods of knowing are legitimate, what perception of water potential is scientific and how accurate it would be to use either technical or historical narratives to legitimise water-related policies and projects. These questions are explored in greater depth in Chapter 5, where I deconstruct the water scarcity narrative in Bahrain.

In the same vein, Kaika (2003) examines the drought that hit Athens between 1989 and 1991 and analyses the role of the scarcity discourse around drought as a natural phenomenon, and its use to legitimise the political-economic transformations towards liberalisation and privatisation of water management. She highlights the change in the "discursive" production and perception of "nature" and "water resources", from abundance to scarcity, in the state's emergency responses adopted to deal with the "drought crisis" (Ibid). It is important to note, that the deployment of scarcity and crisis discourse tends to naturalise the crisis and subsequently overlooks inherited structural socio-managerial issues (Bakker, 2000). As such, Mehta (2001) asks *scarcity for whom?* when a controversial hydropower dam project was proposed to solve water scarcity in Kutch, India. Therefore, scarcity, or "scarcities", have different forms and dimensions and are understood differently by different stakeholders. Nonetheless, powerful and authoritative actors monopolise and mandate the form of scarcity that suits their agenda.

Thus, it is argued that naturalising the causes of the scarcity discourse function to depoliticise the development trajectories entrusted to overcome the issue (Mehta, 2010).

The naturalisation of the water scarcity discourse is founded on scientific methods articulated to chart a given reality that is harsh and arid. Xenos highlights that "scarcity has become a technical concept" as a result of the emergence and development of neoclassical economics that advocate wide-ranging and radical approaches to development (Ibid, 1989).

Mehta (2001) argues critically against the discursive narratives of water scarcity, which were deployed in Kutch, India, to legitimise the construction of a controversial dam project. By tracing and assessing the narratives that capitalised only on drawing attention to the lack of water supply, due to natural forces, rather than looking at human-induced land and water use practices. Mehta (2005) argues that water scarcity is both a "biophysical" phenomenon as well as a powerful discursive construct. As those discursive constructs are usually deployed to highlight the obvious and what people can relate to, they typically operationalise specific development pathways. For instance, Bakker (2000) analysed how scarcity was "produced" following the Yorkshire drought of 1995 and questioned the interpretation of the drought event [and nature] as the primary cause of water scarcity. The resultant water rationing and shortages lasted for the whole summer season in Yorkshire. In her analysis, she argued that water regulations, privatisation and underinvestment were crucial factors contributing to the water shortages (Ibid). As such, the scarcity discourse functions to provide a simplistic explanation of a complex issue, of what powerful actors aim to achieve, and more importantly, what they want to obscure. Following on from this, in Chapter 5 *(The Only Option)* the discursive and hegemonic nature of the scarcity postulate is analysed in order to unpack the winners and losers.

In a similar vein, Scheba and Scheba (2018) trace the drought-desalination assemblage in South Africa. The dominant narrative of drought as a natural phenomenon, they argue, "has become the discursive foundation to postulate the viability of desalination as a solution" (2018, p.99). As such, the narrow framing of the emergence of natural conditions, such as drought, function as a trigger to overlook the social and political construction of scarcity. Subsequently, specific development projects (the construction of dams, aquifers and desalination plants) and reforms (privatisation and increasing water tariffs) are then legitimised to deal with the particular articulation of water scarcity

(Feitelson, 2018; Mehta, 2005). Engaging critically with the water scarcity postulate does not mean that I deny the existence of such a phenomenon in its physical aspect. Still, instead, I try to contribute to what Mehta describes as "an all-pervasive fact of our lives" (Ibid, 2010, p.2). As stated by Luks "there are problems, but they are not merely 'out there'. To discuss something as a problem is already a social construction. This is why many [analytical] approaches emphasise the role of language and construction" (2010, p. 156).

Within the crisis narrative, there is usually a particular agenda that closes down other options, labelled by Mehta as "The manufacture of TINA" (Mehta, 2005, p. 266). The chosen agenda leads to an emphasis being placed on the drawbacks of all options available in order to contrast it to a single "bullet-proof" well-articulated solution. Not only that, the way the discourse is articulated is to underestimate the socio-economic damage that the proposed solution might entail. For the case of SSP[13] in Kutch, a host of stakeholders argued for the ostensible bounty of the project through manufacturing a perception of abundance. In a similar vein, Scheba (2014) analysed how climate change surfaced as central within the crisis narrative, leading to claim that rainfall and surface water sources were unreliable and consequently supporting the adoption of desalination technology as imperative, in South Africa. She examined how monthly Provisional Drought Meetings where the primary focus was placed on sharing information regarding weather patterns and funding opportunities, facilitated the framing of "TINA".

2.3.2 Scarcity-Desalination Assemblage[14]

The promotion of desalination as an emergency drought-fix in South Africa, and other contexts, becomes the discursive foundation to postulate the viability of desalination as a solution. However, scarcity-desalination and its variant drought-desalination assemblages are not limited to the physical aspect of water shortages but rather a linguistic tool to exercise power and knowledge. Subsequently, socio-political consensus is formed in the delivery of key political and development reforms and projects. Scheba and Scheba (2018) trace how drought and desalination come to be assembled as processes. They

[13] Sardar Sarovar Project is a multipurpose irrigation and hydroelectric project in Gujarat.
[14] I refer to assemblages here as processual relationships that cannot be reduced to individual attributes alone to support the emergence of a particular view or solution-problem explanation.

examine how the introduction of desalination plants in Cape Town, South Africa, came about in response to unprecedented drought and low dam levels. In their conclusion, they argue that drought-desalination comes to be assembled as processes that are infused by politics and power, and subsequently overlook the social and political production of scarcity.

Therefore, the uncritical acceptance of a mode of environmental management that understands water as a scarce resource is a prerequisite to the desalination proposition (Williams & Swyngedouw, 2018a). As will be discussed in Chapter 5, desalination as the only option is deeply premised on the assumption that dwindling or uncertain traditional supplies are contributing to growing water scarcity. In other words, a widespread consensus that water scarcity is a problem that requires "new" water resource solutions is essential in justifying the substantial financial and considerable socio-ecological costs of building and operating desalination plants (Ibid).

In this respect, the impending threat of water scarcity is used consistently to advocate for more infrastructure expenditure and institutional reforms (discussed further in Chapter 5). In the GCC, the pursuit of achieving abundance is criticised locally to be alien to the region's heritage and customs (McDonnell, 2013). This is exhibited in the emergence of the modern Gulf States and the idealising of a global materialist, affluent lifestyle as a way to achieve abundance. As such, in the GCC, and Bahrain more specifically, the welfare system is believed to project abundance via access to its services and commodities. Therefore, with rapid urbanisation and an increase in consumption and population rates, the response to the looming "water crisis" is then to maximise supply options, such as desalination.

Linton and Budds (2013) argue that what is at stake here is not merely water. Desalinated "water" develops new waterscapes through the transformation of economic possibilities (e.g. rapid urban development), ecological conditions (e.g. artificial aquifer recharge) and social identities (e.g. Westernisation). A similar study, McEvoy (2014) reports on the effect of incorporating desalinated water into the municipal water supply portfolio in the arid city of Cabo San Lucas, Mexico. The study analysed the competing discourse surrounding desalination and a discussion of alternative water management options for

achieving regional water security, in a broad sense. The study concluded that desalination, as a technical fix to water security, does little to address the more systemic and structural problems relating to the socio-economic and institutional factors that also determine water security. Rather than challenging the business-as-usual development strategy, desalination enables it (Ibid).

Thus, the undertaking of discourse analysis will help me to examine desalination in Bahrain as part of a hegemonic approach to political processes which insist on articulating a *water crisis* that is critical to the socio-economic development of the country. What is usually obscured is the persistence of large-scale infrastructure in the policy arena. In the next section, I review the interplay between infrastructure and politics and their roles in necessitating path-dependency.

2.4 Policy Processes and the Politics of Hydro-Infrastructures

In previous sections, hydro-infrastructures, such as desalination plants, have been discussed and situated in state politics and the broader hydraulic mission, as well as a panacea to cure water scarcity for good. While these two premises are useful, they portray the interplay of politics and infrastructure in one direction. In this section, I review the role of infrastructure in influencing politics. Concepts of co-evolution between infrastructure and politics and path dependency are explored, in the water context. The co-evolution means that political preferences, norms, expectations, and practices influence the development of new technologies, adaptations in infrastructure, actual management and operations, and vice versa (Frantzeskaki & Loorbach, 2010; Teschner et al., 2012). As such, co-evolution could also constrain the unfolding of alternatives because of existing relationships and dependencies. In short, as Levi (1997) put it "there will be other choice points, but the entrenchments of particular institutional arrangements obstruct an easy reversal of the initial choice" (Ibid, p. 21). Before the concepts of co-evolution and path-dependency are discussed, I begin by locating them in the politics of policy processes and dynamics.

The simple formulation of the linear model of policy process theory, several stages leading to a decision, is based on a number of assumptions. This model assumes that policymakers approach the issue rationally, going through each logical step of the

process, and carefully consider all relevant information (Keeley & Scoones, 1999). It implies that the consequences of alternatives have been considered and that the chosen option will be the one to maximise benefit (Sutton, 1999). Several frameworks, theories and models of the policy process have rebutted the linear formulation, characterised by objective analysis of options and the presence of beginning and end, which underestimates the complexity of the process (Wolmer, 2006). Others stress the importance of coupling policy implementation as part of the process and not as a separate stage as per the linear model's assumption (Sutton, 1999). Other formations, such as ambiguity and chaos in decision making, are relevant to agenda setting and policy implementation. For instance, ambiguity inherent in the decision-making framework is drawn from the garbage can model of organizational choice (Cohen et al., 1972) where participants drift in and out of decision making processes, dumping unrelated problems and solutions. This ambiguity gives rise to scope for political manipulation by actors to advocate for their solutions as a means to controlling the ambiguity.

As such, the science of policy setting and decision making has been labelled as a chaos of purposes and accidents (Sutton, 1999), organised anarchy (Cohen et al., 1972) and complex and messy processes (Wolmer, 2006). Kingdon (2003) argues in favour of "an idea whose time has come" as an interpretation that describes an irresistible movement that sweeps over politics and society, pushing aside everything that might stand in its path. He explains this by conceptualising the term "policy window" as an opportunity for advocates of proposals to push their solution or push attention to their special problems (Kingdon, 2003). Therefore, while some groups try to maintain their privileged position by minimising attention to the policy solutions which benefit them, others seek to expand attention, to encourage new audiences and participants, to generate debate and new action (Howard & Hussain, 2010). This dynamic of policy making and negotiation in the Bahraini water sector is further analysed in Chapter 6. The policy window emerges when either a problem floats, by which advocates could attach and lobby for their solution, or quite predictably, in response to the renewal of policy or program (Kingdon, 1995). Next, I review patterns of path-dependency and the co-evolution of political preferences with infrastructure.

2.4.1 Technological Lock-in and Path Dependency in Policymaking

Prior research on large-scale projects debate how they stabilise policies, cause stagnation on politics and "maintain Business As Usual" (Mahoney, 2000; Teschner et al., 2013; Williams & Swyngedouw, 2018b). The argument stems from the significance of accumulated invested capital. In other words, the probability of further steps along the same path increases with each move down that path (Pierson, 2000). Notably, the mechanism of reproduction is analysed to be so casually efficacious that they "lock-in" a given institutional pattern, making it extremely difficult to abolish (Gartland, 2005). A defining feature of path dependence is the idea that it is difficult for actors to reverse the effects of choices made during critical junctures that serve to lock countries into particular paths of development (Capoccia & Kelemen, 2007; Capoccia, 2015). As such, the point in time or the event when that initial choice or decision was made is commonly called a "critical moment or juncture" (Pierson, 2000). Accordingly, decisions taken during this critical juncture can have important influences, sometimes irreversible ones, on future decisions, and are said to be path dependent on the initial decision.

While path dependence theory emerged from the field of economics[15], a diverse range of disciplines has embraced the theory and its applications. In the field of economics, researchers such as Arthur (1990) deploy an understanding of path dependence theory as an alternative framework to the traditional neoclassical theory of evaluating efficiency. Mahoney and Aug (2000) elaborate the importance of the socio-historical approach to understanding why institutions change or persist. In their article "Path Dependence in Historical Sociology", they present two path-dependent patterns: reinforcing and reactive sequences[16] (Ibid).

Furthermore, one of the unique characteristics of reinforcing patterns is known as "increasing returns", when a product starts down a specific track, of which the cost of reversal or adapting alternatives becomes unfavourable (Pierson, 2000). Notably, self-rearrangement processes within resilient institutions could function to absorb shocks in a way to "escape reform" and ultimately maintain course. These self-rearranging processes

[15] For a comprehensive review of path dependence theory and its application in diverse settings, see Gartland (2005).
[16] For convenience, I use the terms "sequences" and "processes" interchangeably in the text.

are of great interest to the discussion in Section 6.3, which focuses on the introduction of water reforms to destabilise the entrenchment of desalination and its dependencies. In other words, even with the presence of exogenous shocks that are meant to directly change the course of how the system and institutions operate, they could potentially rearrange to maintain their core functions. Nonetheless, the question is whether the new path was really all that new. A reactive path-dependent sequence prevails when stakeholders and institutions react to change and transition. The presence of a critical historical junction, "or exogenous shock", that steers policies and reform programs, attempting to modify or replace them, is countered by a reactive sequence (Mahoney, 2000; Nastar & Hansen, 2009).

The argument is about the momentum that the processes gains along a specific path that inevitably reinforces its position. However, to reverse or change course will necessitate overcoming inertia and institutional rigidity. Therefore, any changes in a path-dependent setting would naturally be triggered by exogenous shocks (Méndez et al., 2019). The degree to which the changes are manifested depends on how severe those shocks are and the resilience of the path-dependent institutions. For instance, in historical institutionalism, it is well recognised that periodic "critical junctures" typically emerge in which contingent events yield opportunities to relax the self-reinforcing pressures (Capoccia, 2015).

Teschner et al. (2012) examine water, energy policy and technology development in Israel and observe how socio-technical transitions are conceptualised in co-evolutionary terms and are, therefore, not separable. They highlight that "technology is not exogenously designed and developed in a vacuum….rather, technology is formed within a wider context of social systems that goes beyond its particular function" (Ibid, p.458). In light of this, large-scale infrastructure systems, such as desalination plants, are critical for the welfare and operation of society since they ensure and provide drinking water (Frantzeskaki & Loorbach, 2010). Thus, while they serve societal demands, in return they pave the way for development of a technical base.

In a similar vein, Pahl-Wostl (2007) asserts the need to better understand the interdependence and co-evolutionary development of management objectives and

paradigms, environmental characteristics, technologies and social routines. Therefore, she argues in favour of increasing the ability of the system as a whole to respond to change rather than reacting to undesirable impacts linearly which may constrain alternatives and innovation. Correspondingly, high-tech, and path-dependent responses will likely result in increased reliance on technical expertise, less opportunity for participatory decision-making, and reduced flexibility (McEvoy & Wilder, 2012). This reduction in flexibility is evident in the difficulty in phasing out desalination production plants which are not utilised, because of the substantial capital cost. Barnett & O'Neill (2010) note the US$34 million desalination plant built in 1999 in Santa Barbara, Australia, which has never been used due to ample rainfall since its construction. It is still maintained ostensibly as an "insurance policy" though, but more likely because it is a *sunk cost*. In this sense, creating a tendency towards technological "lock-in" restricts the system in opting for other industrial innovations.

In order to advance our understanding of path dependency in the Bahraini water sector it is imperative to examine how institutions adapt and modify to maintain their competitive position (North, 2005). Therefore, path dependency theory helps to explain why institutions resist change, even with suboptimal results.

Generally, large-scale systems are capital-intensive and have a long life cycle (Frantzeskaki & Loorbach, 2010). Barnett and O'Neill (2010) highlight that a significant issue with extensive infrastructure development is the way it commits capital and institutions to trajectories that are difficult to change in the future, and therefore, reduces flexibility to respond to unforeseen changes in climatic, environmental and social conditions. Teschner et al. (2013) highlight how capital-intensive technological options have offered stability and stagnation of policy regimes in what has been termed "*lock-in*" and path dependency. Therefore, space for decision-makers to navigate the long-term is potentially restricted to the selection of policies that are realistic, considering the established investment in the existing infrastructure. In light of the above, this study approaches the position of desalination as both influenced by and influencing water policies. This interplay is critically important, as will be argued in Chapter 6, to trace path dependency and the effects of lock-in.

2.5 Critique of the Literature on Desalination and an Emergent Analytical Framework

Having reviewed the literature on desalination in the previous sections, it is important to note the limitations of this method. The key limitation stems from the close analysis of desalination as a series of independent events that emerged to deal with specific hydro-managerial concerns. Therefore, the approach offers an ahistorical account of how and why desalination was adopted in any particular context. Yet, in the context of countries with a relatively long history of desalination, such as the GCC States, this approach tends to overlook three things. Firstly, it analyses desalination as an emerging event to respond to a specific contemporary concern. Thus, it underestimates the socio-political evolution of these countries, along development trajectories, and the role of desalination in relation to this evolution. In order to construct explanatory and analytical narratives, I decided to examine the broader political setting and the drivers that accompanied key milestones on Bahrain's desalination journey (Chapter 4). While the contemporary examination of the desalination context is essential, I also endeavour to analyse the socio-political context of desalination milestones in order to explore relationships and dynamics.

Secondly, there is a tendency to conceptualise the role of desalination as a simple, apolitical and determinate water management measure to address the immediate and on-hand issue. Most of the literature on desalination, especially within the GCC, focuses on engineering, managerial and technical matters such as the role of surplus desalination water in aquifer recharge (Ghaffour et al., 2013), desalination and treated wastewater in the establishment of a total water cycle management (Al-Zubari, 1998), alleviating water shortages through desalination plants operated by renewable energy sources (Dawoud, 2005) to name a few. Thus, it usually overlooks how the techno-managerial concerns are intimately interwoven in political, socio-ecological and economic power relations (Williams & Swyngedouw, 2018a). Consequently, mapping stakeholders, analysing interests and identifying conflicts will help situate desalination within the context of the broader political economy[17]. Finally, it appears that desalination emerges in different guises and in various forms, depending on contexts and geographies. What might be

[17] The political economy of natural resources is about the interplay between politics and valuable natural assets. Critical political economy studies examine the relationship in both directions; politics could affect the exploitation of natural assets and natural assets could potentially influence politics and policies (Collier, 2007).

obscured is how the adoption of desalination within a geographical location is influenced by context specific changes that are used to justify its uptake accordingly. That is why I highlight three stages: emergence, expansion and dominance. This multi-faceted approach to data collection was essential in order to appreciate the historical and political contexts of these stages and subsequently, how path-dependency is formed (Section 2.6).

Acknowledging the multiplicity of forms through which desalination could emerge means that different contexts will require an interdisciplinary analysis of politics, discourse and dominant policies framed for various stages of desalination adoption. One way to study the complex nature of adopting and expanding large-scale desalination is through understanding the motivation for the different stages of adoption. To do this, an investigation of the historical and political context is needed to locate motives, roles of different stakeholders and local and regional policy development (Chapter 4). Additionally, as reliance on desalination increases, the development of a "problem-solution" discourse functions to sustain interest in particular managerial options, whilst suppressing others. Unpacking the discourse, interrelated themes, and narrative will be critical in understanding why a particular interpretation of the water problem gains dominance and is seen as authoritative, while other interpretations are discredited (Chapter 5). Finally, analysing the interplay of reforms and lock-in processes can be helpful in shedding light on how recent attempts to deviate from the singular managerial option of desalination towards more integrative approaches has been limited (Chapter 6). As presented in Figure 2.2, these elements can explain how large-scale desalination schemes dominated the water sector in Bahrain.

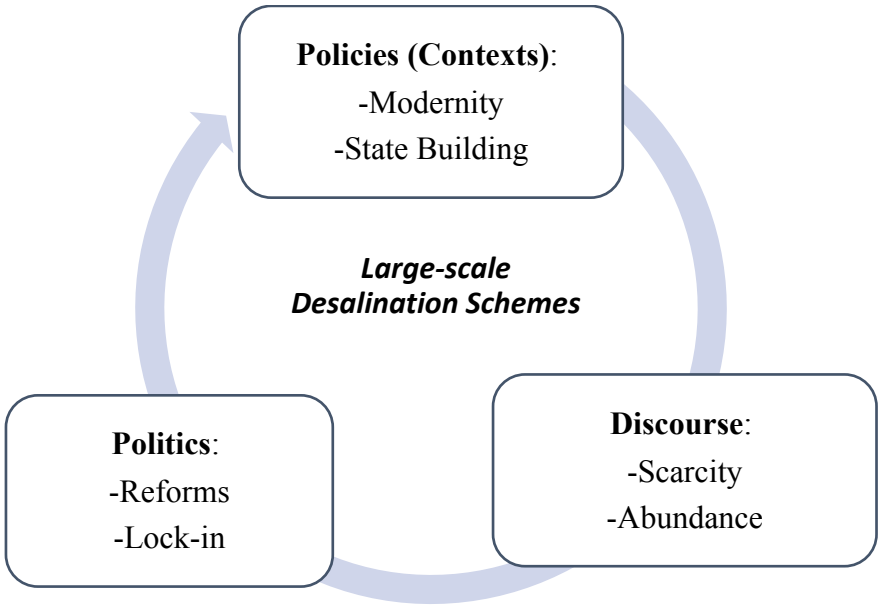

Figure 2. 2: Proposed analytical framework

The chapter now goes on to explore the methodological considerations that helped translate these theoretical concepts into practice.

2.6 Methodology and Research Design

In Chapter 1, I presented the main research question as "*What are the relationships and dynamics between large-scale desalination schemes and changing water management practices and policies in Bahrain?"* With the background of the reviewed literature and the scope of the research question, the research methodology is designed for a qualitative, in-depth, country-case study (Schrank, 2006) that considers multiple levels of analysis and interactions. Case studies are particularly valuable for exploratory research when a thorough understanding of a phenomenon in its context is preferred (Benbasat et al., 1987). Therefore, the qualitative research methodology was designed to address the limitations of previous literature on the changing dynamics of water resource management paradigms concerning large-scale desalination schemes. The study design was not strictly defined in advance, instead, I followed an exploratory, iterative and interpretive approach in which data collection activities supported each other throughout the process (Figure 2.3). Several research instruments were used as per the research design below.

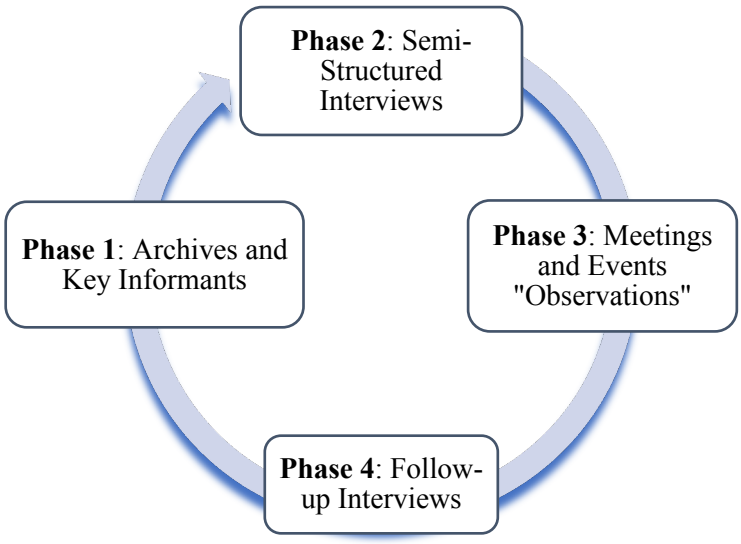

Figure 2. 3: Data Collection Process

2.6.1 Research Design and Method

To answer the research question, I had to choose a methodology that allowed for in-depth investigations into the dynamic processes of decision making around water resources. The reason for designing my research for multi-level analysis was to i) avoid uncritical acceptance of the ahistorical interpretation of the overreliance on desalination and ii) exploit the differences in various stakeholders to understand how "context" and "reality" are constructed. As such, "the case study…[involved] the utilisation of a wide array of different data sources and several different analytical strategies" (Schrank, 2006, p. 23).

Phase 1: Archives

As per the nature of the inquiry, a multi-faceted setting required different methods for data collection and triangulation. As such, interrogating archival sources[18] is used to map out contexts and actors to identify competing explanations.

In this phase, I wanted to explore i) the socio-political context that enabled desalination to emerge in Bahrain and ii) the role that desalination played in a changing water management paradigm. The stark contrast between the contexts, justifications and politics of the past and the present reasserted Vitalis' (2006) statement: "the past is another

[18] For a list of archives materials, see Appendix I

country" (Ibid, 2006, p.5). Upon taking up this project, I was mainly focused on water scarcity and the role of desalination in the contemporary Bahraini setting. I had no idea how deeply-rooted water and desalination, in some form, was in the Bahraini past as well as the present. It was not until I attended a local cultural exhibition entitled "Spring's Tales" that my eyes were opened to how intimately associated Bahrain was with the notion of water abundance. It was like a window was extended to a unique political economy of time and place that is usually unobserved but still much cherished. My research strategy changed. To capture the socio-political context of past events, I had to rely on archival materials. I allocated more time to sourcing archival documents from public and university libraries, ministerial repositories and public authorities. I tracked pre-independence diaries and correspondence, old newspapers, and technical data and reports gathered by international consultants. The archives used for the analysis are situated at the Arabian Gulf University Library, the Bahrain Centre for Studies & Research, the Electricity and Water Authority online repository and the online published materials of the Ministry of Work. The data collection is then complemented by the tracing of official government announcements in the form of decrees, projects and strategies.

Therefore, besides my original focus on mapping the present discourse and conflicts, it was compelling, instead, to work backwards in time. I then decided to enlarge my data collection scope to trace the discourse on water resource perception that had shaped hydro-politics since independence. For this first level of analysis I started by mapping and analysing some of the prominent narratives around the *water question*. More specifically, how discourse on *scarcity* and *abundance* is deployed to allocate the blame as a means to operationalise and favour certain policies. This contextual understanding was needed to shed light on contingent events that influenced decision-making. I started by identifying stages in the desalination journey that led to a change in rates of desalinated water in the domestic supply. Then, I mapped actors and events that accompanied these stages of adoption to understand relations and interplay. Subsequently, I identified the changes and continuity in perceptions of water resources, politics and practices. The aspects that I was particularly interested in were how water resources were perceived, how negotiation and decision-making were conducted and how the outcomes were perceived by different actors.

In this respect, the key limitation associated with this phase of the study was comprehending the socio-political context of events and milestones in the past. I had to cross-check and follow the advice of Vitalis and be mindful of "the need to be consistent [in the] citing of records" (Vitalis, 2006, p. 7). I also relied on semi-structured interviews to complement this phase, as explained below.

Phase 2: Semi-Structured Interviews

To complement the thematic and contextual analysis carried out through the archival work, in the second phase I tracked down the prominent narratives that shape the discourse around water availability and water crisis, and consequently the need to expand the desalination option. Key stakeholders were Electricity and Water Authority (EWA) employees, academics and consultants working in the water sector, and the media. I also noticed that the local voices of "water crisis" were very much associated with broader regional, GCC and MENA, concerns. As such, my focus was to analyse how the perception of the local context has been influenced by the meta-narratives of dryland, dryness and aridity (Chhotray & Stoker, 2010). This regional conceptualisation of the water crisis is not only influential but also contradicts the historical perception of water resources in Bahrain, as discussed above, in Phase 1. Therefore, while it is very tempting to accept the condition of aridity as the signifier of water scarcity and the justification for capital-intensive desalination schemes, I opted to interrogate this premise by analysing narratives, actors and interests.

In order to analyse the narratives of water scarcity and crisis I relied on interviewing water practitioners to understand "reality" through their eyes, and how their beliefs, values and background influenced how the discourse was shaped and reshaped. I followed the media presence of key individuals such as the Minister of Electricity and Water Affairs, CEO of EWA, and key academics and consultants, to map themes and narratives, overall relationships, dynamics and interplays. I then interacted with EWA managers to understand how high-level discussion translates into plans and strategies in the water sectors. Additionally, interactions with engineers and technicians working at the desalination plants provided a unique perspective on the challenges, opportunities and, in general terms, how policies are received in the lower-quarters of the institutional

hierarchy. I interviewed 118 individuals[19] in Bahrain, 25 from EWA, 20 practitioners in desalination plants[20], 18 NGO and civil society organisation affiliates, 25 government civil servants and politicians, and 30 others. The length of the interviews was between 20-90 minutes (for a list of stakeholders and their context, see Appendix IV).

However, some limitations in accessing the general public (expatriates, women) emerged. The limitations were mainly due to the nature of the inquiry and also an unwillingness to contribute freely to the discussion among some sectors. Given the conceptual framing of the topic around politics of large-scale infrastructure, my interactions were scoped around elite managers and practitioners. Additionally, as much as I tried to sense the presence of a class of demographic cross-section, the presence was rare. Issues relating to water politics were deemed sensitive and risky to discuss freely. For instance, one of the expatriates (with a South Asian background) replied to my invitation for a discussion by saying "do you want me to get deported?[21]" (interview #115). Therefore, challenges associated with collecting diverse primary data from ordinary people can be considered a limitation of this study. Nonetheless, this challenge was addressed through the participation in, and observation of, local events, as will be discussed in Phase 3.

In the second phase of the fieldwork, I analysed factors that contribute to facilitating the expansion of desalination in the municipal water sector. I tracked how the formation of the new Bahraini State functions to favour non-conventional ways of augmenting water as a mean to safeguard social and economic gains. Additionally, to analyse the role of desalination in influencing decision-making, I explored how the established presence of desalination played a role in shaping the politics of progress and reform. Specifically, I examined two key events: the establishment of EWA and the participation of the private sector in desalination production that emerged strongly as part of the new vision for the country. I interviewed actors that were involved in these events.

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[19] Some of these individuals were interviewed more than once, the total number of interviews are 144. For a profile of respondent, see Appendix II.

[20] For a map for the location of desalination plants in Bahrain, see Appendix III

[21] Although I never came across direct threat or harm during my fieldwork but these responses from interviewees resonate well with me and made me more cautious to how I approach people and questions.

Phase 3: Observation

The complexity of what I seek to understand required me to go beyond the official statements and interview transcripts. Throughout the fieldwork, I endeavoured to attend and participate in many exhibitions, events, seminars, workshops and conferences. I wanted to understand the extent to which the argument was constructed, and reality was shaped (see Appendix V for a list of events attended).

Among the several I attended, I found the consultancy assignment to draft a Unified National Water Strategy (UWS) for Bahrain very unique. It provided the richest sources of empirical data for exploring the water question from within. The consultancy included background work that required the participation of all water-related affiliates within the Government, academia and NGOs. My intention was to observe managers and other stakeholders in their natural setting. The observation study served primarily to develop an understanding of the position that each stakeholder takes when, for instance, issues of water prioritisation and allocation occur in the discussion. The complexity of the issue and the heterogeneous views were definitely a highlight of the exercise. My participation was as an observer and a note-taker, in an official sense. Casually, I utilised this opportunity to establish contacts and network with these stakeholders for follow-up interviews and "snowballing" (Polkinghorne, 2005).

Phase 4: Follow-up Interviews

As I progressed with the fieldwork, I noticed that data gathered through semi-structured interviews and observations was not optimal. They were quick, prescheduled and sometimes gave contradictory insights. For instance, the sort of information and opinion that a person gave at an event was highly unlikely to deviate from the official statement. After a period of reflections and reading my notes, I jotted down additional questions, events and themes that I wanted to explore further with greater levels of depth. Then, I leveraged my established contacts for another round of in-depth interviews that functioned to tease out conflicts, contradictions and in some form triangulate the data. In other words, these follow-up interviews helped me to "bring it home".

Interestingly, most of the follow-up interviewees consented to audio recordings compared to their initial encounter with me. Meeting me for a second, and sometimes a third time,

showed that there was some trust established and they were more relaxed in sharing their views.

2.6.2 Reflections on the Fieldwork Journey

The fieldwork journey started with me struggling to get a visa to enter Bahrain. These few months before fieldwork began were really stressful, I was unsure whether my research could proceed at all. Thankfully, after several attempts to find a sponsor, a professor at the Arabian Gulf University (AGU) came to my rescue by offering to host me. The arrangement was generous, and I was fortunate to be provided both a sponsorship visa and an office space[22].

During this placement through AGU, I joined as a visiting fellow in the Water Resources Management Centre. This placement helped me immensely in establishing contacts and access to data and informants. There are four key milestones in my placements that contributed directly or indirectly to my data collection. The first one was undertaking and auditing the United Nations (UN) Integrated Water Resource Management (IWRM) Graduate Diploma, run by the Centre. The diploma is conducted through distance learning, with the first and last courses held onsite, at the university. The Graduate Diploma is sponsored by the UN-Water Virtual Learning Centre and aims to engage practitioners in the water sector to share and learn IWRM principles and applications. Undertaking this Diploma paved the way for me to understand the challenges that face the water sector, both locally and regionally, through the experience of managers, engineers and technicians who shared their expertise through group workshops and graduation projects.

The second milestone was participation in the preparation workshops to inform the formulation of UWS for Bahrain. The National Strategy came as a response to the recommendations in the GCC Unified Water Strategy. The preparation of the strategy was awarded to the university, and I participated in workshops, took notes and prepared minutes for meetings. As this was meant to be consultative and participatory, all water-related agencies in the Government were requested to send representatives for

[22] For evidence of confirmation of fieldwork placement, see Appendix V

participation in the brainstorming sessions and reviewing how the National Strategy could be aligned to the GCC Strategy. This series of meetings and workshops helped me to gain a deeper understating of the different sectors within the water management system and how various ministries look after specific tasks that may, or may not, be aligned with others in different sub-sections of the water sector.

The third milestone was organising and participating in the Water Science and Technology Association's (WSTA) 12th Gulf Water Conference in Bahrain, 2017. The WSTA is a regional organisation that provides technical and consultative advice to Arab water practitioners. As it is a science and technology association, it was not a surprise that the majority of delegates at the conference were engineers and technologists. There were also some high-level government representations from across the region who shared their government's plans and strategies on how to tackle the water question.

The last milestone was the interaction with the EWA and desalination plant practitioners, which served to further supplement the extensive networking of the previous milestones. This stage was important to me as it gave a taste of the day-to-day challenges within the EWA quarters and desalination plant operation. Alongside the daily challenges, I also sensed the pride felt by those working in the water sector. I noted the tension between the endeavour to improve efficiency, whilst also meeting an increase in demand that sets fixed operational pathways. I learned that published strategies and policies, or even papers published at conferences, might not fully cover the immense challenge facing the water sector, especially during the operational phase. With regards to the research method, I discuss below the ethics and positionality issues that I encountered in my research journey, as it might have influenced how I interpreted the data.

2.6.3 Ethics and Positionality

As a Yemeni national, studying at a UK university, I anticipated that I would be considered an outsider in Bahrain in my quest for data collection. This is why I decided to seek a placement within a host institution with an interest in my research. On the one hand, my arrangement with a research and education institution, the Water Resource Centre at AGU, facilitated my data collection and access to informants and documents. On the other hand, it shaped the kind of information available to me. Before going to the

field, I conveyed my concern to my host, Dr Waleed Al-Zubari[23], and he promised to facilitate my placement through his contacts and network in the country.

Although I explain my fieldwork journey in terms of "milestones", the reality was rather different. It was not a linear process, and nor was there a smooth transition between stages. Furthermore, although access to informants was facilitated and arranged, the openness to share information was a challenge that I struggled with, at least in the beginning. As far as I could, I tried to explain the confidentiality and the ethics that regulate my data collection. Some respondents were still hesitant to share their positions or views and restricted themselves to sharing the official data and statement. This was mostly observed among civil servants. I found that the level of engagement varied between the elite interviews, those of retired officials and those that still hold positions. "Government is Government" expressed one of my respondents, implying that things, even in the services department, are always kept confidential or as he called it "not to publish". Whereas, retired official, who usually are working as consultants, were more critical of the government, in their views. Another obstacle I faced was that recording was not particularly welcomed. However, most of the respondents that did not agree to being recorded expressed that it would have been alright, in hindsight. I relied on note-taking to ensure that I captured most of the important leads, insights and frustration. After each unrecorded interview, I spent time mapping the themes and details that emerged from the conversation.

Interestingly, my engineering background helped me, incredibly, to get along with desalination practitioners. My familiarity with the processes and operations of desalination plants, let alone my curiosity and excitement, made discussing challenges and perceptions unfiltered.

The next chapter provides the background information needed before going to the empirical findings.

[23] Director of the Water Resources Management Program

Chapter 3: Background on Bahrain, its Modernisation Journey and Desalination

3.1 Introduction

In the previous chapter, I situated water and desalination within changing water resource management paradigms, politics of hydro-infrastructure and their relevance to the state's hydraulic mission. These concepts are essential in the study of Bahrain's sole-reliance on desalination for its domestic water supply. Notwithstanding these thematic concepts, unpacking the specific context and politics of Bahrain are also vital in shedding light on how the journey of ruling the modern Bahraini State influenced decision-making. But first, an overview of the country is outlined.

The term Bahrain[24] has, in the past, been used to refer to the part of the Arab Gulf Coast, known as Hasa, between Qatif and Salwa (Figure 3.1). However, the term is currently understood to refer to the islands of Bahrain, situated off the coast (Figure 3.2). Bahrain has a strategic location in the Arabian Gulf and was a British protectorate for over a century. Several treaties between Britain and the Al-Khalifa rulers, including the Treaty of Perpetual Peace and Friendship of 1861, placed Bahrain under British administration until it gained independence in 1971.

Figure 3. 1: Historical map of Dilmun
Source: Bahrain Tourism Guide (2016)

Figure 3. 2: Current location of Bahrain (island)
Source: (Ibid)

[24] Al-Nabhani, in his book Al-Tuhfa Al-Nabhaniya fi Tarikh Al-Jazira Al-Arabiyya (in Arabic) narrates the *History of Arabia*, he describes Bahrain as "An Island that is surrounded by the sea, with many palm trees, lemons, grapes and orchards" (Ibid, 1924, p.11).

Situated between Qatar to the South East and Saudi Arabia to the West, Bahrain is located in one of the world's leading oil-producing regions. However, in recent years, economic diversification has lessened government reliance on oil revenues. Industries such as tourism, aluminium production, petrochemical processing and refining, and financial services contribute to a considerable portion of the national GDP as part of an economic vision to transform Bahrain's economy beyond oil (Economic Vision 2030, World Bank, 2005). Covering an area of slightly over 700 Square Kilometres and with a population of nearly 1.6 million inhabitants, Bahrain is the most densely populated Arab State (World Bank, 2018). The population is made up of 45% Bahrainis and 55% foreigners: overwhelmingly from South Asia and Arab countries. The increase in non-citizens and the continued flow of migrant labour into the country is attributed to the economic transformation following the onset of oil exploration in the 1930s (Fuccaro, 2000). At the core of the economic transformation was the modernisation of services and infrastructure to enable and sustain the State's vision.

The key message of this chapter is to highlight the intrinsic position of water in Bahraini society and history, which I argue is an important element to understand before analysing the phenomenon that is desalination. The chapter provides a critically important perspective of local politics and power relations in Bahrain, as will be discussed further in Chapter 4. Therefore, to unpack the Bahraini case, I begin (Section 3.2) by outlining and examining important Bahraini relationships, such as those between water-society, the ruling family-society and the internal dynamics within the royal family itself. Next, in Section 3.3, I discuss the modernity model adopted by Bahrain following its independence and the interplay with water resources. Section 3.4 presents the case of desalination, the techniques and processes and the unique aspects of desalination in GCC. Section 3.5 concludes the chapter.

3.2 Unpacking the Bahraini Case: Water, Society and Ruling Strategies

3.2.1 Society and Water: History & Socio-Demographic Context

Similar to the civilisations of Mesopotamia and ancient Egypt, Bahrain attracted ancient settlements[25]. Historians have often described Bahrain as the Paradise of Dilmun[26], one of the oldest civilisations according to the Epic of Gilgamesh, when it prospered due to its abundant gardens and natural spring water (Rausch et al., 2014). As a testament to this, Bahrain was famed for exporting dates to surrounding countries for several centuries. Additionally, the miraculous phenomenon of sweet water within seawater gave Bahrain its current name, which means the "land of the two seas". Bahrain held influence on the trade routes between Mesopotamia, Oman and the Indus[27]. This was due to the availability of water with which traders loaded up their ships. As a result of the flourishing trade, the Island's wealth rose and subsequently attracted many settlers. The current ruling dynasty, The Al-Khalifa family, have ruled Bahrain since 1783[28] (Khuri, 1980).

Until the 1950s, Bahrain had approximately 173 springs. These springs were of two types: Mainland (dry land springs) and Submarine (springs under the sea) [29]. Mainland springs were located all around the Island with a concertation in the North. The submarine springs[30] were scattered in various locations under the sea and were known to Arab divers and sailors (Figure 3.3). These submarine springs discharge sweet water (Kawkab) within salty water (Shawshap), with pearl divers fundamentally dependent on them as a freshwater source during their trips to capture the most precious pearls found near the Shawshap[31]. On the Island, agriculture, such as cultivating dates and vegetables, was part of the Bahraini villages' economic activity around natural springs (Figure 3.4).

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[25] For more detail on Bahrain's history and archaeology, see Lombard (2016). It details several Western archaeological expeditions, such as the Danish expedition of 1959 and French of 1991.

[26] The quest for the real Dilmun, the lost civilisation of Arabia, began when the author of the book "Looking for Dilmun" visited Bahrain in order to explore the thousands of undated burial mounds scattered across the country. A brief season's digging was enough to establish the existence of a major civilisation dating from around 2300 BC (Bibby, 2013).

[27] For more details on Bahrain's strategic trade route location, see *Bahrain and the Indus Civilisation* (Dani, in al-Watheeka, 2011)

[28] There are researchers who depict Al-Khalifa's rule of Bahrain as an external invasion and conquest, for more details refer to Khalaf (2000) and Wright (2006).

[29] See Al-Kusaibi (1997) *History and Present Conditions of Natural Springs in The State of Bahrain*.

[30] Submarine freshwater springs were important supplies of water for fishermen (one could dive and fill a goat-skin sack with sweet water while out at sea). For a list of prominent submarine springs refer to Appendix VI

[31] Al-Nabhani (1986) describes how the sweet water of Bahrain beautifies pearls.

Figure 3. 3: Pearl divers getting ready to dive. Source: Pearl Magazine (2017)

Figure 3. 4: Villagers spending their time at a nearby spring. Source: Khan (1999)

In addition to their economic value, natural springs played a role in the cultural identity and social fabric of Bahraini locales[32]. Since agricultural workers spent most of their day on agricultural land, next to the springs, social and religious activities developed in the surrounds. Mosques, for instance, were built close to springs, on the one hand, to access water for ablution or bathing before praying, and on the other hand, to reduce the effort and time needed to travel from the land to the village. Therefore, stories, myths and folklore depicted the role of springs in people's conscious[33]. There is a traditional Arabic saying in Bahrain, which translates "*Ain Adhari waters the distant lands and deserts the nearby ones*". It often used by Bahrainis in describing family members who prefer strangers over their own family. This phrase is inspired by Ain Adhari's nature, which is the strong water flow that finds its way to irrigate the faraway lands by channels that skip the nearby lands. Despite this long history and association with natural springs, their prominence has subsided in recent decades.

After the discovery of oil in the 1930s, radical transformations took place in Bahrain[34]. Development activities accelerated due to the increase in the country's oil revenue and

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[32] See Al-Kusaibi (1997) *History and Present Conditions of Natural Springs in The State of Bahrain*.

[33] For folktales from Bahrain, see Taibah & MacDonald (2016). They document stories about the springs of Bahrain and narrate a legend that these springs were formed by stars falling from heaven. The stars broke holes in the ground and filled up with sparkling, heavenly water.

[34] Oil was found as early as 1932 in Bahrain, but the major shift in the fortunes of the region came with the Iranian oil crisis of 1951 and more prominently in and after the 1973. In spite of the massive volume of savings that ensued and the huge accumulations of foreign exchange, there was no sustained economic growth in the GCC countries. As a result, these countries accumulated large surpluses which could not be absorbed domestically and were therefore invested abroad.

subsequent rise in its economic base and improved living standards (Kubursi, 1986; Zubari et al., 1993). There are several dimensions as to how this period influenced the status and condition of Bahrain's natural springs. Firstly, after discovering oil in the 1930s, the Government shifted its focus to oil wells rather than natural springs. A comparison of the economic return put natural springs and their related economic activities at a disadvantage[35]. Secondly, the fast growth rate of the population and the associated development processes placed enormous pressure on available natural water resources. Artesian wells were essential to satisfy the increase in water demands due to urbanisation. As the source of Bahrain's natural springs are located in mainland Arabia, in the form of aquifers located in Al-Dammam in KSA, deterioration of the natural springs illustrates the overexploitation of these aquifers (Ibid). Finally, developments, especially land reclamation projects, all around the coastline of Bahrain have caused seawater intrusion to the underground sweet water channels as a result of deep excavation, sand dredging and subsequent reclamation (Zubari et al., 1994). For instance, the development of Salman Harbour in the 1960's saw significant deep excavation and land reclamation[36]. The result of this development on the seashores was an increase in the salinity level of the natural springs. Despite several early recommendations to safeguard groundwater levels, excessive unregulated use of water continues, nonetheless[37]. Power competition between royal elites has, thus, been influential on embracing recommendations for water conservation. In the next sub-section, I review the adaptive nature of Bahrain's ruling strategy, from sectarian politics to more pragmatic elite-driven reforms.

3.2.2 Ruling Strategy: Royal Frictions and Elite Driven Reforms

Since 1783 the country has been ruled by the dynasty of Al-Khalifa[38], who founded a hereditary regime supported by powerful merchant families and the clerical establishment. Politics in Bahrain has always been portrayed as sectarian, especially after

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[35] Al-Kusaibi (1997) documented the deterioration of natural springs in Bahrain. She concluded that both the decrease in piezometric water level and the Government's lack of maintenance and investment contributed to the current status of the springs.

[36] For details on Salman Harbour, see the *history of Bahrain ports*, 2007.

[37] The usual practice is for the Sheikh to sign fresh agreements extending the lease for a further two years for individuals (elites) to continue to drill for groundwater (Farah, 1979).

[38] In 1783 the Al-Khalifa Family seized control of the Island from Persia.

the 2011 Arab Spring uprising[39]. In one sense, to juxtapose the tribal elite and the ruling family with the peasant population, and to compare the minority Sunni Monarchy and their allies with the majority Shi'i population, claimed to be underprivileged. While these premises are ostensibly valid, especially within a conservative elite that has ruled since independence, there appear to be generational changes and calls for reform (Wright, 2006). In his book titled "The Tripe and the State in Bahrain", Khuri (1980) explored the dichotomy that existed in Bahrain upon independence. The traditional Al-Khalifa family came with a tribal background that has maintained their tribal privileges throughout history to sustain their royal prerogative and hinder democratic demands (Ibid). When King Hamad assumed power in 1999, he diverged from the legitimacy of the ruling tribe to drive reforms perceived to secure the Royal Family's position of post-traditional power (Wright, 2006). As such, we could view Bahraini politics and ruler-people dynamics in terms of what Diwan (2014) labels "pragmatic ruling strategies". To fully understand the ruler-people dynamics, I will situate these adaptive ruling politics in two distinct economic phases, that of the pre-oil and post-oil eras of exploration.

The Island's economic base up until the time of oil was the cultivation of dates and pearl fishing. Most of the palm estates were distributed among the ruling Sheikhs and run as feudal estates. Within the palm estates, which often contained a Shi'i village, the Al-Khalifa lord was sovereign. Shi'i intermediaries enforced the administration of the Al Khalifa lord through tax collection and the subletting of land. Through their connection with the Al-Khalifa Sheikhs, the Wazirs, who were mostly Shi'i, earned high status and influence in their respective villages. The Wazirs played a dual intermediary role: they were agents of landlords, and they were patrons of peasants. In their latter role, they would intercede on behalf of their peasants to their landlord to secure access to land for cultivation and water for irrigation. Therefore, access to livelihood for the local peasantry was at the landlord's mercy and their agents who were free to use their labour and impose various taxes (Khalaf, 2000).

In contrast to the tight control the tribal lords kept over the feudal estates, the Al-Khalifa rulers had less central control over the pearl diving industry. Pearl fleets dominated by

[39] For more details on the background of sectarianism in Bahrain, refer to K. Diwan (2014).

non-Al-Khalifa Arab tribesmen were mobile and could leave for other ports to take their profits with them. Many Arab tribesmen had powerful tribal allies on the mainland who they could mobilise if the need arose. The allied tribes headed the pearl diving enterprises and were granted much more independence, at least in earlier times (Nakhleh, 1976).

Khuri (1980) narrates the stronghold dominance of all economic activities by the ruling family at the beginning of the 20th Century. The approach to centralise all economic activities under the Al-Khalifa family's patronage, through tribal order, was met by frequent opposition and instability. Early examples of this instability may be found in various forms of resistance, including violent acts, by impoverished peasants and pearl divers: the primary victims of the Al-Khalifa fiefs and their local agents' excesses. A significant factor in encouraging the British to introduce their reforms was the chronic instability in Bahrain, which at times turned into political turbulence (Khalaf, 2000).

Therefore, the British-led transition to a modern state administration in the 1920s marked a substantial departure from the tribal order (Onley, 2004, 2007). However, these reforms did not overturn the social base of power in the country but instead regulated it. Tribal lords and Wazirs became government officials, and religious clerks became state judges, all receiving fixed salaries (Fuccaro, 2000). In this respect, the Al-Khalifa family-maintained alliances through entitlements and gestures distributed through state-sponsored employment and projects, especially after oil discovery on the Island in the 1930s. The substantial financial gain that accompanied oil rent strengthened the ruling family's position and brought new dynamics and relationships. On the one hand, the British wanted stability to streamline oil production and export. On the other hand, the Al-Khalifa family leveraged alliances and benefited from the prospect of a new political economy. They assumed control over all the State’s sovereign ministries and its growing oil revenues.

The period also accompanied several developments in the ruler-people relationship. The emergence of a semi-structured state made it compete with oil companies for a trained workforce. As such, labour market reoriented towards skills rather than alliances. The established merchant-ruler partnerships were weakened by an empowered state seeking to modernise its socio-political enterprise (Nakhleh, 1976). The British were concerned

with laying the foundations of a local administration to cope primarily with the governance duties of the State, such as maintaining public order, collecting taxes, and allocated accrued oil revenues and customs duties. The newly formed political economy evolved around the two large employers: the State and oil sector.

Similarly, a political transformation took place after independence with the aspiration to achieve a constitutional monarchy. Two years later, the Amir, Sheikh Isa, promulgated a constitution which included safeguards for individual liberties and stipulations for a functioning, and promising, parliamentary system (Nakhleh, 1976). Despite the ban on political parties, the 1973 elections produced a National Assembly that reflected most political affiliations in the country (Khuri, 1980; Diwan, 2014). In 1975, the Amir ended the constitutional experiment without setting a date for its re-institution. Since then, the core of the political leadership was made up of the Amir, his brother Sheikh Khalifa, the Prime Minister, and his son Sheikh Hamad, the Crown Prince. Prominently, the Prime Minister, Sheikh Khalifa, strengthened his conservative agenda by maintaining a firm security grip on the Island (Khalaf, 2000). Sheikh Khalifa wanted to preserve the ruling family's privilege by exerting force against unrest, especially the protests that sparked in the 1990s, and political opposition. Political participation stagnated from this point until the late 1990s with the death of Sheikh Isa. His successor, Sheikh Hamad, had a reformist agenda for Bahrain, which was in stark contrast to his father and uncle (Gengler, 2013).

Soon after his succession, Sheikh Hamad began a process of national dialogue and consultation with the broader society on their concerns and aspirations for the future. There was clear evidence that a pragmatic break from the past was emerging under Bahrain's new ruler (Ibid). His popularity rose to new heights during his consultation period. The result was the pardoning of all political opponents, which translated to the release of all detainees who were being held for their role in the unrest of the 1990s. Key to these initial gestures towards the opposition was the abolition of the State Security Law which granted the Government special rights to ensure internal security (Wright, 2006). Thus, the new ruler of Bahrain acted in both a pragmatic and strategic fashion in the initial stages of the reform process. By providing this wide-ranging series of royal gestures within a relatively short period, he has fostered strong support amongst Bahrain's general public.

Notably, today, the King and Crown Prince enjoy a high level of support throughout society as they are seen to be actively working towards the advancement of Bahrain's people as a whole (Mitchell, 2010). By doing this, the King and Crown Prince have also contributed towards their legitimacy. Wright (2006) argues that these reforms came from a generational change being driven by King Salman and Prince Hamad's desire to safeguard Bahrain's post-traditional tribal rule for the future. The strategy behind the reforms is to promote liberalisation with limited democratisation, in order to solidify the power of the ruling tribe without the need to use coercive means to maintain its position (Ibid).

All in all, ruling politics in Bahrain seem to be portrayed either by the notion of societal friction and sectarianism led by conservatives, such as the Prime Minister or by romanticising the King and Crown Prince's elite-driven reforms. Yet, this contrast is better understood as changing ruling politics to maintain the power and the prerogative of the Al-Khalifa family, yet with different strategies. On the one hand, Sheikh Khalifa championed traditional tribal rule by relying on alliances, elites and security[40] to silence opponents (Bahry, 1997). Being the first Prime Minister of the State after independence and the brother of the Ruler, Sheikh Khalifa held considerable influence with the country's ruling elite. On the other hand, King Hamad and Sheikh Salman viewed the ruling family's stability differently in the post-traditional tribal rule. They wanted dialogue and limited democratisation to appease opponents (Gengler, 2013; Khalaf, 2000). The generational difference between both sides is evident in how they viewed the country's future and the fierce competition for power retention and influence between the established Sheikh Khalifa and the "young" Sheikh Salman. Thus, Sheikh Salman's reformist agenda, of diverging from a close elite circle to broader societal engagement could be understood as a strategy to assume legitimacy. In the next sub-section, I review the modern Bahraini State's journey since independence with a view to the contentious policy-making of the various factions within the royal family.

[40] Documented in a BBC Special Report titled "Blind Eye to the Butcher". The report exposed the coercion practices of the Bahraini regime, against protest, under the direction of British security expert, Ian *'The Butcher'* Henderson, Head of the General Directorate for State Security Investigations.

3.3.3 Power Competition in Royal Factionalism

In the previous sub-section, I outlined how the generational change, between the Prime Minister on the one hand, and the King and Crown Prince, on the other hand, ignited contestation for power and power-sharing. In this section, I review how policy-making takes place within royal factionalism. While the Prime Minister and his inner circle represent the conservative and traditional tribal rule, the King and Crown Prince push for a more reformist agenda. This is discussed in light of the country's journey of modernisation since independence.

The established and robust presence of Sheikh Khalifa in the earlier phases of state creation gave the political elite significant leeway[41]. He was the de facto ruler of the State, especially during the last few years of the late Amir's life (Kinninmont et al., 2012). Once Sheikh Hamad took office as the Amir of the country, tensions rose with the royal family as factions responded to competing visions for the country, and, subsequently, influenced how decision-making was negotiated (Ibid). Old and new players emerged leveraging their closeness to one faction or the other. King Hamad enjoyed a reputation of relative probity and concern for the regular Bahraini people. However, he was constrained by his uncle's entrenched power, as Sheikh Khalifa's reign and control extended to every aspect of the regime (Diwan, 2014; Khalaf, 2000). Notably, King Hamad made several important decisions in the first few years of his reign, namely, i) announcing the National Charter, which boosted his popularity; ii) constitutional reforms to consolidate absolute power around the King, and iii) the re-structuring of decision-making dynamics.

Announcing the National Charter and reforms were the flagship programs of King Hamad (Peterson, 2009). The King's efforts to appeal to the people raised his popularity while leaving other stakeholders puzzled. The conservative faction within the royal family was in limbo and left to walk the fine line between adhering to the King's policies while not infuriating Sheikh Khalifa. Whilst the opposition was confused by the King, presenting himself as a reformist through liberalisation projects, and not being able to gather social base (Khalaf, 2000). While some internal actors, especially within the opposition,

[41] The presence of co-rulers is not a new concept in Bahrain. As early as 1796, Sheikh Ahmed bin Abdullah Al Khalifa had a senior co-ruler, Sheikh Salman bin Ahmed Al Khalifa, and a junior co-ruler Sheikh Abdullah bin Ahmed Al Khalifa (Onley, 2007).

understood the reforms to be a political manoeuvre by the King, others applauded them as a genuine effort to deviate from the traditional tribal role (Diwan, 2014).

Nonetheless, the new constitution for the Kingdom, in 2002, enacted the King as the absolute ruler and constitutional reference against all opposition parties, political forces and factions within the royal family (Coates Ulrichsen, 2013). Primarily, the 2002 constitution, therefore, undermined Sheikh Khalifa constitutional and legal status. Yet, the established State around Sheikh Khalifa was more experienced and more predatory. In this respect, King Hamad took between 1999 and 2005 to re-structure Bahrain's politics and decision-making processes. Firstly, the political domain was transferred to the Royal Palace, of which all stakeholders are now obliged to follow the Royal Palace's decision. Secondly, the economic realm was transferred to the Economic Development Board (EDB), chaired by the Crown Prince, Sheikh Salman. Thirdly, the King, actively, rearranged the cabinet by replacing the old guard with new players, with allegiance directly to the King (Bu Safwan, 2012).

Generally speaking, government and cabinet positions were given exclusively to royal family members or prominent tribal families, see Table 3.1 for cabinet members up until 1999 (Khalaf, 2000). The Bahraini Government's formation maintained a conservative structure of strong allegiance to Sheikh Khalifa. However, with Sheikh Hamad's inauguration in 1999, allegiance was shifted gradually towards him by appointing new individuals that are more aligned to the Amir's reformist agendas.

Table 3. 1: Bahraini Cabinet Members to 1999

No.	Position	Background	Name	Merits
1	Amir	Al-Khalifa	Isa bin Salman	
2	Prime Minister	Al-Khalifa	Khalifa bin Salman	Brother of the Amir
3	Crown prince	Al-Khalifa	Hamad bin Isa	Son of the Amir
4	Commander of National Guard	Al-Khalifa	Rashid bin Isa	Son of the Amir
5	Minister of Amiri Court Affairs	Al-Khalifa	Ali bin Isa	Son of the Amir

6	Minister of Defence	Al-Khalifa	Khalifa bin Ahmed	Cousin of the Amir
7	Minister of Foreign Affairs	Al-Khalifa	Mohammed bin Mubark	Cousin of the Amir
8	Minister of Interior	Al-Khalifa	Mohammed bin Khalifa	Cousin of son-in-law to the Amir
9	Minister of Justice & Islamic Affairs	Al-Khalifa	Abdullah bin Khalid	Cousin of the Amir
10	Minister of Housing, Municipalities and Environment	Al-Khalifa	Khalid bin Abdulla	Son of No. 9
11	Minister of Transportation & Communication	Al-Khalifa	Ali bin Khalifa	Son of No. 2
12	Minister of Oil & Industry	Al-Khalifa	Isa bin Ali bin Hamad	Son-in-law of the Amir
13	Minister of Education	Sunni-Tribal	Abdul Aziz bin Mohammed Al-Fadhil	Army officer
14	Minister of Cabinet Affairs & Information	Sunni-Tribal	Mohammed bin Ibrahim Al-Motawa	Cousin to No. 15 & 16
15	Minister of Finance & National Economy	Sunni-Tribal	Ibrahim Abdulkarim Mohammed	Cousin to No. 14 & 16
16	Minister of Electricity & Water Supplies	Sunni-Tribal	Abdallah bin Mohammed Juma	Cousin to No. 14 & 15

Source: Adapted from Khalaf (2000)

The first, limited, ministerial change took place in May 1999 with the appointment of three new ministers. Only one was affiliated with the King, Dayej bin Khalifa, replacing Abdallah bin Mohammed Juma (No. 16). The other two ministers were closely affiliated with Sheikh Khalifa. They were Abdullah Saif for the Ministry of Finance & National

Economy and Ali Almahrous for the Ministry of Housing, Municipalities and Environment. This limited ministerial reform was only seen as a way for the new King to exercise some power while not disrupting the current power balance (Bu Safwan, 2012). Therefore, the new cabinet composition only consisted of two ministers with affiliation to the King: the Ministers for Defence and Electricity and Water. The rest of the cabinet's members were loyal to Sheikh Khalifa.

Subsequently, in April 2001, another ministerial change took place but this time by increasing the number of ministers selected by the King, without reducing the Prime Minister's quota in the Government. The first change was the withdrawal of the Information Affairs assignment from the portfolio of Mohammed bin Ibrahim Al-Motawa (No. 14) and its assignation to Nabil Alhamer. Notably, Al-Motawa was known for his close relationship with Sheikh Khalifa. The second change was to appoint Mohammed Abulghafar as a Minister for Foreign Affairs, replacing Mohammed bin Mubark (No. 7). The third change was to appoint Fahmi Aljawder as a Minister for Works. Aljawder was affiliated with the Crown Prince and represented a newly emerging player, promised in the country's new era, as will be examined further in Chapter 6.

The restructuring and reforms introduced during the six year period of 1999-2005 were not straightforward. At times, the King found it easier to create new organisations and ministries from scratch rather than force existing bureaucracies to change. This served to empower and weaken different stakeholders (Bu Safwan, 2012). Evidence of this can be seen in the establishment of the EDB to allow a more influential role for the Crown Prince and his liberalisation agenda. Member ministries, such as Finance and National Economy, Workforce and Social Development, Transportation and Telecommunication, Electricity and Water and others, had to report to the Crown Prince and implement the recommendations of the EDB. Although the general trend of functional differentiation was seen shifting towards the Crown Prince, power balancing concerns often influenced bureaucratic expansion and reforms (Kinninmont et al., 2012). For instance, Sheikh Khalifa maintained a say on deputies and the appointment of other senior administrators to exercise his authority atop of the Government and showcase his relative control and relevance (Ibid). As such, the intensity of the competition for power increased alongside

modernisation and development activities, with every camp wanting a say on the way forward.

Despite the fierce competition for power between the Bahraini factions, there was a strong uniting drive towards projects to modernise water and other services, as well as infrastructure. In the next section, I present the interplay between Bahrain's journey to modernity and its water resources.

3.3 Modernity and Water Resources

Like most of the GCC Countries, Bahrain has experienced accelerated development growth since the early 1970s. This occurred due to the sudden increase in the country's oil revenues, which led to a rapid rise in its economic base and improved living standards, resulting in a rapid rise in population. A significant share of oil revenues has been used to modernise infrastructure and further improve people's standard of living. Water supply and sanitation services have been made accessible to a large percentage of the population, and have reached almost 100% and more than 95% in these two categories, respectively (World Bank, 2018).

However, the fast growth rate in the population and associated development processes, represented by rapid urbanisation, expansion of irrigated agriculture, and industrialisation, have brought about substantial increases in water demand in the last four decades. Total water demands in the Kingdom have increased dramatically from about 160 MCM[42] (Mm^3) in 1970 to more than 460 Mm^3 in 2018 (EWA, 2018). Despite the rapid increase in water demands and the limitations of its fresh groundwater resources, the Kingdom has done well to provide water for its expanding municipal sector by resorting to desalination since the mid-1970s. Furthermore, reuse of treated municipal wastewater, particularly for agriculture and landscaping, started to become an essential source for the Kingdom's water supply in the late 1990s.

Currently, Bahrain's water requirements, amounting to about 460 Mm^3/y (2018) are met mainly by desalination plants, groundwater abstraction, and to a lesser extent, by tertiary

[42] MCM refers to Million Cubic Meter which is another way of using Mm^3.

treated wastewater. The main water-consuming sectors in the Kingdom are the municipal, agricultural, and industrial sectors. The water requirements of the Municipal sector are met mainly by desalination plants. They are complemented by groundwater abstraction (either for blending purposes or to meet deficits), while the water requirements of the agricultural sector are met by groundwater abstraction and tertiary treated wastewater. The industrial sector's water demands are met by groundwater, both fresh and brackish, and its own desalination plants, with some industries also utilising the municipal network (10%) (Zubari, 2014).

Moreover, the Kingdom of Bahrain has experienced a dramatic population growth in the last four decades. The average annual population growth rates nearly doubled from 3.6% per year during 1980-1990 to 7% per year over the period 2000-2010 (CIO, 2009). Currently, Bahrain's population is over 1.52 million, indicating a relatively lower growth rate of 3.4% over the period 2010-2012. Population growth is influenced by two key factors. First, improving the standard of living and socio-economic conditions has encouraged the native Bahraini's population growth (Figure 3.6). Second, Bahrain's increasingly diversified economy has produced a growing demand for skilled labour, particularly within the industrial and service sectors, which has attracted foreign labourers. Total population figures over the last few years show expatriates have slightly exceeded the number of citizens, in contrast to the year of 2000 when they were only about half the native population (World Bank, 2018).

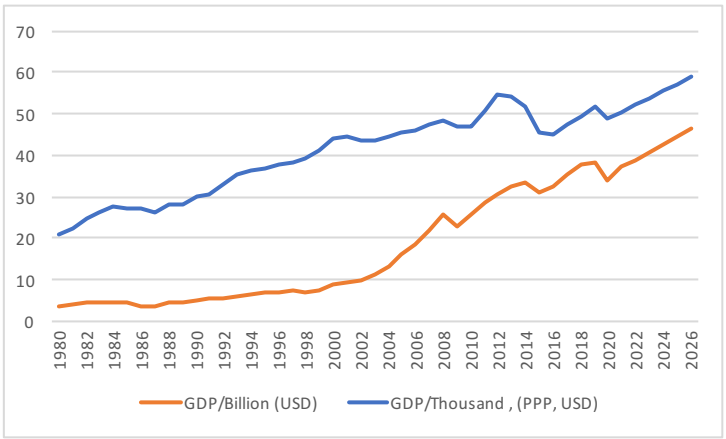

Figure 3. 5: Gross Domestic Product (GDP), Average Per Capita Income, 1980-2026.
Data source: IMF Indicators (2017)[43]

[43] See https://www.imf.org/external/datamapper/PPPGDP@WEO/BHR

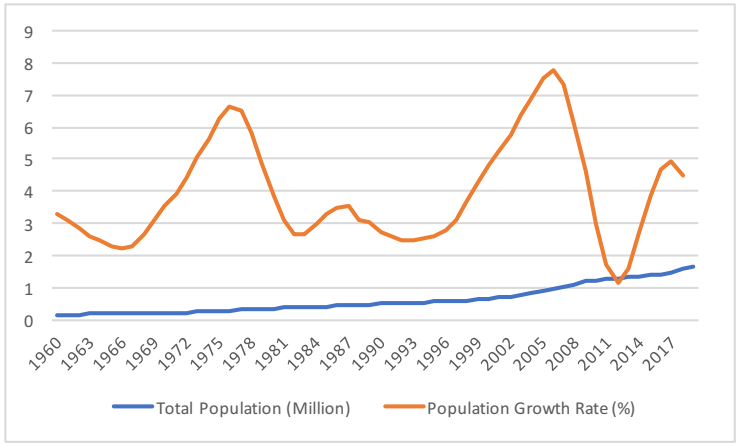

Figure 3. 6: Population, and Population Growth Rates, 1960-2017.
Data source: World Bank Indicators (2017)[44]

The Government's official projections for the population (CIO official data) indicate that Bahrain's population will reach about 2.13 million by the year 2030 (Table 3.2). Such anticipated population growth, and its associated urbanisation, will definitely have an impact on municipal water demands, which have to be met mainly by desalinated water, and complemented by groundwater, owing to the low quality of groundwater and the continuous deterioration of its quality. Food demand in the Kingdom is expected to increase as the population grows, which will further affect agricultural water demands. Furthermore, it is expected that under the Kingdom's plans to expand and diversify its industrial base, there will be rapid increases in future demand for water in the industrial sector (Zubari, 2014). However, it is expected that the majority of this water requirement will be met by the sector-owned desalination plants.

Table 3.2: Projected Population Growth

Item	2012	2015	2020	2025	2030	2035 (2032)
Population (1000)	1,234.9	1,359.8	1,592.0	1,849.8	2,128.2	2,247.6
Population Growth Rate (%)	3.4	2.0	3.4	3.2	3.0	

Note: Population growth rates between years are estimated from the data
Source: World Bank Indicators (2016)

Generally speaking, the demand for municipal water is a influenced by two main factors, population and per capita water consumption. Water consumption records indicate that

[44] See https://datacommons.org/place/country/BHR

Bahrain has a relatively high per capita water consumption rate. The daily per capita consumption for the period 1980-2011 is illustrated in Figure 3.7. As can be seen, the per capita water consumption fluctuates highly. This can be attributed to many factors including rationing programs, leakage control programs, awareness and conservation campaigns, and the increase of vertical expansion.

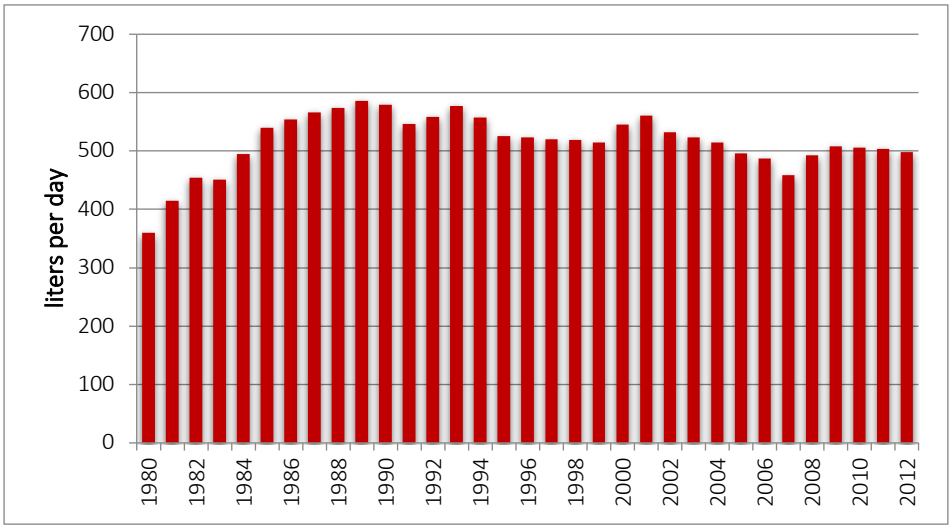

Figure 3. 7: Average per capita daily consumption in the municipal sector, 1980-2012. Data source: EWA

The records indicate that per capita daily water consumption has been increasing since 1980 to reach a peak in the late 1980s at 590 l/day, it then more or less stabilised at just above 500 l/day until the early 2000s, with a general decrease evident since then[45]. The latest records indicate that in 2012 and 2013, the daily per capita water consumption in the municipal sector was about 500-530 l/day. However, it should be noted that these figures are based on the quantities of total water supplied, and do not consider the network losses through leakage, which reached about 27% in 2010. If the variable leakage percentage is taken into account, the per capita daily consumption would be less (Almasri,

[45] The argument behind the various presentation of municipal water consumption rate is how different actors quote and cite numbers in a way to externalise the blame. For instance, on this page, the high consumption rate of around 500 l/day is presented by EWA to attach the blame to the end-users for intensive water usage. However, the 500 l/day does not exclude the network leakage which is estimated to be around 27% especially in the old towns. When considered, the actual consumption rate will reduce by a quarter. This is articulated on p.132 where the range of consumption value to capture seasonal and socio-economic variances between citizens and residents are provided. The ranges of 350-550 l/capita and 180-400 l/capita average to be 370 l/capita which is consistent with other values such as on p.65 (when leakages are accounted for). In essence, EWA's interest in cherry-picking data is to spotlight the intensive water consumption and avoid any criticism on its requirement to improve the distribution network and reduce NRW, as per the argument on Section 5.3.3.

2011b). By comparison, the average per capita domestic water consumption rate in non-GCC Arab countries is about 200 l/day (Al-Zubari, 2015).

Against this background of Bahrain's development journey, desalination continues to provide a relatively reliable source of domestic water. In the next section, I give an overview of the technology, processes and its status in the GCC.

3.4 Desalination

3.4.1 Desalination Techniques and Processes

To comprehend the politics of desalination, it is imperative to understand the current state of technology. There are two broad categories of removing salt from water: *thermal distillation* and *membrane* treatment, refer to Table 3.3. Thermal distillation involves the heating of saline water to produce de-salted steam or vapour. Of the various distillation techniques, the most commonly used is multi-stage flash distillation (MSF), which utilises a series of chambers heated to different temperatures to produce "flash" evaporation. The MSF process, which is almost always twinned with thermoelectric power generation, is favoured in some regions because of its suitability for large-scale co-production of water and energy and is widely used in the Middle East (Khawaji et al., 2008). For example, the largest desalting facility currently operating globally, the Shuaibah Independent Water and Power Project in Saudi Arabia, is a hybrid plant that combines the MSF/thermoelectric processes.

By contrast, membrane processes of saline water conversion separate salt and water using a physical barrier. Techniques include electrodialysis, electrodeionization, forward osmosis and reverse osmosis. Reverse osmosis (RO) is the dominant membrane technique by far, with other membrane processes being used primarily for specific industrial functions rather than for the municipal water supply. In the RO process, water is forced through semi-permeable membranes, usually in a spiral-wound configuration, trapping dissolved salt and allowing freshwater (Charcosset, 2009). The entire purification process usually requires at least two stages: one of pre-treatment to remove suspended solids, the RO treatment to remove dissolved solids, and two, the post-treatment to fix specific chemicals and for re-mineralisation. Technological improvements since the 1980s in all stages of the process, particularly in membrane performance and the development of

energy recovery devices, have roughly halved both the energy requirements of treatment and the unit cost of water (Ibid).

Table 3. 3: The leading technologies of saline water conversion, including share of the global market

Categories	Technology	Market Share (%)	Details
Thermal	Multi-stage Flash Distillation (MSF)	26	Evaporation achieved below boiling point. Technology still used extensively in the Middle East. Almost always twinned with electricity generation facilities.
	Multiple Effect Distillation (MED)	8	Evaporation achieved at boiling point. The oldest commercial desalination technique. The lower boiling temperature achieved through reduced pressure. Only used on a small scale.
	Vapour Compression	<1	The lower boiling temperature achieved through reduced pressure. Only used on a small scale.
	Solar Distillation	<1	Investigated extensively but with significant drawbacks, including capital intensity and surface area required.
Membrane	Reverse Osmosis (RO)	60	Dominant desalting technology since the late 1990s. Feedwater is forced through semi-permeable membranes, most commonly spiral wound or hollow fibre. The process requires high pressure (usually 600-1,000 psi for seawater)
	Forward Osmosis (FO)	<1	A focus of industry R&D but is unlikely to overtake RO in the foreseeable future. Currently used only for specific industrial applications.
	Electrodialysis (ED)	4	Appropriate for treating certain feedwater but does not compete with RO of MSF on a large scale.
	Electrodeinoisation (EDI)	<1	Produces very pure water. Used for specific industrial applications.

Source: Adapted from Khawaji et al. (2008), Ghaffour et al. (2013), Williams & Swyngedouw (2018)

3.4.2 Desalination in the GCC: Water-Energy Nexus and Complexities

Desalination technology was introduced in the GCC countries in the 1950s and has developed rapidly to meet the qualitative requirements for drinking/domestic water

standards. At present, municipal water supplies in the major cities of the GCC rely mainly on desalinated water, which is used either directly or blended with groundwater (The Economist Intelligence Unit, 2010). All the GCC countries are embarking on significant desalination expansion projects. Based on the contracted desalination plants, each GCC country's desalination capacity would be doubled by the year 2030 (Figure 3.8).

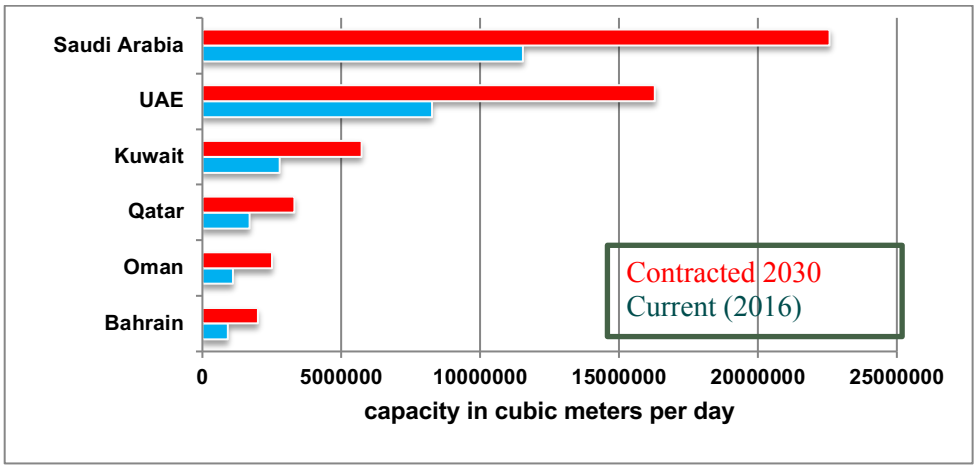

Figure 3. 8: Current desalination capacity in the GCC (2016) and projected in 2030

Source: GWI (2016)

The primary desalination process used in the GCC countries is the thermal process, particularly utilising MSF distillation technology. This is an established technology and is combined with the co-generation of electricity, which significantly improves the economics of desalination. It also exhibits significant economies of scale which are critical for large-scale production. Furthermore, MSF plants have a useful life of about 25 years that can be nearly doubled through proper plant maintenance and refurbishment (Schenkeveld et al., 2004). An alternative thermal technology, MED, combines with thermal vapour compression and is more energy-efficient than MSF, especially for smaller desalination plants. MED technology has been increasing in the region over the past few years. While the GCC countries look set to rely on large-scale distillation plans, like MSF for bulk water supply, for the foreseeable future, other technologies are gradually being adopted. RO technologies, for use with both seawater and brackish water, are now used in some relatively large plants in certain countries (e.g., Bahrain), while in other countries it is still under evaluation (e.g., Qatar).

The main fuels used for desalination are oil and natural gas, which are primarily produced within each country, with a general trend to move to the relatively cleaner natural gas. Although most GCC countries are rich in fossil fuels, meeting escalating demand for

water by expanding desalination has become a very hydrocarbon-intensive process, claiming a sizeable portion of their main export. The adoption of desalination technology in the region, particularly co-generation power desalination plants (CGPD), is energy-intensive, with the cost of energy representing about 85% of their running cost and placing strain on the environment (Dickie, 2007). Available figures indicate that in Kuwait, desalination consumes about 55% of the total energy used in the country, in Bahrain it is about 30% and in Saudi Arabia about 25% (Alyousef & Stevens, 2011; Darwish et al., 2014). Projections of these trends are alarming.

Accordingly, growing water-energy interdependency has started bringing sustainability issues to the fore. For example, in Saudi Arabia, which is home to more than 18% of the world's desalination capacity, 25% of domestic oil and gas production is utilised to produce water through CPDPs. If the current trends continue, this share will reach as high as 50% by 2030 (Alyousef & Stevens, 2011). Similarly, in Kuwait, electricity and desalinated water consumption have been continuously on the rise, practically doubling every decade due to population growth and increased standards of living. The projections show that in a business as usual scenario, the energy demand of desalination plants will be equal to the country's 2011-2012 oil production (2.5 Million barrels of oil per day) by the year 2035 (Darwish et al., 2014).

Undoubtedly, these projections are of concern both from a sustainability and environmental point of view: greenhouse gas emissions and seawater pollution by discharged brines to give just two examples (Meerganz von Medeazza, 2005). One of the most significant areas of environmental concern when it comes to desalination plants is brine management (Ahmed et al, 2001). Brine discharge is often a mixture of saline concentrate, along with thermal and chemically added pollutants (Medeazza, 2005). The solution's salinity concentration is largely dependent on the technology employed; though often double the ambient seawater salinity. Furthermore, if thermal desalination is the predominant technology employed, as is the case within the Arabian Gulf, the temperature of the brine mixture will often be above the average sea temperature (Sale et al, 2010). The aforementioned by-products can negatively impact the Gulf's native biota; be they mangroves, corals or other aquatic species (Ibid); particularly given the brine's

density which sinks it to the bottom of the seabed where most ecological activity takes place in the Gulf (Medeazza, 2005).

For instance, there are certain mechanisms, specifically related to the desalination process, that directly influence the environment. Setting mitigation measures can hugely reduce the impacts, saving the seawater's ecosystem through controlling the brine discharge of desalination plants. Desalination plants could implement a better way of discharging brine through dilution and dispersion via a discharge diffuser, away from the coast, to reduce the thermal pollution. Additionally, regulatory enforcement should be considered to control the temperature of the brine to a maximum 3 degrees higher than the intake water.

In terms of greenhouse gas emissions, for every cubic meter produced by desalination, a range of 10-20 kg of carbon dioxide (CO_2) for cogeneration MSF technology, 11.2-19.6 kg CO_2 for cogeneration MED, and a value of 3.6 kg CO_2 for RO is emitted (Zubari, 2014). While the impact of discharges from thermal desalination plants has not been studied in depth at the regional level, given the enclosed nature of Gulf, the GCC countries are increasingly concerned about the potential damage to the fragile marine ecosystem (Saif et al., 2014). In general, the available information indicates the need for a comprehensive environmental evaluation of all major desalination projects at the global level (Lattemann & Höpner, 2008). Furthermore, to ensure the sustainable development of coastal areas, it is important to consider integrating desalination activities into regional water resource management plans (UNEP/MAP/MEDPOL, 2003).

Yet, there are some initiatives in the region to reduce energy consumption in desalination processes. The most important is the "King Abdullah Initiative for Solar Water Desalination", which was launched in 2010. The initiative aims to use solar energy to desalinate seawater at a low cost to contribute to Saudi Arabia's water security and the national economy. The implementation of the initiative will be made in three stages over nine years. The first phase, which will last three years, aims to build a desalination plant with a production capacity of 30,000 m^3/day to meet the drinking water needs of the town of Al Khafji (Dawoud & Mulla, 2012). The plant will use reverse osmosis technology and be powered by solar energy farms currently being constructed. The second phase

aims to build another solar desalination plant with 300,000 m^3/day production capacity. The third phase would involve constructing several solar plants for desalination in all parts of the country (Al-Rashed & Akber, 2015). The ultimate goal is for the technology developed to also be licensed outside of Saudi Arabia (Al-Zubari, 2015).

Overall, the GCC countries have been able to meet the rising municipal/domestic water demands in quantity and quality through the expansion of desalination plants. This has been associated with a heavy burden on the national budgets of the GCC countries, which is exaggerated by the current heavy subsidies of the water sector resulting in very low-cost recovery percentages (Zubari, 2014). Given recent trends in the growth of water demands, the fiscal burden is likely to be very heavy in most GCC countries (Alyousef & Stevens, 2011). One of the measures that has been taken towards reducing the cost and alleviating the financial burden of desalination, on the demand-side, is privatisation. Except for Kuwait, all the GCC countries have moved to privatisation. Many desalination plants are built as independent water and power projects (IWPP), with water purchased by the Government (Alawadhi, 1999; Al Misnad et al., 2017; World Bank, 2005).

3.5 Summary

This background chapter unpacked details about the Bahraini case by examining relationships and interplays of water-society, ruler-society, and power contestation between traditional conservative and post-traditional reformist camps, through a historical lens. The chapter discussed the changing ruling strategy from that of a centralised stronghold to a more liberalised participatory agenda, focusing on power-struggles after 1999. The fierce competition for relevance between powerful actors, namely the Prime Minister and Crown Prince, was evident through the introduction of reforms. Additionally, the generational difference between Sheikh Khalifa and King Hamad fuelled the contestation for relevance between the two camps.

Moreover, the expansion of the economy and the modernisation model necessitated push-back between the conservative and reformist camps as viewed through the appointment of individuals. Usually, if the Minister was believed to be affiliated with the King, his deputy was chosen by Sheikh Khalifa and vice versa. While this contestation for power was heightened over the last few decades, development progress was not hampered. For instance, access to water and sanitation was a unanimous project for all parties and the

country scored highly in delivery. However, conventional water resources, such as natural springs and groundwater wells, were exhausted in the process. In their place, desalination offset any reduction in domestic water supply and enabled the country to continue on the modernisation journey.

Despite the technological advancement of membrane technology in desalination, the techniques and processes used in the Gulf are mostly centred around thermal distillation. This process requires significant energy to extract the desalted water. The official narrative emphasised how the Gulf water's unique characteristics necessitated the prominence of thermal distillation techniques. These characteristics include the Gulf's semi-enclosure and high salinity levels. The desire to use a co-generation configuration to produce electricity also played a role. Yet, as will be discussed in the empirical chapters, other factors influence the decision to opt for desalination technology.

Chapter 4:
Desal-fever: State-Building Policies and Paradigms, and the Emergence of the Desalination Phenomenon

Chapter Summary

This chapter argues that the early phases of adopting desalination in Bahrain were motivated by post-independence modernisation projects, well before water came to be constructed as scarce. This chapter addresses the following questions: what are the political and historical junctions that enabled desalination to emerge, and what factors influenced the subsequent expansion of the desalination industry? By tracing the evolution of the Bahraini state and state-building politics, I first analyse how the relationship between state power and water control is historically reproduced and changes over time. Then, I examine the interplay between food and water politics in Bahrain, with acknowledgement of the influence from the broader GCC development trajectories. Ultimately, by analysing development trajectories and the various milestones in the adoption of desalination in the municipal water sector, I assess the evolution of the water resource management paradigms, state-building processes and perception of water in Bahrain.

4.1 Introduction

Desalination, like a river, crosses boundaries. Its adoption story in Bahrain is a manifestation of broader GCC regional trajectories of development. Although Bahrain introduced desalination later than other Gulf States[46], in the 1970s, it is now part of what is called "a desalination hot-spot" (Lattemann & Höpner, 2008). The Arabian Gulf is now a source of more than half of the global desalinated water. Countries in the region, especially GCC countries, are expected to expand desalination production as demand for domestic water increases. However, today's desalination outlook, and the political economy of water in Bahrain, is radically different from that of the 1970s. An outlook that is very much contingent on regional development trajectories and local events.

In this chapter, I provide a history of desalination and shifting water resource management paradigms and state-building processes around water in Bahrain and the GCC. Specifically, how and under what circumstances was desalination found favourable? Who were the actors, individuals and institutions that enabled desalination to eventually dominate the municipal water sector? Furthermore, how did the discourse, both nationally

[46] Gulf States are a common used name in the region and it is used in the text interchangeably with GCC.

and within the GCC, on food self-sufficiency, and food and water security, influence the position of desalination as a reliable and strategic water policy in the Bahraini municipal water sector?

As illustrated in Chapter 3, the position of desalination as a municipal water supply in Bahrain has gained significance since independence. To understand the current dependence on desalinated water in Bahrain I examine the contexts, origins and politics that accompanied the journey of the modern Bahraini state. In this chapter, I analyse the shift in water resource management paradigms, state-building processes and perception of water, since independence. In doing this I highlight three phases in the desalination journey; the first phase corresponds with the inception of the first desalination plant in Bahrain (Section 4.2); the second phase corresponds with the expansion of the desalination sector (Section 4.3) and the third phase corresponds with the prominence of desalination across water policies (Section 4.4). State-building processes are an essential part of the Bahraini journey towards modernity and development. As such, the relationship with, and the perception of water [resources] evolve according to national development plans and trajectories. Additionally, alongside state-building politics and processes, I identify actors, analyse interlinkages, and the evolution of interest between water for food and water for drinking.

As discussed in Section 3.3, Bahrain has experienced development growth since independence, similar to other countries within the Gulf. In a modernisation journey[47] that is expected to follow that of Western countries, GCC countries gear towards material possessions and lavish lifestyles (Reiche, 2010). Of particular importance to this chapter is the effort of regional governments to augment and provide food and water, as illustrated in Chapter 3. So, how have regional and global political trajectories influenced the national direction of development and modernisation in Bahrain? In this chapter, I argue that it is necessary to analyse the regional and local sanctioned discourses of modernisation and development since the policies actioned in the water sector are likely to follow what is pursued outside of it.

[47] I refer, here, to the processes of the progressive transition from a traditional to modern society, experienced by the GCC countries since the onset of oil exploration (Parsons, 1960). It also refers to an increase in levels of economic and social development, increasing standards of living, rapid growth in population, and an influx of a large number of expatriates (The Economist Intelligence Unit, 2010).

Furthermore, contemporary scholarship around desalination primarily emphasises the role of water scarcity narrative as the ultimate reasoning for considering desalination as a water resource (Al-Mutaz, 2001, 2001; Al-Otaibi & Abdel-Jawad, 2007b; Helal et al., 2004; Lattemann & Höpner, 2008; Scheba & Scheba, 2018; Williams & Swyngedouw, 2018b). While water scarcity is an essential and explanatory factor of the rationale for augmenting water through an expensive means, little is discussed about the historical settings within which desalination was introduced in Bahrain. As a matter of fact, most state-building policies, post-independence, were governed by a perception of abundance up until the 1990s, such as the food self-sufficiency policies and programs that were dominant between the 1970s and 1990s. I refer to these periods as the *First and Second Paradigms* of water resource management (Section 4.2 and 4.3), during which policies and programs were influenced by a perception of water abundance. A complete shift in how water is viewed and perceived manifests in the *Third Paradigm,* where the water scarcity narrative governs politics and polities (Section 4.4). To understand how and why the shift in perception from water abundance to water scarcity happened, I examine processes of state-building, including food and water policies, and the hydraulic mission of the state.

As Bahrain gained independence[48], there existed development trajectories that shaped how water was perceived. These development trajectories were very influential in determining how policies around services were enacted. At the core of these services was the provision of food and water (see Table 4.1 for a snapshot of key development trajectories, actors and policies). Although with regional flavour and origin, these development trajectories overshadowed any options and policies to be discussed and implemented locally in Bahrain. Additionally, I would use the Alatout approach in discussing how the shift in narrative from one of water abundance to water scarcity could be understood as a political tool that is tailored to facilitate specific state-centric agendas (Alatout, 2008). As such, the enshrined position of the abundance postulate is analysed by examining development trajectories associated with state-building politics and actors advocating for water abundance as a prominent force in the path for capitalising natural

[48] Bahrain Independence Day occurred on 15 August 1971, when the country declared independence from the British. Bahrain declared its independence marked by the signing of a friendship treaty with the British.

resources (especially water and oil), for the strengthening of local government (Centralisation), self-sufficiency, and to some extent, leveraging pan-Arab relationships (Alatout, 2008; Woertz, 2011).

Post-independence was an eventful period for Bahrain with a lot of reflection and realisation of how the identity of the country was formulated[49]. An identity that is greatly influenced by its surrounding GCC countries that have already embarked on the journey of modernity. Hugely influenced by regional surroundings, the group of actors advocating the prominence of abundance was represented by a number of elites associated with the former Amir[50] and the Bahraini Prime Minister[51]. The perception of water abundance for this group was not scientific in its approach, with no inclination for the physical quantifying of water resources. As will be discussed in Section 4.2.2, the group of actors advocating water abundance was influenced by theoretical and historical perceptions of the past in making policy for the present.

However, slowly there appeared an upcoming and opposing narrative (Table 4.1) arguing against the abundance postulate, or at least against the visionary perception of eternal abundance and the massive, unsustainable extraction of resources. The upcoming narrative was premised around water scarcity, as typical for arid and semi-arid lands. The scarcity narrative was put forward by, and formed part of the opinion of, the technocrats trained and worked for the British mandate and proceeded to take position in various governmental agencies post-independence. As will be discussed in the next sections, policies around food and water have shifted dramatically since the group of actors advocating for water scarcity has gained ground, supported by technocrats. At the later stage, this group of actors was championed by the Crown Prince[52], who was appointed as heir apparent in 1999, marking an important milestone in the formation of the modern Bahraini state and a shift to the *Third Paradigm* of water resource management. However,

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[49] Among the political reformation process was the establishment of the first national constitution on the 11th of July 1973. The first clause states "Bahrain state is an Arabic and Muslim state with sovereignty, its people are part of the Arab Nation and its state is part of the broader Arab World…"

[50] Sheikh Isa bin Salman Al Khalifa was the first Amir of Bahrain from 1961 until his death in 1999. Born in Jasra, Bahrain, he became the Amir upon the death of his father, Salman bin Hamad Al Khalifa.

[51] Sheikh Khalifa bin Salman Al Khalifa is still the Bahraini Prime Minister since 1971. He is the brother of the former Amir and the uncle of the current monarch.

[52] Prince Salman Bin Hamad was appointed as heir apparent to the crown on 1999.

with lots of mobilisation that started much earlier than 1999, during and after the British mandate.

At every turn, the contestation and displacement between the two groups (networks) was not an easy process, and the regional shift in political climate played a significant role in how individual groups of actors pursued and advocated their positions. With that in mind, I will be examining the historical junction that permitted the inception of desalination as well as highlighting the displacement of water abundance narrative in favour of the water scarcity one. The main milestones in the expansion and domination of desalination in the Bahraini water sector are identified to mark the shift in focus of how water is perceived.

To understand the historical junctures, and contingent events, that enabled the emergence of desalination, I first explore the "*First Paradigm*", which includes historic Bahrain (pre-1971), and the post-independence era (1971-1989). During this era, the commissioning of the first desalination plant was decided in 1974. Section 4.3 examines the "*Second Paradigm*" of water between 1990 and 1999. In this era, desalination expanded, and new plants were built to offset the contribution of groundwater towards the municipal water supply. After that, in Section 4.4, I assess the "*Third Paradigm*" of which desalination dominates the municipal water sector policies and institutions. Finally, in the conclusion I reflect on how the emergence of desalination, to a greater extent, was a mere fever that was highly influenced by broader regional politics and development trajectories.

This chapter draws on i) review of primary data in the form of government documents; ii) archive materials found at the Bahraini Centre for Studies and Research (BCSR) and Arabian Gulf University Repositories (Figure 4.1) and iii) accounts of current and retired government officials at various government ministries and agencies. Table 4.1 summarises the development of food and water policies and programmes promulgated since independence. While the listed policies and programmes seem to fit neatly into a matrix of themes and a timeline, policies interact with each other and influence one another by complementing or competing for the interests of various stakeholders.

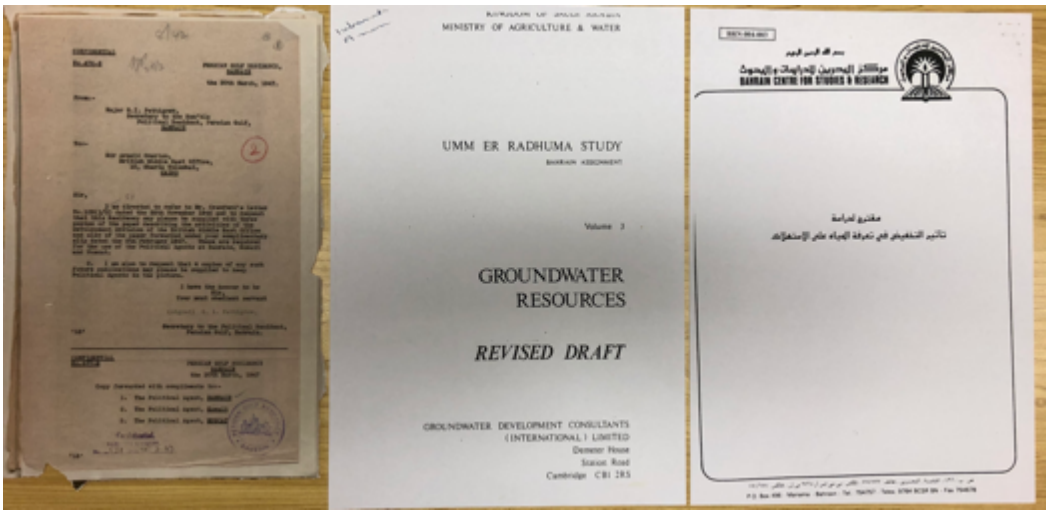

Figure 4. 1: Sample covers of the archives from left to right (1947, 1980, 1992)

Table 4. 1[53]: A summary of food and water development policies and programmes 1970 – 2018 in Bahrain

Major events	The 15th of August 1971: Independence, The 1973 OPEC-oil embargo	The 2nd of August 1990, Kuwait Invasion, New Monarch in 1999	Bahrain became a Kingdom in 2002, Food and fuel crisis 2007, Arab Spring, 2011.
Development Trajectory/ Desalination milestone	*First Paradigm* / Emerging (1970 - 1989)	*Second Paradigm* / Expanding (1990 - 1999)	*Third Paradigm* / Dominating (1999 – Present)
Key Themes	Food self-sufficiency, Decoupling GW from Municipal sector.	Water Security, Food Security.	Legislative reforms, Institutional reshuffle.
Advocates of Water Abundance (key actors)	Amir and Prime Minister, Agriculture sector.	Amir and Prime Minister, Agriculture sector.	Prime Minister, Agriculture sector.
Advocates of Water Scarcity (key actors)	BAPCO Engineers and Technocrats, Bahrain High Council for Water Resources.	MoW Engineers, Bahrain High Council for Water Resources.	King, Crown Prince, EWA, Private Sector, MoW&M.
Manifestation of Contestation	Ministerial orders and Amiri Decree to Ban drilling of water wells in the Dammam aquifer. Nonetheless, during this period, an increase in well drilling was apparent.	Government imposed a rising block water pricing structure in 1990. In 1992, tariff structure was reduced and modified.	Food policies were modified to achieve relative food security. Overhaul of water legislation and reform.

[53] Source: Author, based on compilation of notes from fieldwork.

4.2 The First Paradigm of Water Resource Development and the Emergence of Desalination

The four main elements of the *First Paradigm,* in both historic Bahrain and during the two decades after independence, can be summarised as: water resource abundance; state exploitation of water resources to satisfy unique development trajectories; natural springs and groundwater considered as common-pool resources, and the emergence of desalination as a modernising tool to associate Bahrain with its neighbours in the Gulf. During this period, water resource development/desalination processes were funded and sponsored by Bahrain's regional allies.

4.2.1 Pre-desalination and pre-independence Bahrain (Before 1971)

I first sensed the intense feeling of the water legacy in Bahrain when I participated in a heritage festival in Manama in 2017 (Figure 4.2). The festival name is '*Springs' Tales',* and showcased artists' paintings depicting Bahraini life around springs and the cultural and spiritual meaning of springs to the Bahraini community. As explained by one presenter in the festival "historic natural springs played a role in the formation of society and the old urban fabric in Bahrain" (interview #122). Not only have natural springs influenced people's lives, but they have also contributed to the formation of a unique society within its geographical location. On the one hand, historians have pictured Bahrain throughout history as the *Paradise of Dilmun* (one of the oldest civilisations according to the Epic of Gilgamesh), when it prospered by its profound natural sweet springs that were influential culturally, socially and spatially (Rausch et al., 2014). On the other hand, these springs are no longer prominent due to recent intensive water resource development (Zubari et al., 1993). Evidently, this strong perception of natural springs and water abundance is shared and has been a basis for a robust framework around policies involving water and economic development in Bahrain, even before independence.

Figure 4. 2: A portrait of Adhari natural spring as articulated by a Bahraini artist
Source: photo by author during a visit to Bahrain Heritage Festival 2017

In an exchange with a Bahraini historian who was present at the festival, I enquired about the position of natural springs in Bahraini society in the past and present, his reply was as follows:

> *"The spring water was considered with some holiness (he means blessing). People used to enjoy the water and bring their families and kids to springs for vacations and recreations. The kids would swim, and the elders would dine and catch up on daily matters. This societal aspect has been lost, and everything transformed into shopping-mall visits. Even when they (the Government) start assuring farmers and domestic users of the availability of water, despite the degradation of springs through urbanisation projects, we still miss the social aspect of having a natural resource. The urbanisation process, land reclamation and dredging activities have blocked and dismantled the link between the earth and us (he refers to springs as natural water coming from the ground with some sort of blessing)."* (*Interview #131*, 2017)

In the period between 1932 and 1971, the relationship between the British Empire and the Al Khalifa family gained enormous corporation, due to Bahrain's geographical position and the prospect of oil exploration (Belgrave, 1959). This transitional period also saw a centralisation of power and the consolidation of both the British and Al Khalifa family's position in Bahrain. As discussed in Chapter 3, the unique arrangement of a minority Sunni ruling family over a majority Shi'i population brings its own dynamics of interaction, dominance and governance. For the Al Khalifa family, the British presence

was important to ensure protection from external threats (Khuri, 1980) and, to some extent, in supressing internal protest through their security apparatus (Nakhleh, 1976, 2011). For the British, the [relative] established stronghold of the Al Khalifa family in Bahrain, since 1783, provided a cornerstone in maintaining maritime security and trade (Khuri, 1980). Though Bahrain was nominally independent, Britain had dictated its foreign policy since the 19th century, before consolidating its power over the islands in 1900 with the creation of the post of British Political Agent in Bahrain. One of the most prominent figures in this era was Charles Belgrave (1926-1957). In Bahrain, he was commonly referred to as *Al Mustashar* (Arabic: المستشار), "the Advisor". In over three decades, Belgrave was Adviser to Shaikh Hamad bin Isa Al Khalifa, and then Shaikh Salman bin Hamad Al Khalifa, the rulers of Bahrain.

Belgrave showed great interest in the water question in general, along with the oil exploration that started in 1932 in Bahrain (Belgrave, 1972). The Office of the British Residence in Bahrain represented the core resistance to the advocates of water abundance represented by the royal family and broader public. As several archival materials narrate, there was a clear split and vigorous contestation between The Office of British Residence and the Al Khalifa family in how they perceived water resources, their availability and the best ways for their development. At the core of this dispute was the perception of whether water was available in abundance or was scarce. Moreover, the reference point of the disputed camps was also debated. The British mandate and its hydraulic apparatus relied on the physical quantification of water resources: inland and marine springs. On the contrary, the Al Khalifa family relied on the historical and theoretical prophecy of eternal flow of water in the land of Bahrain.

Together with The Office of the British Residence, the staff of the BAPCO[54] (The Bahrain Petroleum Company) advocated for water scarcity and the need to evaluate Bahrain water resources. For the scarcity camp, the water question was scientific and instrumental to maintain oil exploration, which the British wanted to sustain (Belgrave, 1972). As BAPCO used a considerable amount of water in their refinery, the company was mandated to log and record water table drop every quarter and report to The Office of

[54] The Bahrain Petroleum Company (BAPCO) is an integrated national oil company of Bahrain. BAPCO was established in 1929 in Canada by Standard Oil Company of California for oil exploration activities in Bahrain. BABPC was then merged with the Bahraini National Oil Company in 1976.

British Residence. In competition with irrigation activities, oil exploration and refinery became an important economic activity that would transform Bahrain and the perception of water resources in decades to come. As such, the dominant view of water resources and continuous drop in the water static level, as BAPCO engineers highlighted, could be attributed to the contestation of different economic activities.

On the other hand, the Al Khalifa family were reluctant to accept the notion of "Bahrain running out of water" as Belgrave indicated in his diary (Belgrave, 1972). Rather, the ruling family were convinced that water was available to cater for all economic activities. In the early 20th century, a considerable portion of Bahraini society was either associated with agriculture or pearl trading activities. While agricultural activities relied on the surface flow of inland natural springs, pearl divers relied on submarine springs (Shawashib) for their water supply during their month-long journey into the sea (Khuri, 1980). With limited exploitation, water supply seemed sufficient for both inland and off-land activities in Bahrain. Therefore, this close dependence on natural springs by Bahraini society governed their perception of water and its availability.

The prominence of the natural springs (inland and submarine) were reflected theoretically in tales and poetry (see Figure 4.2 earlier), and scientifically through surveys and measurements carried out by both BAPCO and the British mandated hydraulic apparatus[55] . As can be seen in the below extract of the exchange between Crawford[56] and Burrows[57] on water supplies in Bahrain:

> *"There has been a belief that very large quantities of fresh water from submarine springs were going to waste in the sea around Bahrain, especially off the North East corner of the island and that if these were captured the island would never be short of water"* (Crawford, 1953)

In another exchange between Burrows and Belgrave, Burrows indicated that there was a limitation to the development of any reliable submarine springs' water. These limitations

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[55] As part of the British presence in Bahrain, several hydrologists working in India, Egypt and Kuwait made several visits to help Belgrave in assessing the water potential in Bahrain.
[56] Sir Walter Ferguson Crawford was the head of the Development Division, British Middle East Office (Foreign Office). In December 1953, he was on a visit to Bahrain in connection with the Kuwait water supply and the Trucial Coast development.
[57] Bernard Burrows became Political Resident in the Persian Gulf, based in Bahrain in 1953.

were mainly due to the dispersed nature of the submarine springs and the higher level of salinity they experienced, as advised by BAPCO. Burrows memo to Belgrave was as follows:

> *"BAPCO have now done much to investigate these supplies, and figures shown to me by Godfrey show that the 20 springs known to the Arabs and investigated by them have a total discharge of only 164,000 barrels (about 4.7 million gallons) a day. This is very disappointing. As these springs are very scattered, I am sure it would not be economic to capture the water and pump it to the mainland for purposes of irrigation. Also, salinity figures are very high and vary from spring to spring from 1450 to 8925 parts of salt per million. Godfrey says that the salinity of the submarine springs may be lower as in many cases, it was difficult to take samples."* (British Residency, 1957)

Towards the end of his assignment, in 1950, Belgrave was presented a BAPCO report[58] which drew up the water use in the country. The report estimated a daily consumption of about 70 million gallons for all purposes. In the report, they considered that, on average, there had been a lowering of the static water head of nearly 2 inches a year since 1932. Belgrave's position on the yearly decline is that "not all of it due to the use of water in Bahrain as some years ago the Saudis started uncontrolled exploitation of water from the same underground supply" (Belgrave, 1972). Subsequently, he advised that the Bahraini Government should engage reputable consultants to examine the whole water question. He reasoned that "a well-known firm of consultants has its good name to consider when evaluating the development of water resources in Bahrain", in comparison to the already dominant view within the BAPCO investigation (Belgrave, 1972). Clearly, while the actors advocating water scarcity seemed to have a consensus on the water question, they were still in disagreement on the way forward. It is worth noting, to the actors advocating water scarcity, water availability was a scientific discourse, employing empirical methodologies and directly contesting the theoretical accounts of water abundance.

On the other hand, the Bahraini royal family doubted Belgrave's advice. Belgrave recorded in his diary that the Sheikh did not want to prioritise or allocate funding for the engagement of any international consultant to evaluate and investigate water resources on the island (Belgrave, 1972). Even after the departure of Belgrave in 1957, leading up

[58] The report consisted of regularly monitored wells and springs data, salinity levels and salinity records of drilled wells.

to independence in 1971, the perception of water abundance remained strong. The historical and theoretical narrative of water abundance was prominent in the living memory of the royal family and the people of Bahrain alike. As will be explained in the next section, the requirement to appoint a specialist firm only materialised after independence when several consultants reviewed and studied the water potential in Bahrain. Among the prominent ones were Italconsult (1971), Wright (1977), FAO (1979) and GDC (1980).

4.2.2 The Emergence of Desalination (1971 - 1989)

4.2.2.1 Historical and Political Context

On 15 August 1971, even though the Shah of Iran was claiming historical sovereignty over Bahrain, he accepted a referendum held by the United Nations which enabled Bahrain to declare independence and sign a new treaty of friendship with the United Kingdom. Bahrain joined the United Nations and the Arab League later in the same year. Although the cabinet of the first government consisted of highly qualified technocrats, the key ministries were still run by the Al Khalifa family, including the Prime Ministership, which was held by the brother of the Amir, Sheikh Khalifa bin Salman Al Khalifa. Diwan (2014) argues that the Sunni-Shi'i polarisation and sectarian lines in Bahrain tend to distinguish and reinforce class (Diwan, 2014). As discussed in Chapter 3, the majority Shi'i population is historically viewed to have practiced farming and pearl trading. Whereas the minority Sunni population tended to be associated with the Government and business (Khuri, 1980). As such, the historical view of how the ruling family assumed power and were able to implement policies, is in a way, hegemonic, to strengthen the position of the Sunni businessmen over the Shi'i farmers.

A controversial book by Emile Nakhleh entitled "Bahrain: Political Development in Modernising Society"[59] critiqued the tribal orientation of the new state. Nakhleh highlighted that there existed a divide in the ruling family on how to respond to political demands or representation. Nakhleh called these camps as "realists" and "tribalists" to distinguish between those who are open to accept other paradigms of thinking beyond the strong hold of the tribe (Nakhleh, 1976). What is key to this labelling is that the Prime

[59] The book remains banned in Bahrain.

Minister represented the head of the tribalists camp. As such, to this day, there remains the presence of Prime Minister Sheikh Khalifah atop the authoritarian tribalists, resisting any constraints on his royal prerogative. These categorisations are useful to the discussion, here, with slight modification. I will be using similar categories but will call them *conservative* and *reformist* camps. While Nakhleh was interested in the differences within the royal family, I am extending the scope to also consider how the rest of the technocratic elites associated themselves with different groups of the royal family. Therefore, there will be many mentions in this thesis of the distinction between the *conservative* and *reformist* camps.

Local and regional political events have paved the way for the group advocating water abundance to dominate the political scene in this era. "It was nearly impossible for technocrats within BAPCO and the wider government agencies to withstand opposition to the Government's vision for the country" (interview #26). Needless to say, progress to undertake limited scientific measurement found its way. As discussed in the previous section (section 4.2.1) there was some concern from the British Residence about the status of water resource in Bahrain, namely springs and groundwater. These concerns manifested in a set of recommendations to the Bahraini state, post-independence, and in particular, the need to conduct an independent hydrological survey of water resources on the Island to establish a realistic baseline for policy developments.

During the early post-colonial period, comprehensive hydrological and agricultural investigations of the groundwater resources of Bahrain were conducted. Among the prominent ones were Italconsult (1971), Wright (1977), FAO (1979) and GDC (1980)[60]. Italconsult (1971) presented the *Natural Depletion Concept.* It states that analysis of the linear recession of static head data, indicative of the lowering of groundwater levels, is mostly due to uncontrollable natural discharges rather than to extraction from wells. In their conclusion, they stated that the Dammam aquifer system is naturally depleting. This view was disputed by Wright (1977) through the indication of a localised response to abstraction, evident from the available piezometric maps, where a significant cone of depression was shown around the major abstraction areas.

[60] Groundwater Development Consultants (GDC) concluded that the best quality water is found in the Dammam aquifer in the Northern and Western coastal regions.

More broadly, the Food and Agriculture Organization (FAO, 1979) completed a comprehensive survey on shared water resources in the Gulf States. The objectives were to review all hydrological reports available for the area in order to determine whether water resources are shared between these countries. Building on the FAO analysis, GDC (1980) produced a groundwater demand projection for the Dammam aquifers for the year 2000 based on a simple extrapolation of historical trends. The result indicated that a total of 167 Mm^3 would be required to meet the overall demand by the year 2020. This calculation assumed the availability of an additional amount of about 23.4 Mm^3 of desalinated water, plus what was then available for municipal consumption starting from the year 1985.

These surveys (Table 4.2) conducted a comprehensive study of groundwater resources, both in terms of quality and quantity. The focus was to establish bio-physical hydrogeological and hydro chemical information. Elements covered in these studies include the geometry, subsurface geology, and aquifer boundaries presented in hydrogeological mapping activities. As will be discussed in this section and in Chapter 5, these studies provided the baseline for advocates of water scarcity and influenced the narrative to push for reforms (legislatives and institutional).

Table 4. 2: Summary of key investigations on the Bahraini water potential, post-independence (1970 – 1980)

Consultant (Date)	**Key Findings**	**Output**
Italconsult (1971)	• Hydraulic inter-communication between the Eocene and Cretaceous aquifer systems. • Natural Depletion Concept: the analysis of the linear recession of static head data in	• Contamination by seawater to the Dammam aquifers on the basis of a salinity contour map and Ca/Mg ratios. • Piezometric and water quality contour map of the Dammam aquifers at a scale of 1: 100,000

	the Eocene aquifer system.	• Series of nine structural contour maps
Wright (1977)	• Attempt to visualise the head change for the period 1942-1966 by plotting the average heads against time. • Possible equilibration in response to changes in discharge regime which signifies the local wells abstraction.	• Co-relationship between groundwater conditions in Bahrain and the Saudi Arabia coastal area. • Piezometric map for the Khobar aquifer, of which aquifer salinity was shown to increase with decreasing heads, with minor salinity modifications.
GDC (1980)	• Verifying previous work and concluded that Wright's calculation (1977) was not definitive and that there is a much greater flow to the Dammam aquifers. • Salinity evidence indicated that saline groundwater invasion had taken place only as a direct result of over-pumping in particular areas.	• A set of structural and isopachyte contour maps for the various aquifer and aquitard units at a scale of 1: 50,000. • A set of piezometric and salinity distribution maps for the Khobar and Rus-Umm Er Radhuma aquifers at the same scale. • 3 schematic hydrological cross sections at a horizontal scale of 1: 100,000 and a vertical scale of 1: 5,000.

As a result of these studies (Table 4.2), Amiri Decree No. 12 (1980), governing the use of groundwater, was issued. The decree aimed at protecting the available water resources from further salinization and deterioration. It further introduced a robust participation system to reduce the number of wells, and therefore, total abstraction from the aquifer (GoB, 1980). More importantly, the decree required owners of irrigation wells to install meters for measuring water flow. Hence, the owners of the wells are transformed into users of groundwater, having to lodge their application to the government (relevant authorities) to obtain a license and permit to dig and to use groundwater. Here, licensing is meant to be an exercise of power and authority. As Diwan argues, the minority Sunni royal family were in favour of accumulating alliances, license distribution speaks to that end (Ibid, 2014).

A licensing system was also introduced giving the Ministry of Commerce and Agriculture[61] (MoC&A) the right to determine the quantity required for each plot of agricultural land, and if more than the authorised quantity is drawn, the excess to be charged. Based on the articles and clauses set out in the decree, two Ministerial Orders were issued to ban the drilling of water wells in the Dammam aquifer from 1980 to 1984 to allow aquifer recovery (Ministerial Orders No. 23/1980, and 4/1983). Therefore, these administrative measures were meant to give the Government the authority to act and determine the allowable quantities to be withdrawn from the aquifer so that it can be conserved sustainably. Even where these legislations existed they were not fully implemented.

Although Amiri Decree No. 12, and the following related ordinance and executive framework, looked encouragingly into water management issues from a regulatory point of view, they failed in implementation. In fact, the drilling of water wells continued. It is worth mentioning that within the first four years of the ban (1980-84), the rate of increase in the number of wells drilled in the aquifer exceeded the rates observed in the 1970s. AI-Noaimi (2005) reported that the total annual groundwater abstraction in 1979 was 147.4 Mm^3, whereas the abstracted volume in 1985 was 185 Mm^3. The increase in groundwater

[61] Currently, the agriculture sector is a directorate within the Ministry of Works, Municipality and Urban Planning (See Section 4.4.2 for analysis on Institutional Reshuffle).

abstraction reflects the ability of the advocates of water abundance to hinder any restriction to access groundwater resources. Al-Noaimi further commented:

> *"A special royal decree in 1980 (Royal Decree 1980/12) was enacted for regulating groundwater usages and its conservation. Subsequently, ministerial orders were enacted to prohibit the drilling of groundwater wells for four years between 1980 and 1984 (Ministerial Orders 4/32, 82/80) to facilitate the replenishment of the groundwater storage. However, any observant of that period will notice that wells drilling did not continue only but instead intensified and grew."* (Al-Noaimi, 2017)

Additionally, it was mentioned in a few interviews (interview #17 & #21) that the direct waivers, to grant digging for more wells, came across from the Prime Minister himself and others in the royal family. The well participation system, licensing system and taxation for water wells were not adopted. Despite some legislation, the strength and dominance of the group advocating water abundance is evident in the continued act of drilling. In other words, the increase in well drilling and water abstraction highlights the dominance of the advocates of water abundance over the advocates of water scarcity, in the operational sense.

Similarly, other institutional reforms in the water sector were established. For instance, in 1982, the Bahrain High Council for Water Resources (BHCWR) was initiated (Legislative Decree No. 7/1982). The prime duties of the High Council were stated as 1) to draw up the country's water policies given the results of recent water resources studies and surveys; 2) to protect and develop the water resources to ensure their continued availability and efficiency and 3) to take necessary measures to solve any problems that might arise during the implementation of the water policy. The council was then formulated under the chairmanship of the Prime Minister and with membership from the concerned governmental ministries (Prime Ministerial Edict No. 10/1982).

The establishment of the BHCWR was due to the repeated recommendation from most of the previous studies on groundwater resources[62] in Bahrain to establish an integrated platform for all stakeholders. "The BHCWR was associated with the Prime Minister's

[62] At this time, groundwater was supplying most of the water for all the various water users in Bahrain.

office, which was the highest executive authority in the country, to ensure that policies are integrated, and resolutions and actions are implemented" (interview #23). On the practical side, the council convened only four times, and most of its authority was therefore passed on to the Ministry of Commerce and Agriculture. Although the advocates of water scarcity managed to mobilise some actions, in the form of getting legislation to ban well drilling and establishment of the BHCWR, it fell short of seeing any material outcome.

In the next sub-section, I analyse how the claim of water abundance for the sake of pursuing food self-sufficiency policies, through projects of agricultural expansion, was concurrent with the establishment of the first desalination plant in Bahrain. Furthermore, I examine how the claim of introducing desalination in Bahrain was mainly to decouple groundwater from the municipal water supply, as a way to pursue and enforce water abundance for agriculture, less so for countering water scarcity.

4.2.2.2 Food self-sufficiency and water allocation: the start of the distinction between water for food and water for drinking

The water question was inseparable from the question of food production. However, tackling food production in the early stages of the modern Bahraini state was of critical importance, something that would only be realised in later decades, as will be discussed in Section 4.4. Initially, the newly formed Bahraini state focused on two areas of intervention: i) aggressively exploiting water resources for achieving food self-sufficiency and ii) maximising the use of groundwater for agriculture and slowly decoupling other water users from abstracting groundwater. State-building processes were significantly influenced by both internal and external development trajectories and required concerted policy interventions and efforts from multiple domains.

Two major events greatly influenced the way the Bahraini Government operated with regards to how food and water were perceived and provided. These events, in the case of Bahrain, were the gaining of independence from the British, and the OPEC-oil embargo event, 1971 for the former and 1973-74 for the latter. Similar to other regional countries, Bahrain found it imperative to secure water and food supplies. The claim was one of sovereignty: "what you do not internally source is something you do not own and hence cannot control" (Interview 19).

Bahraini independence from the British mandate marked the beginning of an important phase in modern Bahraini history. It involved the feeling of pride and honour (Nakhleh, 1976, 2011). It also added to the experiment and tested how successfully and efficiently the state could run a government without direct involvement from the British. The intense feeling of patriotism felt locally, and the aspiration and commitment to ensure a better outlook were substantial influencing factors in the formulation of Bahraini policies (Diwan, 2020). The Amir at the time, Sheikh Isa bin Salman Al Khalifa, and the Prime Minister, Sheikh Khalifa bin Salman Al Khalifa, had a strong vision of what Bahrain's future would look like. They believed, both in modernising the state and improving the living standards of the people. This was possible, of course, with the significant contribution of oil revenue into the government budget (Zubari et al., 1993).

The second event that shaped the contemporary Bahraini state has a regional dimension. The oil embargo of 1973-74 reinforced the regional identity of the Bahraini state as part of the Arab states, and more importantly the GCC, later in 1981. The oil embargo, and its consequences, refocused the importance of local and regional dimensions. The oil-embargo triggered a global wave of economic shocks, and in return, the Arab nations found it imperative to prepare for retaliation from the rest of the world (Looney, 1988). Among many commodities, food was the critical one that the countries in the region found essential to secure within their borders[63]. Food policies mushroomed in every country intending to improve the status of food availability locally. These food policies were heavily encouraged and subsidised by governments with massive incentives distributed to farmers and corporations (Zubari et al., 1993). The countries in the region, to a great extent, believed in their ability to convert the desert environment into green farms (Zeitoun, 2011). The magic words were *oil* and *water*, both of which originated below ground and were believed, for a while, to be in abundance.

However, the agricultural expansion programs and food self-sufficiency policies lacked competitive advantage. For instance, historically in Bahrain, typical agricultural activities were diverse on the production of dates, vegetables and fodders. A publication by the

[63] Pan-Arab nationalism was at its peak during the 1970s, an emphasis on Arabic identity at its core, influencing how the nations were interacting with each other.

MoM&A (Figure 4.3) highlights that 30% of the agricultural expansion in Bahrain in during the 1970s and 1980s can be attributed to fodders, and yet this consumed 70% of the abstracted groundwater (GoB, 1997). Additionally, a common theme of food self-sufficiency policies is the push to enable investors to reclaim and expand agricultural lands. Agricultural companies were permitted to employ and import foreign workers (mostly Asians) as well as access to advanced machinery (mostly Japanese and Europeans) to achieve maximum production. An academic explained the predicament:

> *"While small farmers continued to leverage their understanding of no-tillage agriculture practices to relatively expand their production of dates and vegetables, some big agricultural companies leveraged the availability of government subsidies, such as cheap diesel, no charge on water and access to hydraulic pumps and other equipment through interest-free loans. These companies left and relocated when the subsidies were reduced… small traditional farmers remained with no subsidy and a deteriorated quality of land and water."* (Interview # 95)

Figure 4. 3: Fodder agriculture (Alfalfa)
Source: MoM&A publication, 1997.

The mandate of the agriculture directorate, during this era, was to facilitate the implementation of food self-sufficiency policies through the allocation of water, as well as ensuring that farmlands (big and small) had access to secondary materials such as fertilisers. While groundwater was the available solution to cater for water-intense fodder agriculture, soil treatment was a challenge that faced the big agricultural companies. A local researcher reported that the magnitude of chemical fertilisers used on expanded lands were higher than the global average. For fodder production, nearly 450kg of chemical fertilisers were used per hectare, in comparison to only 100kg per hectare in

other countries (Aldarazy, 2003). Consequently, groundwater reserves became contaminated and land fertility deteriorated. Thus, "deserted agricultural lands were converted to residential allotments in Both Muharraq and Al Rifaa" (interview # 31).

Initially, the increased water requirement, due to economic growth, was met by groundwater. However, there existed movements in the MoM&A to restrict the withdrawal of groundwater for any purposes other than for meeting the aspiration for food self-sufficiency. As narrated by a retired official at the Agricultural and Water Resources Directorate:

> *"There was a consensus around opting for desalination at this time. In 1975, the Government had a healthy financial standing to afford it, and there were plenty of examples in neighbouring states. Our directorate was in favour of prioritising groundwater for agriculture. Moreover, the opposing camp, such as the expanding municipality sector, wanted something allocated for them."* (Interview #19).

As highlighted, many respondents narrated the inception of desalination in Bahrain as a tool to separate "water for food" from "water for drinking". It also highlights the Government's firm commitment towards food self-sufficiency by prioritising groundwater for the sole purpose of agricultural production. Notably, in the near decade between 1975 and 1984, and before the Sitra desalination plant was expanded in phase two and three in 1985 and 1986 respectively, desalination capacity stagnated at under 8 MCM per year. In the same period, annual municipal water demand increased from 20 to 35 MCM.

Therefore, while the inception of the Sitra desalination plant (Figure 4.4) marked a significant milestone for advocates of water scarcity, there was substantial traction to overcome. The general perception of this era was formed and shaped around how resources were perceived, and to a great extent, a general feeling of abundance was present. As "the oil revenue poured in, the Government started the mission of building and upgrading infrastructure to sustain the economic transformation that the country was experiencing" (interview #13). Several former EWA and current MOI officials (interview #1, #2, #3, #24 & #25) highlighted that as "the economy moved at a fast pace, people's preferences and consumption pattern followed closely". This massive economic transformation has also attracted "more foreign workers which has further escalated

population growth" (interview #71). Socio-economic conditions and the continuous intensification of agricultural production continued to exert pressure upon the Government. Over the two decades since independence, the population grew by 58%, increasing from 216,000 to 518,000 people between 1970 and 1989 (CIO, 2009).

Marking a strong relationship with its surrounding states in the region, Bahrain was gifted the Sitra plant from the Abu-Dhabi Government. Until now, "the first scheme of Sitra station is usually referred to as the 'Abu-Dhabi plant' to differentiate it from the second and third upgrades of the station" (interview #107). Similar regional assistance was given by other states, "Kuwait played a central role in training Bahraini engineers and technicians in how to operate and maintain desalination plants" (interview #109).

This regional support can be seen as part of the endeavours of the Bahraini Government in the journey towards modernity, like its neighbours in the Gulf. Almasri, on "Evaluating Water Resources", highlights that "augmenting non-conventional water in Bahrain was a milestone in the journey of the state post-independence…. the start of water desalination occurred in 1975 to meet the demands on the municipal water supply and reduce reliance on groundwater" (Ibid, 2011a, p. 54). Subsequently the 1985 and 1986 expansions of the Sitra plant were motivated as a modernisation project that was meant to reinforce the centrality of the state and its hydraulic mission. As such, it started as a step to modernise water resources through the leveraging of financial support and energy availability, yet it did not expand as per the regional pattern, at least in this period.

Figure 4. 4: Aerial photo of Sitra power and desalination plant
Source: EWA publication, 2008.

Furthermore, the Ministry of Agriculture and Municipalities oversaw the institutional set-up of the municipal water supply in the first cabinet after independence until 1974. However, in the second cabinet of 1975, the Ministry of Works, Electricity and Water was formed by the Amiri Decree No. 18. It was in this same year that the municipal water supply was allocated an individual directorate. It is worth noting that the separation of the municipal water supply from the Ministry of Agriculture and Municipalities functioned to distinguish “water for food” from “water for drinking” and was greatly influenced by the introduction of the Sitra desalination plant, also in 1974.

As discussed in this section, there existed a dominant perception of abundance in post-independence Bahrain. The perception, evidently, relied on historical and theoretical narratives of water legacy around natural springs in Bahrain. Key actors advocating water abundance were prominent figures in the royal family, such as the Amir and the Prime Minister. Food self-sufficiency policies mandated the agricultural sector to adopt the vision that was hegemonic at that time. To a lesser extent, a colonial legacy viewed the water question as sitting within the scientific domain and asserted the need to construct policies and legislations based on empirical knowledge about groundwater resources. In this first era between 1970 and 1989, Bahrain embarked on a food self-sufficiency endeavour (Lundqvist & Larson, 2013; Ouda, 2014). As most agricultural production in Bahrain was irrigated, it relied heavily on groundwater (Ouda, 2014). Although there existed a contestation between the advocates of water abundance and the advocates of water scarcity, a general consensus was reached on the commencement of seawater desalination as it was motivated by institutional reform in the early Bahraini Governments. Desalination in Bahrain was, therefore, introduced to decouple groundwater from the domestic water supply gradually. In other words, the "problem" that desalination was introduced to address was generated politically. The subsequent section (Section 4.3) will show how desalination expanded to reinforce the decoupling of the municipal water supply from the groundwater reserve.

4.3 The Second Paradigm of Water Resource Development and the Expansion of Desalination

The conventional wisdom of the *First Paradigm*, in the 1970s and 1980s, could not hold for too long. In an economically interdependent world, national priorities and securities

were refined in response to regional events and local politics. Three factors manifested in the refinement processes of this era (1990-1999): contestation for water allocation between agriculture and the growing municipal sectors, the elevation of groundwater as a strategic reserve and, most importantly, the expansion of desalination, which marked a shift in water resource development and management in Bahrain.

4.3.1. Historical and Political Context (1990 - 1999)

The invasion of Kuwait on the 2nd August 1990[64] marked a historical day that prompted countries in the region to begin to view several services within the unique setting of securitisation, and in an inward manner. As one interviewee commented: "What I own internally is what I can count on when emergencies happen" (interview #19). Among these services was water. The current view of water security is a testimony to that. Water security is measured by how much water supply the country possesses until the desalination plants are rectified from any emergency or malfunction (Darwish et al., 2014). In other words, how much storage capacity the country possesses to deal with regular or rational consumption until desalination plants are brought back to usual usage. Countries in the region started the construction of water storage facilities both above and below ground. Kuwait, for instance, progressed the furthest on this path, the success was attributed to its financial standing at that time. As the construction cost of massive water storage reservoirs is prohibitively expensive, countries realised the important function of groundwater as a safe, secure and strategic storage facility (Al-Otaibi & Abdel-Jawad, 2007).

As such, groundwater gained a boost of importance as a strategic resource that should be treated with care and consideration. Competing users, therefore, perceived access as restricted, or even denied, and that was why water became "politically scarce" (Allan, 2001). The immediate reaction saw the gradual abandonment of food self-sufficiency policies, that were believed to have relied heavily on groundwater reserves (Lundqvist & Larson, 2013). More importantly, the elevated status of groundwater to that of a strategic reserve, paved the way for advocates of water scarcity to mainstream other policies that would enforce their narrative. Thus, the narrative is based on measurement and scientific

[64] The invasion of Kuwait on 2 August 1990 was a two-day operation conducted by Iraq against the neighbouring State of Kuwait, which resulted in the seven-month-long Iraqi occupation of the country.

understanding about resources (quantities). It is important to note that the majority of actors in both camps, the advocates of water scarcity and abundance, were in favour of ensuring that socio-economic growth and development continued, but with a different focus.

In essence, two factors influenced how water was perceived and augmented, and subsequently served to facilitate the expansion of the desalination sector in Bahrain. These factors were i) intensive food and water policies that were later abandoned due to the resultant exploitation of groundwater and ii) the understanding that socio-economic development needed safeguarding.

4.3.2 Food - Water Nexus: Constructing National Priorities around Groundwater

In this second era, between 1990 and 1999, the reliance on groundwater to meet agricultural expansion peaked (Figure 4.5[65]). Notably, as a result of agricultural intensification and its associated extensive utilisation, groundwater was depleted and then prioritised as a strategic reserve (Al-Ibrahim, 1991; Al-Otaibi & Abdel-Jawad, 2007; Zubari et al., 1993). The nature of groundwater in the region can be compared to that of a fossil, with minimal or no replenishment potential (Al-Zubari, 2015). As governments in the region began to recognise that food self-sufficiency was not economically viable, there was a shift to food supply management as a means to achieving food security (Darwish et al., 2014). Consequently, from this point, groundwater gained importance as a means of water storage and not as a resource. This governmental concern for groundwater paved the way for mainstreaming other *waters* to meet regular water demands. Desalination in Bahrain was, therefore, expanded to reinforce the decoupling of groundwater from the domestic water supply. Subsequently, this necessitated a more significant expansion of Bahrain's desalination industry.

[65] The figures reported in figure 4.5 are the official data from the Water Resources Directorate and published by Al-Noaimi in a government sponsored conference. Hence, this data does not include unlicensed groundwater abstraction.

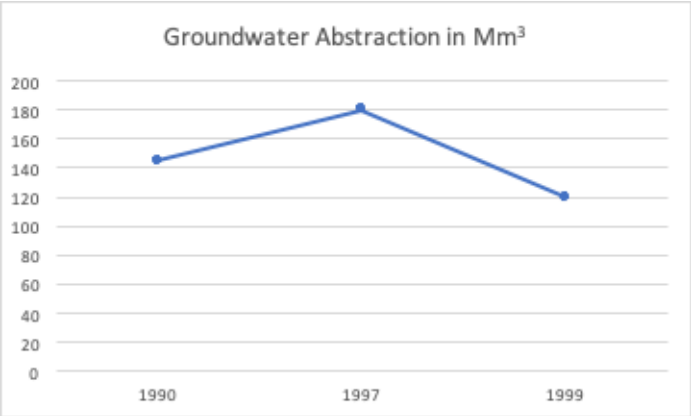

Figure 4. 5: Groundwater abstraction for irrigation purposes
Source: modified from (AI-Noaimi, 2005).

The interplay and linkages between food and water have put much emphasis on the priorities, how much water Bahrain is willing to spend on agriculture, and the short and long-term importance of different waters. A unique and different discourse, amongst elites and technocrats, emerged on the value of groundwater, and subsequently, what level of food security is worth undertaking. For instance, academics argued that the abstraction of groundwater should be limited to 100Mm^3 per year to match the annual natural recharge (interviews #93, 94 & 97). Implicitly, this means water demands should be balanced by seeking other water sources. While significant reduction in groundwater abstraction for agriculture purposes was achieved by abandoning food self-sufficiency programs gradually in late 1990s, the water demand from the municipal sector remained significant. As such, Bahrain expanded the development of non-conventional water resources to reduce the reliance on groundwater, and to minimise exploitation and decline in terms of quantity and quality.

The result was the securitisation of groundwater, influenced by the Kuwait invasion (1990) and subsequent war in the Gulf (1991). During these wars, the Gulf experienced massive oil spillage. As narrated by a historian, "in these wars, the largest deliberate oil spill occurred in the Arabian Gulf region between January and February 1991, when about 60 million barrels of oil were discharged into the desert and about 9.5 million barrels of oil were discharged into sea water" (interview #123). In addition to its human and economic losses, desalination plants that are stretched from Shatt al-Arab in the direction of Kuwait, Saudi Arabia, Bahrain and Qatar were impacted. Evidently, the way water security in the region is theorised is around "available and secured … quantities of fresh water to meet normal/rationing demand under emergency situations until water

production facilities are constructed or rehabilitated" (Al-Otaibi & Abdel-Jawad, 2007; Cook & Bakker, 2012).

Furthermore, exploring and expanding non-conventional water resources, such as desalination, was also imperative to sustain reliable water resources for increased water demand. Along the journey of realisation and reflection it becomes more evident that the group of actors advocating water scarcity has established a stronghold in policies and institutions and demanded better representation. This is usually shown, along with scientific arguments, by bureaucrats in associating Bahrain's endowment of water with arid lands (Elagib & Addin Abdu, 1997). In one of the interviews with a retired manager from the Agricultural, Engineering and Water Resources Directorate in MoW&M, he pointed to the tension between food self-sufficiency policies, available irrigation schemes and the sustainability of the sector as a whole:

> *"Assuming that the food self-sufficiency policies achieved their aims, this was only made possible with a significant financial bill and a substantial loss of groundwater quantities. Worse still, the sustainability of the agricultural sector was never achieved, as seen in the drastic shift to abandon national agricultural production and rely on either imports or investment in agricultural land abroad in favour of protecting groundwater storage."* (Interview #41)

Self-sufficiency policies relied primarily on the expansion of agricultural land to achieve increasing production targets. The discourse within the agricultural sector gradually shifted to include the notion of "relative sufficiency" and "achieving comparative advantage" in describing the role of the local agricultural sector and small farmers (interviews #18, 21 & 26). The agricultural sector maintained a strategic importance as a source of food, and socially, as a main source of income for more than five thousand Bahraini families (GoB, 1997). A former manager in the sector highlights that farmers were left worse-off after agricultural projects were abandoned. He states:

> *"The outlook of the agricultural sector, through the expansion phase, consisted of investors and workers employed in farms. As such, once the Government's subsidies were downsized, the entire sector shrank, and investors moved elsewhere, to different countries or sectors. The traditional farmers, however, were left behind with no safety net and a dwindling groundwater supply."* (Interview # 26)

During this era, the agricultural sector experienced unprecedented growth in the water used for irrigation. Likewise, farmed land expanded from about 22.2 km^2 in 1970 to about 30 km^2 in 1990. The increase in agricultural land was accompanied by a relatively reasonable increase in the abstraction of aquifer water by about 23 Mm^3/ yr (Zubari et al., 1993). Although food subsidies allowed and encouraged the expansion in agricultural land and production, it subsequently degraded groundwater resources due to over-exploitation as per the ESCWA and UNDP evaluations of the agricultural sector in the GCC.

> *"... the absence of any legal or administrative measures to control the groundwater abstraction rate has prompted the uncontrolled drilling of wells. The absence of water tariffs for utilising groundwater has also contributed to unhealthy agricultural practices such as low-efficiency irrigation rates that subsequently contributed to over 50 per-cent of water being used for irrigation."* (ESCWA, 2003)

> *"The agricultural development policies aiming for food self-sufficiency without a corresponding clear priority on water use efficiency have led to excessive water use in the agricultural sector."* (UNDP, 2005)

Thus, as groundwater continued to deteriorate, migration of farmland and a decrease in national agricultural production was apparent across all countries in the region (Woertz, 2011). It is important to note here, as groundwater hydraulic levels continued to drop, and quality continued to deteriorate, GCC countries started to review their agricultural policies[66]. Governments were then convinced that they could not achieve food self-sufficiency due to the limitation on freshwater resources and therefore prompted a discussion on the relevant level of food self-sufficiency for the countries in the region. In Bahrain, "the shift was made to maintain a relative local food supply in term of vegetables and farm-food for husbandry" (interview #18). Evidently, in the mid-1990s, the Government stopped distributing lands for agricultural production and decreased

[66] The major crops cultivated in the GCC countries can be categorized into four categories: cereals, fodder, vegetables, and Fruits and Dates. The trends in the total cultivated area, and the cultivated areas of each of these four categories, has varied from one country to another in the past three decades. In Saudi Arabia, and as indicated earlier, due to agricultural policy reforms concentrating on the phasing out of wheat production (after a major increase in the mid-1990s), the total cultivated area has shown a general decline with a steady negative trend in the 2000s. In 2010, the total cultivated area in Saudi Arabia was about 755 thousand ha, which is about half of the peak of the cultivated area of the mid-1990s (1.6 million ha). A similar pattern in the cultivated area is observed in the UAE, where after a peak increase in the 2000s, reaching about 244,610 ha (a 13 times increase compared to its 1985 levels), a general decline in the cultivated areas continued down to about 76,000 ha in 2010 (Al-Zubari, 2015).

incentives in the sector in the form of subsidising agricultural production inputs, and cutting the practice of de-risking investment by guaranteeing the purchase of the agricultural yield. All of these measures aimed to stop the continuous depletion of groundwater as well as lessen the burden on the fiscal budget.

There are two parts in the realisation of the food security approach. The first part was the realisation that "food imports are way cheaper than produced locally, and the local production lacks a comparative advantage" (interview #107). The second part was the realisation that "groundwater extraction was happening at a rate that is not sustainable, and the risk of creating a far worse problem" (Zubari et al., 1993). Once these realisations were internalised, of course, after a regional acknowledgment, the advocates of water scarcity (reformist camp headed by the Crown Prince), were becoming properly entrenched in strategic approaches to tackling policies and priorities. A manifestation of the prominent narrative of water scarcity was, for instance, that the Government of Bahrain initiated a revised major agricultural development programme represented by:

(1) Improvement of irrigation methods to more water-efficient ones by subsidising more than 50% of the cost of their implementation.
(2) Construction of a major agricultural drainage system on Bahrain Island, thus alleviating waterlogging and salt accumulation.
(3) Provision of agricultural extension services in terms of educating and advising farmers on types of crops suitable for agriculture under present circumstances.
(4) Introduction into agriculture of sewage-treated water. (MoW&M, 1999).

As food self-sufficiency programs were being phased out, towards the end of 1990s, the perception of water resources evolved to consider different waters and their relevance in the socio-economic development of the state (Kotilaine, 2010). Groundwater resources remained under the patronage of the Agriculture Directorate, but with a different mandate to safeguard water resources and achieve relative food production. The shift in priority from expanding agriculture to protecting groundwater had also influenced how water was augmented in the municipal water sector. Desalination expanded to meet the increasing demand in the municipal sector due to population growth and urbanisation. During this period (1990-1999), the desalination supply increased from 52% to 65% in the municipal sector, a volumetric amount of 54Mm^3 to 89Mm^3, respectively (EWA, 2004). As such, desalination had become a central techno-political strategy in Bahrain's quest for

development. The supply-oriented water managers found desalination as imperative to reduce reliance on groundwater while maintaining a sense of water abundance. This imperative of projecting water abundance is seen as an essential component of a sustainable socio-economic society as will be discussed in the next sub-section.

4.3.3 Manufacturing Abundance and Sustaining Socio-Economic Transformation

In this section, I analyse the role of subsidies and the welfare system in manufacturing a sense of abundance. This is discussed given the social contract that governs the relationship between the state and the people (see section 2.2.2 on reference to the *rentier state*). In particular, subsidies and grants are considered to be social processes that are used "to express, exercise and validate legitimacy and power by the ruler" (Beblawi, 1987). In Bahrain, as well as the other GCC countries, subsidies and new projects are presented and celebrated with the mission of ensuring the well-being of the population and striving to improve it all the time.

Both society and the economy have undergone significant transformation in the modern era. With the onset of oil exploration in the 1930s, the Gulf region witnessed a drastic transformation, particularly during the last few decades (Alyousef & Stevens, 2011; Sgouridis et al., 2013; The Economist Intelligence Unit, 2010). In a brief period, countries in the region have been able to construct megacities and advanced infrastructure. The relatively poor Gulf Emirates have emerged as modern and wealthy states. More importantly, apart from infrastructure modernisation, the Gulf States maintain one of the most comprehensive welfare systems, of which most services are provided at a very nominal price for both locals and migrants[67] (Kamrava, 2009; Reiche, 2010; Schwarz, 2008). This system of governing incentivised both socio-economic transformations as well as higher demand for conventional and non-conventional resources.

As discussed in the previous subsection (4.3.2), once it was established that water was not, in fact, in abundance, advocates of water scarcity managed to forward their position dominantly. This was achieved by a particular reliance on technological interventions to address increasing water demand. This position became more appealing with the

[67] There has been some recent modifications to the welfare system to privilege citizens with targeted subsidies. Subsequently, this has attracted some criticism from rights groups on the living standards of migrants.

Government's commitment to sustain social and economic gain, whilst also manufacturing a sense of abundance. As Allan (2001) argues, there are "political imperatives to the selection [of policies] and distortion of information on water in the Middle East". These imperatives drive governments to assert that their economies have not run out of water (Allan, 2001, p. 5).

Despite the escalation in prominence of views of water scarcity, the general mode of policy did not change radically to restrict access. It was, instead, a matter of opting for different policies and technologies. This was due to the strong government projection of manufactured abundance and its desire to support socio-economic gains post-independence. As documented by McDonnell, the emergence of the modern Gulf States idealised the rush to a modern, materialist, affluent lifestyle as a way to achieve abundance (Ibid, 2013).

The reasons for the uptake and rollout of large-scale infrastructure in the GCC have been discussed and analysed by many. Sultana (2013) sees it primarily as pertaining to the hydraulic mission of the state and as a means of reinforcing its position. Others, like McDonnell (2013) situates the decision to take the desalination route as a modern phase of a governing system with a long tradition of a strong ruler-people relationship. For Beblawi (1987), modernisation projects befit GCC's status as rentier states, one that redistributes wealth through a comprehensive welfare system. Regardless of the stance, the commonality within these views is a government system showing a commitment to the provision of welfare on a large scale. Despite all the challenges and difficulties, the only constant was a comprehensive welfare system built upon a socio-economic base that continued to expand. The only changes were seen in the powershifts of policies and networks depending on how natural resources were viewed and prioritised. As such, while the demand for services and resources was increasing, governments were leveraging the accumulated wealth from oil production to commit to large-scale infrastructure projects.

Bahrain, like most of the GCC Countries, has experienced accelerated development growth since the early 1970s (refer to Section 3.3). This occurred as a direct result of the sudden increase in the country's oil revenues, which led to a fast increase in its economic base and an improvement in the standard of living of Bahraini citizens. Consequently, the country experienced an influx of migrants to help support the growing economy. This in

turn, resulted in a rapid increase in the country's population. A significant share of oil revenues has also been used to modernise Bahrain's infrastructure, whilst water supply and sanitation services have been made accessible to a large percentage of the population.

In the last four decades, the Kingdom of Bahrain has experienced population growth. The average annual population growth rates ranged between 2.3 - 3.6% per year during 1990-1999 (CIO, 2009). The population was recorded as 518,243 and 637,582 in 1990 and 1999 respectively (refer to Figure 3.6). Two key factors influenced population growth in Bahrain, firstly, "improving the standard of living and socio-economic conditions have encouraged the growth of the native Bahraini population" (interview #29), secondly, "Bahrain's increasingly diversified economy has produced a growing demand for skilled labour", particularly within the industrial and service sectors", which has attracted foreign labourers (interview #35).

The fast growth rate in the population in the last four decades, and the associated development processes[68], have brought about a substantial increase in water demand. The water demand increased, for all usages, from nearly 270 MCM in the year 1990 to reach 347 MCM in the year 1999 (AI-Noaimi, 2005).

Notably, in 1990, the Government imposed a rising block pricing structure to promote water conservation in the municipal sector, with different rates set for domestic and non-domestic consumers. Charting tariffs for piped water marked a significant change in how water was perceived. Although some government effort had been made to regulate abstraction from groundwater for irrigation purposes, there was no attempt to address consumption in the domestic water sector. It is worth noting that the imposition of water tariffs for the municipal water supply marked a change in the waterscape and how Bahrainis viewed water. While many technocrats and water practitioners favoured the presence of a price-signalling mechanism in the water sector, the decision was modified and significantly reduced in May 1992 by a Royal Decree.

[68] Represented by rapid urbanisation, expansion of irrigated agriculture and industrialisation

The 1990 decision to implement water tariffs was motivated by a change in lifestyle due to the high domestic per capita income in Bahrain. The culmination of effort from water practitioners in the MoW also translated into this recommendation, supported by several consultancy studies. The modification of the decision in 1992, on the other hand, was political in nature. A local study on the effect of water tariffs on consumption patterns labelled the 1992 decision to reduce tariffs as "a royal grant to reduce the cost of basic needs…which aims to alleviate the burden on the people of Bahrain" (BCSR, 1992). It was narrated that the decision was made after the Amir returned from medical treatment abroad.

More critically, there existed a strong projection and political vision of abundance from the ruler, this was evident in terms of the sustained comprehensive welfare system. At the core of the comprehensive welfare system is the provision of services and resources at significantly subsidised rates. The Government's role, therefore, was to ensure the provision of the spectrum of services and commodities to support the economic transformation that the country was experiencing, in a way, to ensure the sufficiency of the provision to the public.

The contestation between the group of actors advocating water scarcity and the ones advocating water abundance was intense in this era, with a changing policy environment allowing the different groups to forward their views. The socio-economic transformation and the Government's commitment to sustaining economic growth manufactured a sense of abundance around services. These transformations and political settings, therefore, facilitated the expansion of the desalination sector as a "techno-fix" to previously detrimental food and water policies, and the current increase in water demand (Scheba, 2014; Swyngedouw, 2013).

4.4 The Third Paradigm of Water Resource Development and the Dominance of Desalination

To a great extent, the *Third Paradigm* of water resource development stands in stark contrast to what transpired a few decades ago in Bahrain. Food itself is handled like an ordinary commodity that can be sourced competitively from international markets. Ambitious food sufficiency programs have practically disappeared from the current discourse around the utilisation of water, and along the way, the once trivial issue of

desalination has become the cornerstone of the *Third Paradigm* with water policies, legislations and institutions revolving around it.

4.4.1 Historical and Political Context (1999 – Present)

In the first three decades after independence "Bahrain has had enough experience of understanding its strengths, weakness and its position in the surrounding" (interview #71). Significant progress was witnessed with the appointment of the new ruler, Hamad bin Isa Al Khalifa, in 1999. He instituted elections for parliament, gave women the right to vote, and released all political prisoners. A referendum on 14–15 February 2001 massively supported the National Action Charter. As part of the adoption of the National Action Charter on 14 February 2002, Bahrain changed its formal name from the State (*Dawla*) of Bahrain to the Kingdom of Bahrain. The political landscape was also further re-arranged by the appointment of Prince Salman Bin Hamad as heir apparent to the crown. He was then appointed as the Deputy Supreme Commander of Bahrain Defence Forces in 2008 and the first Deputy Prime Minister in 2013.

In part, the new Crown Prince wanted to assume a space in the political sphere and policy making, and was labelled as "the spearhead of Bahrain's reforming elite" (Coates Ulrichsen, 2013). The appointment of Prince Salman leveraged the position of advocates of water scarcity in direct contestation of the already suppressed advocates of water abundance who were still consolidated around the Prime Minister, Prince Khalifa. Subsequently, advocates of water scarcity, who championed governance, then galvanised their grip and charted desalination as "the protagonist" to curb water scarcity for good (Hartmann et al., 2005). Fascinatingly, the arrangement of actors shifting between the two groups took several decades to settle and was always skewed towards the water scarcity group, though positions became more evident after 1999. As discussed in the previous two sections, water for agriculture was reviewed to limit agricultural expansion. Groundwater was then viewed as a strategic reserve, closely linked to the definition of water security in the region. Subsequently, desalination became *the new conventional source* for water, and in some way, a tool to alleviate pressure from abstracting groundwater.

The third era, between 1999 and the present, is a result of the first and second eras. The food and water policies of the 70s, 80s and 90s, coupled with a strong commitment from

the Government to ensure abundance in supply across all services, have facilitated the position of desalination as a response to water shortage and as a means to sustain and safeguard social and economic achievements. As per Figure 4.6, reliance on desalination continues to increase, currently in Bahrain it peaks at over 94% of the domestic water supply. Desalination is considered locally a synonym to water. Water policies and government budget allocation to the sector mainly revolve around desalination. Proponents label desalination as a bulletproof water policy because it is independent of externalities such as rainfall or climatic factors, whereas opposers describe it as a technological lock-in/ sunk cost that restricts decision making from considering alternatives due to the technical know-how and the already invested capital (Barnett & O'Neill, 2010; Frantzeskaki & Loorbach, 2010). Detailed analysis of the lock-in effect and desal-dependent path is provided in Chapter 6.

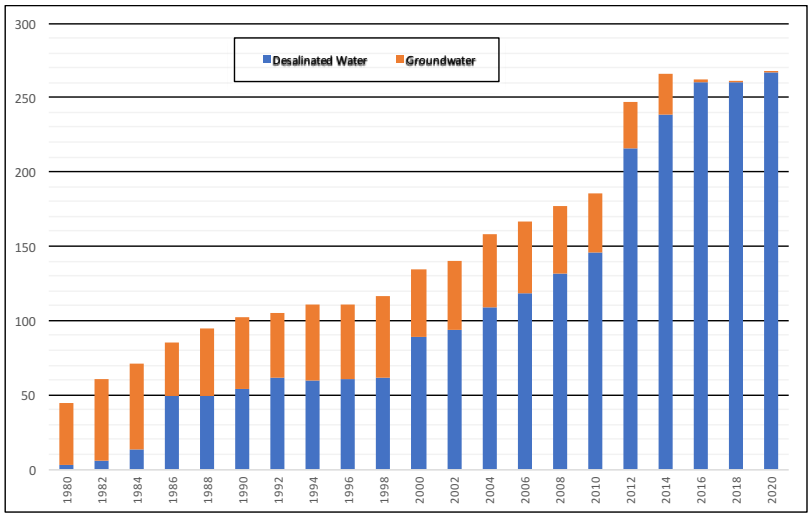

Figure 4. 6**:** Desalinated water and groundwater meeting municipal sector water requirements (MCM) in Bahrain (1980-2020) Data source: EWA

4.4.2 Legislative Position: Alignment of Policies and Affirmation of Water Scarcity

In 2008 the Economic Vision 2030 was introduced, detailing strategies that were entrusted to provide a prosperous future for Bahrain, including a sustainable and progressive economy. Some difficulties shaped the formation of the vision. Negotiation and contestation continued along the way between the abundance and scarcity camps. Experts believed the role that the Crown Prince played in moving the country towards strategic planning and management was an important and timely one to counter the established state, headed by his uncle, the Prime Minister (Kamrava, 2009). Inspired by

global and regional events such as the 2007-8 food-fuel crisis, dynamics of scarcity emerged strongly with justification (Mehta et al., 2019). Further discussion on how the scarcity narrative is articulated in Bahrain is provided in Chapter 5. A central element of the 2030 vision[69] was how the advocates of water scarcity clearly articulated the need to shift from intensive and unrealistic food self-sufficiency policies towards conservation and efficient water allocation. The Economic Vision continues to further formalise scarcity as a doctrine that will need to be evaluated and dealt with. Instead of the blanket subsidy policies that usually apply to all sectors of society, subsidies will be targeted, and scarce resources will be rationed for sustainability purposes:

> *"Subsidies for water, electricity, gasoline and food, for instance, will .... reduce costs and avoid overconsumption of scarce resources."*
> (Excerpt from Bahrain Economic Vision 2030) (GoB, 2008a)

Thus, to translate the Economic Vision 2030 into a practical project, every ministry and government authority produced interim strategies and master plans between 2008 and 2016 (Table 4.3). The first four plans were produced by the Agricultural, Engineering and Water Resources Directorate in MoMUP in 2009, 2010 and 2011, and one EWA strategic plan was produced in 2013. In 2018 a new National Water Strategy was prepared by the Water Resources Council as a joint effort between the Ministry of Electricity and Water (MoEW) and Ministry of Works, Municipalities and Urban Planning (MoWMUP). The institutional context within which these plans were produced is vital to understand the relationship between technoscience and politics in this case.

In order to understand how policies were aligned to affirm water scarcity as a political and scientific fact, I provide a textual reading of water scarcity as it gradually became the dominant technical and political discourse between 1999 and the present day. I do this through a critical reading of six strategy and master water development plans. I also provide a reflection of the institutional and personal struggles that took place in the process.

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[69] The 2030 Economic Vision is the Crown Prince's Flagship strategy to transform the Bahraini economy beyond oil.

Table 4. 3: Bahraini Water Plans (2009 - Present)

Plan	Year	Agency / Institution
Strategic Plan for Water Resource Management 2009-2014	2009	MoMUP
National Master Plan for Sanitary Engineering Services 2010 – 2030	2010	MoMUP
National Strategy for Sustainable Agricultural Development in Bahrain (2010)	2010	MoMUP
Strategic Plan for the Municipality and Agriculture Ministry 2011-2016	2011	MoMUP
EWA Strategy 2013 – 2017	2013	EWA
National Water Strategy 2015 – 2030	2018	EWA & MoWMUP

Textual analysis of the interim strategies and master plans identify three major themes that are articulated and emphasised to assert water scarcity as a given challenge and a common obstacle to overcome. These themes are i) preserving groundwater as a strategic reserve and the importance to capitalise on non-conventional waters (desalination and treated wastewater) to meet increasing regular water demand; ii) protecting groundwater aquifers while sustaining relative food security and iii) reliance on advanced scientific measurement and modelling to understand baselines and the future outlook for food and water. Below is an examination of the build-up of these themes and a discussion of how legislative water reforms were enacted and institutionalised.

Legislative reforms

Reprioritising development trajectories around water and food, as discussed in Sections 4.2 and 4.3, influenced how water is perceived. It is the gradual shift in the political economy of water that dominated the formulation of these strategies and master plans, all of which favoured a particular understanding of water conditions. Subsequently, in the process, a new framework of government emerged that strongly advocated certainty,

scientific modelling and technical fixes. Notwithstanding the efforts of all government bodies in producing policies and legislations, there remain critics who assert these strategies and plans are sectoral and fragmented. An academic view on water policies in Bahrain commented:

> *"However, looking closely at these legislations, one will notice that they are sectoral and were enacted and implemented as a reactionary measure when a problem [of water scarcity] manifested, not through a holistic and integrative approach of legislation framework"* (Interview #94, 2016).

In every document, there is an explicit indication of the challenges facing the water sector, and an attempt to explain how to address and deal with these challenges. Some documents outline the broad scarcity challenges facing Bahrain, as can be seen in the following extracts:

> *"Bahrain and the Gulf Cooperation Council (GCC) countries are situated in one of the most arid regions in the world, with an extremely poor endowment of freshwater resources. Despite the water scarcity, the GCC countries have done well in providing water for their ever-increasing population and rapidly expanding economic base."* (National Water Strategy 2017 – 2030) (GoB, 2018)

> *"The Kingdom of Bahrain....has committed to a comprehensive renaissance that is based on sustainable development pillars which consider environmental [natural], social and economic dimensions."* (National Strategy for Sustainable Agricultural Development in Bahrain, 2010) (GoB, 2010)

While other documents refer to specific scarcities within the water sector and focus on ways to address the problem and find a sustainable path. An example of this can be seen in the following extracts:

> *"This critical condition, due to the decline in groundwater, put us up against immense challenges which require swift actions and responses to remediate the condition."*(Extract from the Strategic Plan for Water Resource Management 2009-2014) (GoB, 2008b)

> *"…the groundwater reserve is in significant decline which necessitates us [Ministry] to put together a holistic and integrative plan that regulates the usage of this resource and require us [Government and users] to efficiently use agricultural and municipal lands."* (Extract from the Strategic Plan for the Municipality and Agriculture Ministry 2011-2016). (GoB, 2010b)

As discussed, in this era, there began a shift towards viewing water as a scarce resource, which implied that *waters* needed to be augmented through various [non-conventional] means. This emphasis is clearly presented in EWA and MoMUP documents. For instance, EWA's Strategy Vision stated that "by 2017 EWA [is to become] a model of excellence in the provision of electricity and water services with minimum interruptions and timely revenue collection". The emphasis on reliability and quality is shown in the same document's mission, which states the aim "to provide [a] reliable and quality supply of electricity and water for sustainable development of Bahrain". In 2018, EWA reported that the augmented groundwater for blending purposes was 0.2%, of which the remaining 99.8% was produced via desalination, in a trend to maximise the usage of desalination for meeting non-agricultural activities (municipal, industrial, tourism). Whilst the reported water production capacity was over 313 MCM in 2018, the total demand was under 261 MCM. Thus, there was a spare availability of nearly 52 MCM of desalinated water as a buffer to meet the seasonal peak increase in water demand. This tendency to ensure the projection of sufficiency in the municipal water sector reflects how EWA operates, as part of the Government's projection of abundance.

While desalinating seawater and saline groundwater remains the primary source of non-conventional water, there has been a great deal of effort to utilise treated sewage effluent (TSE) and discharged agricultural water, with limited usages. Bahrain has embarked on a phased construction of sewage treatment plants to provide secondary treatment before dumping into the sea, and tertiary treatment for agricultural and landscaping purposes in order to alleviate pressures on Dammam groundwater. The central wastewater treatment plant in Bahrain is based at Tubli and was constructed in 1984. The utilisation of TSE on the reclaimed agricultural lands, although small in amount, reached 14.8 MCM in 2014, reflecting the same tendency to alleviate pressure on groundwater resources. The main focus of the National Master Plan for Sanitary Engineering Services (2010 – 2030) is the evaluation of the development of TSE demand over the next 20 years, in addition to the established reuse of TSE in agricultural and landscape irrigation. Since enhancing the sustainability of the water supply system is essential for the country to be able to meet the increasing future demand, TSE could play an important role in this regard. For instance, policies and recommendations are available to increase the rate of reclaimed water utilisation through treating wastewater at high levels depending on its intended end-use. The country

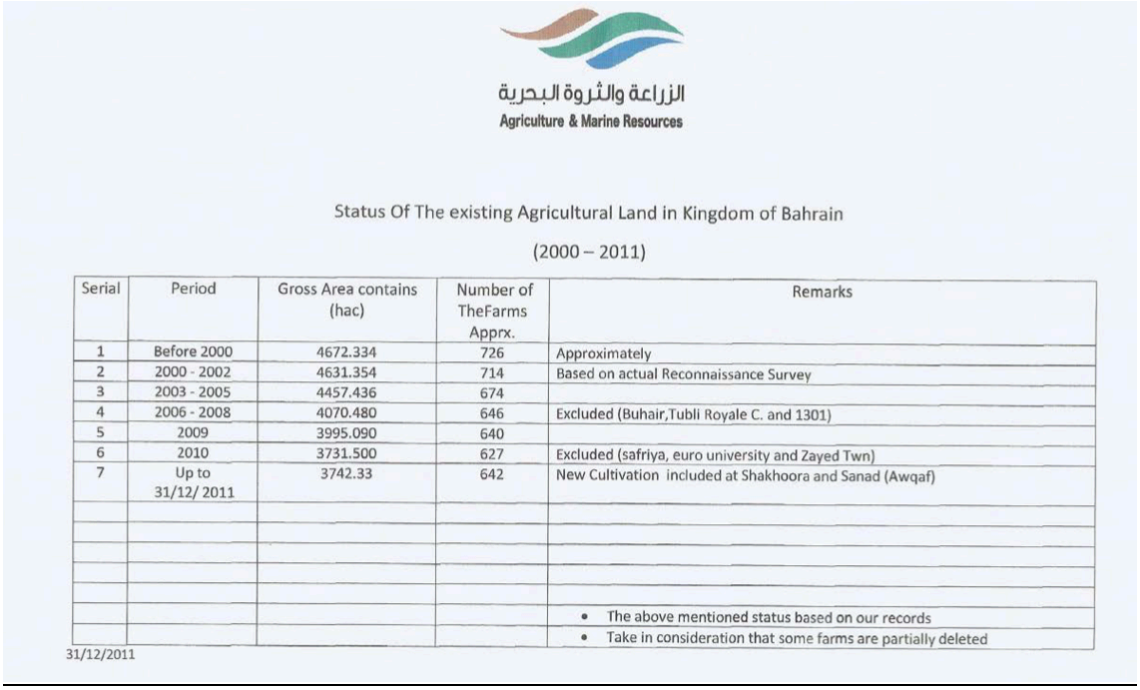
could start using reclaimed water for irrigation, landscape decorations (ex. fountains), and gradually improve the level of treatments to be used domestically. Nonetheless, public hesitancy is prominent, with cultural and religious reasons cited.

Additionally, the Agricultural Sector Strategy indicated a shift to targeted and relative food security as a means to ration groundwater abstraction. As such, the Agricultural Development Strategy has eight main strategic objectives/portfolios[70]. These strategic objectives consist of a number of sound and modern principles in agricultural development and appear comprehensive in covering many issues. If fully implemented, these principles would significantly improve the performance of the agricultural sector in Bahrain, not least, through the efficient use of water. Among the suggested modification policies in the agricultural sector, measures such as improving agricultural drainage systems and farming practices, and changing the crop patterns (particularly alfalfa) to less water consuming crops have been considered (AI-Noaimi, 2005). However, an action plan for implementation of the strategy has not yet been developed.

The trend of focusing on relative food security emerges strongly in the construction of national priorities and the broader discussion on the importance of securing groundwater resources. A reduction in the total area under cultivation is evident in Figure 4.7, which shows that in 2011 the total area dropped to approximately 3,740 hectares out of 11,000 hecatres[71] of arable land available in Bahrain (GoB, 2010b). In economic terms, Bahraini agriculture contributes about 1% to the country's GDP (FAO, 2019).

[70] 1) Achieving relative food security; 2) Encouraging agricultural investments; 3) Agricultural health care; 4) Conservation of natural resources; 5) Agricultural development and the use of modern technologies; 6) Development and protection of agricultural lands; 7) Capacity building and development; 8) Small farmers and breeders support.

[71] 3,740 hectares = 37.4 km^2 and 11,000 hectares = 110 km^2



الزراعة والثروة البحرية
Agriculture & Marine Resources

Status Of The existing Agricultural Land in Kingdom of Bahrain

(2000 – 2011)

Serial	Period	Gross Area contains (hac)	Number of TheFarms Apprx.	Remarks
1	Before 2000	4672.334	726	Approximately
2	2000 - 2002	4631.354	714	Based on actual Reconnaissance Survey
3	2003 - 2005	4457.436	674	
4	2006 - 2008	4070.480	646	Excluded (Buhair,Tubli Royale C. and 1301)
5	2009	3995.090	640	
6	2010	3731.500	627	Excluded (safriya, euro university and Zayed Twn)
7	Up to 31/12/ 2011	3742.33	642	New Cultivation included at Shakhoora and Sanad (Awqaf)
				• The above mentioned status based on our records
				• Take in consideration that some farms are partially deleted

31/12/2011

Figure 4. 7: Trends of reduction in agricultural land area (2000 – 2011)
Source: (GoB, 2010b).

Furthermore, the language used in formulating the strategies and master plans aim to establish certainty by encouraging the utilisation of scientific measurement, rigorous modelling, and scenario forecasting for supply and demand. The ultimate aim, of course, is to guide the decision-making process through the provision of evidence-based results. This process reflects the changing approach in how the Government views resources. For instance, the Strategic Plan for Water Resource Management (2009 – 2014) stipulated a project plan to build a numerical model for the Dammam aquifer. The project was estimated to be completed by 2014 and cost BD 65,000. Although existing hydrological information could be considered sufficient, as per the numerous local and international consultancy reports, the importance of this project is "to update existing baseline information in terms of data collection, processing retrieval and presentation" (interview #24), to subsequently inform "the preparation of a comprehensive computerised groundwater database" (interview #25). It is worth noting that the essence of adequate aquifer characterisation, or simulation modelling (both flow and salinity), is to facilitate hydraulic behaviours and predictions against various demand scenarios. The mandate to establish baselines and benchmarks can also be seen in the terms of reference for the UWS when it stated:

"The Consultant will develop national benchmarking and KPIs in line with those of the GCC UWS to monitor the success of water strategy implementation and

to benchmark Bahrain's various water sector strategies. Outline for a benchmarking system should be designed, and a baseline shall be established for the year 2014." (Extract from the Development of the National Water Strategy and Implementation Plan for the Kingdom of Bahrain (2017-2030) (GoB, 2016)

As such, despite a growing consensus on water scarcity amongst elites and officials, the overwhelming response from the various interim water plans and strategies was to augment more water. Bahrain's pursuit in navigating the (water scarcity) crisis capitalised on technical fixes and the assertion of plentifulness, as will be examined further in Chapter 5. Both desalination and TSE were seen as instrumental in closing the water supply gap. Although desalination managed to dominate the municipal water sector, supported by the narrative of crisis in the groundwater space, institutional reform evolved considerably at a level that allowed desalination to be the favoured policy. In this regards, non-conventional water resources gained more traction as a reliable option to supply the domestic sector.

Institutional reshuffle

Although institutional reform and legislations have improved in this era, water affairs, both domestic and agricultural, have shifted between several ministries along the way. There was a struggle on whether water should be perceived "as a resource or as a service" (interview #101). It also marked the evolution of the contestation between the advocates of "water for food" and "water for drinking". Agricultural and irrigation affairs had been associated with the Municipality Ministry from independence until it was merged with the Ministry of Works in 1995 to form the Ministry of Works and Agriculture. However, in 2001, agricultural affairs were re-assigned back to the Municipality Ministry until the formation of the Ministry of Works, Municipalities Affairs & Urban Planning in 2014. Similarly, domestic water supply had been associated with the Ministry of Works, as a directorate, since 1975 and that continued as such until 2011 when the Electricity and Water Authority was merged with the Ministry of Oil and Gas Affairs to become the Ministry of Energy in February 2011. In July 2012, the Ministry of Electricity and Water Affairs was formed as a separate entity to oversee electricity and domestic water supply.

The continuous reshuffling of the water affairs department across different ministries resulted in policies and legislations that were sectoral in nature. Several local and international researchers have criticised the fragmentation of water politics and policies,

and the absence of a holistic and integrated approach to the water question. These critiques are as follow:

> *"….there are, in fact, individual sectoral strategies available in Bahrain, which are being drawn up by the different ministries."* (Zubari et al., 1993)
>
> *"Institutional weakness and fragmentation of responsibilities are one of the major reasons for water policy failure. Responsibilities for water development, use, and management in the country are distributed among several water authorities."* (AI-Noaimi, 2005)
>
> *"Traditional decision-making and policy implementation that is undertaken mainly within sectoral boundaries and lack…in-place integrative mechanisms, …. will not necessarily contribute to long-term [institutional] sustainability."* (Teschner et al., 2012)

Early on in 1982 the Government established the Bahrain High Council for Water Resources (BHCWR), a ministerial body responsible for drawing up the country's water policy and coordinating concerned authorities in all aspects of water resource development and management. However, the Council was not very active, and responsibilities were still fragmented with a lack of proper coordination among the water authorities.

Recently in 2009, the High Council for Water Resources (BHCWR) was activated with a renewed mandate and renamed "The Water Resources Council (WRC)." The re-activation of the WRC reflected the consolidation of the water scarcity advocates into one body to oversee various departments in different government bodies. The new chairman for the council was the Deputy Prime Minister, Sheikh Khalid bin Abdulla Al Khalifa, which served to distance the direct involvement of the Prime Minister, and subsequently the remaining advocates of water abundance. As Sheikh Khalid indicated in an official statement the "Water Resources Council (WRC) reflects the Government's efforts in the protection and development of water resources, as well as increasing community awareness of the optimal ways of using and exploiting it" (Sheikh Khalid, 2015). In essence, the WRC is entrusted with the "formulation of the overall water resource policies and strategies for the Kingdom of Bahrain, coordinating government water policies and ensuring integration of these policies, following up the implementation of water policies and plans and set[ing] up priorities for the implementation of the developed strategies and

programs" (WRC, 2010). It was expected that this institutional reform, i.e., the establishment of the WRC, would have a crucial role in addressing the water sector challenges in Bahrain and in formulating overall water resource policies and strategies for the Kingdom.

A significant milestone for WRC was seen when it was commissioned to develop a National Water Strategy (NWS) and Implementation Plan for the Kingdom of Bahrain for the period 2017-2030 (Bahrain Vision 2030) and beyond. The aim of the strategy is to achieve sustainability of the water sector in the Kingdom of Bahrain. Both the MoW&MU and MoEW sought a unified water plan and mandated WRC to formalise the National Water Strategy to comply with the GCC Unified Water Strategy (GCC UWS). In 2016 and 2017, I was part of a team from the Arabian Gulf University (AGU) tasked in reviewing and analysing existing sectoral water strategies/master plans and legislations (refer to Section 6.2). The developed and delivered National Strategy and Implementation Plan ought to be based on a comprehensive assessment of the various water sectors and their strategies/master plans in the Kingdom and, should be in line with the strategic objectives of the developed GCC UWS, 2034. Later in 2018, Shaikh Khalid Al Khalifa chaired the Water Resources Council meeting and approved the National Water Strategy in the presence of the concerned ministers and officials.

4.5 Conclusion: Desal-fever: A Journey from Abundance to Scarcity

This chapter investigated the continuity and change in food and water policies in Bahrain. The chapter aimed to present an overview of food and water policies and strategies that remained relevant throughout different major historical events since independence, as well as to highlight the policies that threaded in and out of one period to another. This overview is relevant because the current Government's food and water development policies, and vision of modernisation, are based upon premises that were suppressed a few decades ago. Yet, the reconfiguration of social and political power geometries engendered in the changing roles and sources of water supply chart new water resource development and management in Bahrain.

The analysis of previous food and water development strategies and policies revealed that the current perception of water as a scarce resource in Bahrain has not always been as dominant. As a matter of fact, the ruling family and public believed water to be abundant

in both historical and post-independence Bahrain, before a total reversal took place in the late 1990s. The starting point in the design and framing of all water and food projects was how to capitalise on the abundance of water to achieve food self-sufficiency. Considering this arrangement and the vision of modernisation the country aspired to post-independence, the emergence of desalination can be viewed as a *mere fever* and less so a necessity (Xenos, 2010).

Despite the difference between water politics today and those of yesterday, there was an important element of continuity running through the policies being promoted in the first two eras (1970-1989) and (1990-1999), of which the decoupling of groundwater utilisation from the municipal water supply accelerated to maximise the availability of water for agricultural intensification. In return, the municipal water sector relied on the non-conventional water supply to offset any restriction to groundwater. Desalination, therefore, expanded as a reliable source of domestic water that could be capitalised upon to facilitate the separation of the municipal water supply from groundwater.

There have also been important changes in some of the central policies during the first two eras, (1970-1989) and (1990-1999), and those being promoted today in the *Third Paradigm*. Food self-sufficiency and the perception of water as an abundant resource are not present in today's legislation, reforms and policies. On the one hand, groundwater is now considered a strategic reserve that is entrusted for emergency purposes, limiting its abstraction for regular usages. On the other hand, desalination upgrades dominate water policies to ensure the quantity and quality of domestic water supply is sustained. Therefore, desalination became greatly valued simply because "a market has been created for it" (Xenos, 2010).

In the process, the political economy of water changed drastically. Policies and politics advocating abundance and food self-sufficiency were dismantled and, in their place, a *unique perception* of water resource development that was skewed towards scarcity dominated policies, legislation and the outlook of modernisation. My intention here is not to discredit the Bahraini Government's enthusiasm for rapid and transformative development. Instead, it is worth noting that the character of water scarcity, the fact that there is both scientific and political consensus around it, often leads academics and other commentators to take for granted not only water scarcity but also its supposed political

effects (Alatout, 2008). It is with this critical, yet constructive, approach that the Government's vision, and food and water policies were appraised in this chapter. For discussion on elements of the *Third Paradigm,* subsequent chapters engage with dominant discourses and institutions of water.

This chapter aimed to provide the historical background to the Bahraini State's journey to modernisation since independence, through water, outlining major political and historical events and key policies that influenced how desalination emerged, expanded and dominated the Bahraini water sector, forming a *unique phase* in water resource development and management: *the Third Paradigm*. As will be discussed in Chapter 5 and 6, the *Third Paradigm of water resource development* is very much constrained by i) the hydrocracies own belief structures, training, background and how they perceive reality and ii) path dependency within certain institutional frameworks. On the one hand, the Government has proved itself by establishing and delivering essential public services (particularly in the health sector, housing, water and food supply), as well as providing security and political stability. Many international observers applaud the success that Bahrain is experiencing in achieving sustained economic growth and development. On the other hand, these transformations necessitate the centralisation of [water] management and the reliance on technical fixes as "the only option", as will be discussed further in the next chapter.

Chapter 5:

The Only Option: Unpacking and Understanding the Interplay between Water Scarcity and Desalination

Chapter Summary

This chapter considers the assumptions underlying the construction of water scarcity as a threat and desalination as the only option to cure it. *Why does the narrative of the negative consequences of water scarcity persist?* In this chapter, I argue that the negativity surrounding water scarcity is underpinned by a particular understanding of science, development and water security in Bahrain. Through in-depth interviews, official documents and discourse analysis, the chapter explores and reveals the explicit influence of the water scarcity narrative in augmenting non-conventional water resources.

5.1 Introduction

In the previous chapter, the historical formation of the modern Bahraini state was analysed, revealing an essential interplay between food, water and state-building politics. Clearly, state-building politics have changed since independence, so too has the propensity for distancing the municipal water sector from groundwater resources. The result has been an opening up of opportunities for utilising other sources of water for domestic use, as analysed in the three paradigms of water resource development. In this chapter, I expand the enquiry into the *Third Paradigm* and the prominence of water scarcity discourse as an influencer in policy selection. This is analysed through the experiences, backgrounds and "belief structures" of key stakeholders and the influence on discourse of "how they perceive reality" (Hamidov et al., 2020; North, 2005). The aim of this chapter is to analyse the framing of water scarcity more closely, including how the concept is discussed and presented, as well as the coalition approach where actors come together around a "shared meaning to push for policy and agenda-setting" (Kingdon, 1995). As explained in Chapter 2, it is important to analyse how stakeholders perceive reality and how their own belief structures constrain their choices. Given the crucial roles that language and discourse play in shaping views and paradigms, it is essential to understand the discursive nature in which desalination is proposed as "the only option" to overcome the perceived water scarcity.

Here, I use discourse both in the Foucauldian sense of analysing power exercised in the generation and interpretation of knowledge, as well as of plotting the narratives and storylines around the way water scarcity is defined as a specific ensemble of ideas around natural aridity. I also consider how water scarcity and its categorisation is produced, and

reproduced as a threat. Engaging critically with the water scarcity postulate does not mean that I deny the existence of such a phenomenon in its physical aspect. Still, instead, I try to contribute to what Mehta describes as "an all-pervasive fact of our lives" (Ibid, 2010, p.2). Therefore, the purpose of this chapter is to deconstruct the prevailing water scarcity narratives, specifically critiquing those that present aridity conditions as the reason to legitimise the capital-cost investment in desalination and present it as the "*only option*".

Following this introduction, the chapter begins in Section 5.2 by examining how the narrative of water scarcity is produced and deployed to forward a particular sanctioned discourse, looking mainly at official statements related to water sector development. The official statements promoting large-scale investment in the water sector are of interest because they reflect development agendas and attempts to solve an articulated challenge. In Section 5.3, I explore how the discourse is framed to spotlight the apparent limitation of conventional water resources and shape the dialogue of doubt around whether there is another option. Next, in Section 5.4, I analyse the underlying assumptions made by the proponents of the water scarcity narrative and the conditions that enabled the dominant use of non-conventional water resources as a means to supply the municipal water market. Lastly, the chapter concludes with a reflection on the entrenched position of desalination through a discourse that is framed to distance government functions from the issue that causes the problem.

5.2 Problematising Water Scarcity

5.2.1 Setting the scene

As discussed in Chapter 4, water resource development was continuously adjusted in favour of desalination, particularly after independence. The adjustments happened for several reasons, but most critically through the presentation of water scarcity as a threat to socio-economic development. Public discussion of water security and development, especially by elites and technocrats, constructed a water scarcity threat in which natural aridity and climate change were positioned as contributing, by virtue of the *uncertainty* attached to them, to a decline in socio-economic development.

Underlying the assessment of water scarcity as a threat and desalination as the only option, is a discourse on development that is technology-oriented and reliant on a narrow articulation of the water management system. This articulation of the water management

system tends to capitalise on infrastructure rather than institutions. It is under this assumption of water security and development, as an investment in infrastructure, that public discussion evolves to describe water scarcity as a threat. Although perceived water scarcity has a number of dimensions, such as consumption patterns and urbanisation, these dimensions are usually less prominent and taken for granted (Bakker, 2000; Mehta et al., 2019). They are justified as superfluous to the Government's development goals/aims. Furthermore, it also indicates that this discourse is not necessary, i.e. that social and institutional challenges[72] need not be understood or related to water scarcity.

The concept of development and modernity through the accumulation of resources to superimpose a sense of abundance was invented in societies in the Western world in the nineteenth century (Xenos, 1989). Its uptake in Bahrain was, therefore, a cultural construction, and as Allan articulates, a "political imperative" (Allan, 2001).

In an interview with a Bahraini TV program (Al-Mokhtasar), the Minister of MoEW, Dr Mirza[73], discussed the challenges and opportunities that the electricity and water sector face (Figure 5.1). In this interview, the Minister explained, in a somewhat simplified manner, the prominence of discussions on water, for livelihoods and in development, compared to that of other services:

> *"The public can't live without water. In fact, they can survive without roads or access to medical facilities (for a while), but water is rather an imperative and at the heart of development… And Bahrain does not have a natural abundance of water to leverage on. That is why we are taking progressive steps to improve our water status…Similarly, electricity and water remain critical to other sectors and industries such as tourism, oil exploration and light-weight manufacturing, such as Aluminium."* (Mirza, 2016)

Being a former executive in BAPCO, Dr Mirza's position on water is constrained by his "experience and belief structures [which] shape how he perceives reality" (North, 2005).

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[72] I refer here to institutional challenges as water management systems that are not capable of enforcing demand management and are experiencing wastage in the form of non-revenue water.

[73] Before joining the Ministry of Electricity and Water Affairs in 2012, Dr Mirza was the Minister of Oil and Gas Affairs from 2005. As detailed in his online bio, Dr Mirza was one of BAPCO's early outstanding Bahraini trainees who was sent by the company in the mid-1960s to the UK to pursue a university degree. He was the 1st Bahraini to be promoted to the position of BAPCO's Deputy Chief and Acting Chief Executives in 1998. For more details, refer to http://ires.ku.edu.bh/wp-content/uploads/2018/01/Abdul-Hussain-Mirza-bio.pdf.

As a former prominent and high-profile BAPCO employee, Dr Mirza's view is of water scarcity in its absolute physical sense. As discussed in Chapter 4, BAPCO's role in arguing in favour of water scarcity was evident, even before independence. This stemmed from the logging of the static water head in their wells on a bi-monthly basis.

Figure 5. 1: Dr Ali Mirza (left) on a Bahraini TV program discussing the challenges, and possible solutions, facing the Ministry.

Therefore, the way Dr Mirza highlighted the aridity challenge that faces Bahrain is particularly important in understanding how the water scarcity narrative is constructed. By way of comparison, he stated that "other Arab countries such as Egypt, Sudan or Iraq enjoy the availability of surface water in the form of rivers"[74]. Dr Mirza's statement in this interview constructed water scarcity in Bahrain as a bio-physical lack of water, and its associated negative consequences as the ultimate challenge to economic development and social wellbeing. Hence, the emphasis was placed on the progressive steps being taken by the Ministry to overcome such a challenge. What is critical in this statement is the signalling of water scarcity, in its bio-physical form, as the problem, without conceding to other forms of scarcity and different dimensions to the issue.

[74] This statement is taken from an interview on a Bahraini TV program called "Al-Mokhtaser" broadcast in December 2015.

The political process of discursively [re]producing the water scarcity-desalination assemblage involved a range of actors. On the one hand, donors and NGOs, through their partnerships, seminars and publications, played a significant role in conveying the similarity between Bahrain and mainland Arabia, despite all the historic socio-economic differences. On the other hand, the media, through their hosting and covering of academic and scientific conferences and talks, reproduced and simplified the scientifically proven notion of water scarcity into something people could easily relate to.

Furthermore, corporate actors have also played a key role in framing and emphasising dominant debates and solutions. The Head of the European Desalination Society, Ms. Miriam Balbani, delivered a keynote speech at the 12th GCC Water Conference entitled "Development in Desalination in the Arabian Gulf Region, 1981-2016 Europe and the Gulf Region". As discussed in Chapter 3, desalination is an imported technology, for the GCC countries. The way desalination companies approach the middle east market is very central to how desalination is viewed, and this can be analysed in two-folds. Firstly, as per the title above, there is an emphasis on the longevity of cooperation and partnership between Europe and the Gulf region. It is, therefore, paramount for desalination companies to pose as a long-term partners with a track-record. Clearly in Balbani's presentation, the partnership is not equal. For Europe, the Arabian Gulf region is not only a lucrative market, but also a test-bed for product development (Usher, 2018). Secondly, there is a tendency to explain the problem and solution in a very fancy and technical language. Other presenters at the same conference emphasised their technological-edge and ability to provide a package of solutions. For instance, a German company "Water Systems GmbH & Co. KG" exhibited their wide-ranging solutions for what they labelled the "Development of Regenerative Water Resources in Semi-Arid Regions"[75].

For these companies, attending and sponsoring water-related events and conferences provides an opportunity to both conceptualise the need and pitch products to suit the audience. It is important to note that both the partnership and the framing of the debate are considered crucial to the survival of these tech companies. Having sat the scene of how water scarcity is articulated and its relationship with development, I examine, next,

[75] The title of presentation "Development of Regenerative Water Resources in Semi-Arid Regions: Methods and Processes - Synopsis of a Package Solution"

how the water scarcity discourse is presented as a threat to Bahrain's development journey.

5.2.2 Development as a Transitional Phase and Water Scarcity as a Peripheral Threat

The pursuit of development in the GCC is evident in the emergence of the Gulf States' rush to emulate an idealised modern global materialist affluent lifestyle (Reiche, 2010). As illustrated in Chapter 3, the journey to modernity and development in Bahrain has taken a unique course, transforming a relatively poor state into a modern Kingdom, since independence. The vision of the ruling family focused on converting the petrodollar into infrastructure and social welfare projects. However, the discourse around Bahrain's development journey is still viewed in a transitional sense, still fragile and surrounded by threats and vulnerabilities (Hartmann et al., 2005). Thus, understanding scarcity as a component with the potential to derail Bahrain's development journey clearly underscores water scarcity as a peripheral threat.

In this subsection, I try to explore how actors (Table 5.1) have framed water scarcity to be "the main challenge facing economic growth" and "jeopardising the socio-economic gain" that Bahrain has attained since independence (interview #4 & 35). In other words, flagging water scarcity to be the main obstacle to sustainable development in various sectors of the economy as well as a hindrance to economic development. Specifically, I analyse how, and by whom, the water scarcity discourse is articulated, produced and reproduced. This is mainly official rhetoric that is exhibited in frequent formal statements and publications by the Government, MoEW, EWA, MoW and MoMUP. It is usually further reproduced by the media, donors and NGO actors.

Table 5. 1: Mapping of Actors and Discourse

Stakeholders	**Discourse and Justification**
MoEW, EWA	➢ Massive urbanisation and economic growth surpass the system's ability to supply a sufficient quantity and quality of water.

Industries (Tourism, BAPCO, ALBA)	➢ Industries leverage their economic contribution to justify the need for a reliable water supply.
Officials (elected and nominated)	➢ Desalination reduces pressure on groundwater aquifers. ➢ High expenditure bill on large-scale infrastructure.
Donors, Think Tanks and NGOs	➢ Sector sustainability is under question due to lack of demand management, high subsidies and consumption rates.

Locally, the water scarcity discourse and its imminent threat are reflected in the formal rhetoric of top officials (Hartmann et al., 2005). The general official rhetoric presents water scarcity as a challenge, threat or an obstacle to socio-economic development. However, the discourse is also complemented with the recognition that water scarcity is a top priority, and more importantly, with an indication that there have been measures taken to deal with it sufficiently. The head of the Bahraini parliament participated in a local conference entitled "Food and Water Security Concerns in the GCC", in March 2017. He emphasised the importance of discussing and cooperating with regional members of the GCC. In a statement from his speech, he argued that food and water are politically sensitive topics and could potentially stabilise or destabilise economies and countries. His statement should be viewed within the context of the broader unrest facing other Arab countries post-Arab Spring. He stated:

> *"It is rather imperative to discuss water and food securities and ways of cooperation within the GCC, especially given that the [Arab] region as a whole is facing exceptional political and economic transformation. They [water and food securities] are going to contribute significantly to the wellbeing of individuals and the future of countries."* (Al-Mola, 2017)

The language of equating scarcity of resources with instability is rather popular, or at least has gained more popularity, in the post-Arab Spring era. On the one hand, it obscures the "characteristics of the political [authoritarian] regimes before the Arab Spring" and undermines the "aspiration for a transition to political and democratic liberalisation"

(Szmolka, 2014). More importantly, countries that did not experience social and political turbulence, such as those of the GCC[76], are viewed to have a successful model of provision to the public that served to maintain peace and stability.

In a similar vein, the King has clearly expressed the importance of "ensuring that all social and economic investments are sustained" (King Hamad, 2016). As such, this command has shaped the vision of the Government, and the wider policy arena, to expand into non-conventional resource approaches to support and maintain the expansion of the economy. It is important to note that the problematising of the water scarcity narrative around the immediate and impending threat to sustainable socio-economic development in Bahrain, has supported the claim of the need to augment water beyond conventional sources.

My observation about the water scarcity discourse is that the regional rhetoric on the issue influences it greatly. Most of the discussions I had with both officials and non-governmental personnel reinforced the position that Bahrain is a small [island] state and relates greatly to its surroundings. There is a regional emphasis on the water scarcity challenge. Whether generally through UNDP reports of the Economic and Social Commission for Western Asia (ESCWA) block, or more specifically through GCC sub-regional reports that address the severity level of water scarcity.

UNDP reports have indicated that water resources in the Arabic Countries are under threat and require immediate institutional and policy rehabilitation. Generally, the reports echo the broader academic literature that "equates drought as the primary determinant to water scarcity" (Solh & Van Ginkel, 2014) and the GCC region as water-scarce (Dawoud, 2005). The reproduction of this discourse continues to position water scarcity as "a [top] threat" facing the economies in the region. Figure 5.2, a Gulf Daily News[77] article, is just one such example (GDN, 2017).

[76] Bahrain and Oman were the only countries in the GCC to experience limited unrest in 2011.

[77] GDN is the most popular English language news agency in Bahrain.

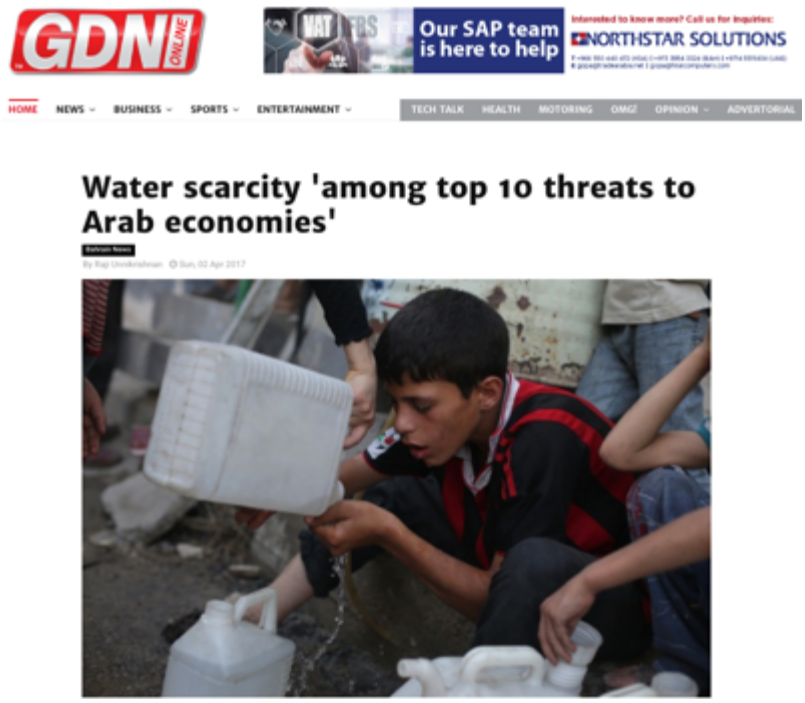
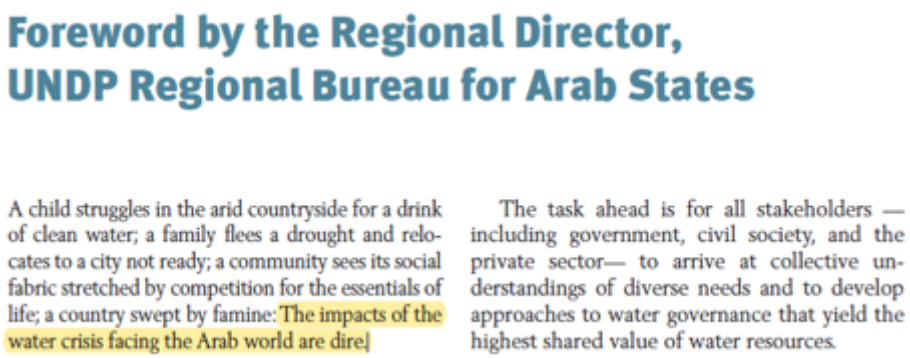


Figure 5. 2: News story on the threat that water scarcity poses to the region (Gulf Daily News Network, 2017).

Perhaps the most talked-about report among experts in Bahrain's water sector, according to the respondents, is the UNDP report for the ESCWA region, entitled "Water Governance in the Arabic Region; Managing Scarcity and Securing the Future". In the report, the discussion sought to identify challenges that face Arab countries in managing scarce resources. Subsequently, the report recommended an immediate response to the increasing demand for water resources in these countries. The report's foreword sets the scene (Figure 5.3), very clearly, in the direction of the absolute disadvantage the region experiences:

> *"A child struggles in the arid countryside for a drink of clean water; a family flees a drought and relocates to a city not ready; a community sees its social fabric stretched by competition for the essentials of life; a country swept by famine: The impacts of the water crisis facing the Arab world are dire."*
>
> Source: Excerpt from the UNDP Arab Water Report (RBAS, 2013)



Foreword by the Regional Director, UNDP Regional Bureau for Arab States

A child struggles in the arid countryside for a drink of clean water; a family flees a drought and relocates to a city not ready; a community sees its social fabric stretched by competition for the essentials of life; a country swept by famine: The impacts of the water crisis facing the Arab world are dire.

The task ahead is for all stakeholders — including government, civil society, and the private sector— to arrive at collective understandings of diverse needs and to develop approaches to water governance that yield the highest shared value of water resources.

Figure 5. 3: Excerpt from UNDP Arab Water Report
Source: (RBAS, 2013).

While the above quotation presents an extreme scene of the impact of water scarcity on communities and countries in the Arab world, the purpose of reproducing this discourse is twofold. The narrative of water scarcity and crisis, in the GCC, tends to contrast local achievements with conditions in neighbouring countries. In return, validating the State's vision of modernity and development. Furthermore, the report relies heavily on scientific terminologies and tools to detail how much water is available for the region. The quantification of water availability is instrumental in highlighting the disadvantaged position of the region with regards to freshwater endowments. The report stated:

> *"With more than 5% of the global population and about 10% of the world's area, the region receives only 2.1% of the world's average annual precipitation and contains 1.2% of annual renewable water resources."* (RBAS, 2013)

The UNDP report and the message of water scarcity was further reproduced in the local media, as can be seen in the Alwasat[78] coverage. The article entitled "An international report urges the Arab region to face up and stand up against water scarcity problem" (Alwasat, 2013). The media article highlighted that the report emphasised the pervasiveness of water scarcity in the region, in a tone of urgency to act now before it is too late. Stating:

> *"Water challenges can and must be addressed if the Arab region is to achieve the Millennium Development Goals, attain shared prosperity, and reach a future of sustainable human development. Addressing water challenges ... of which potential crises could result from*

[78] Alwasat newspaper is an independent Arabic language news outlet. Alwasat is considered one of the most popular daily news providers in Bahrain. The Government suspended Alwasat on the 7th of June 2017.

> *inaction: such as unplanned migration, economic collapse, or regional conflict."* (Alwasat, 2013)

Similarly, in February 2016, Alwasat covered the GCC Conference for Sustainability with an article entitled "Water and Sustainable Development in the GCC States". The news article highlighted that "participants discussed the *water crisis*…" (Alwasat, 2016).

The portrayal of water scarcity as a limitation of water, as a problem that could hinder the livelihoods of individuals, families, communities and countries, triggers discussion on how best to overcome the challenge, and ultimately, avoid undesirable outcomes. Several suggestions are presented in the broader academic literature of the GCC region. Some suggestions call for a soft approach to water resource management and reference water governance, conservation, demand management and IWRM principles (Al-Zubari, 1998; Brooks & Holtz, 2009; Gleick, 2003). Other suggestions emphasise a hard approach to dealing with water issues which claim to have certainty in delivering solutions (Dawoud, 2005). These suggestions or approaches tend to agree that there is a water resource issue but differ on the execution of the solution. The soft approach sees the path to achieving sustainable water resource management in system and institutional improvements and the charting of efficiencies. The hard approach capitalises on the ability of supply management infrastructure to overcome water scarcity through the provision of bulk quantities of water.

Contrary to these dominant narratives, there are also hidden narratives that engage with the side-effects of the development model adopted by the Government. Academics, NGOs and consultants tend to criticise the high per capita consumption rates of the GCC countries. As described in Chapter 3, the massive endeavour in water supply augmentation through desalination has allowed the Government to provide reliable water coverage for nearly all its population. The issue, however, remains in the increase in demand that continues to surge, both in term of the overall quantities and individual consumption patterns. Several voices criticise the lack of a demand management approach to water issues, as water tariffs remain the lowest in the world, despite the massive financial allocation for augmentation. Further aspects of consumption patterns and their intensity are examined in Section 5.3.3.

Furthermore, the discourse extends to discuss how water scarcity is a hindrance to the governmental plans and economic aspirations of GCC countries. This is viewed in the recent efforts, of the GCC countries, to diversify activities beyond oil production and exportation. In a statement by a Bahraini economic researcher, he stated that "oil price fluctuation uncovers the frightening face of the GCC economy" (Al-Saeigh, 2017). Therefore, the "path to sustainable economic development" is usually celebrated by "the growth in the non-oil sectors", as described by the Bahraini Crown Prince (Prince Salman, 2017). In a discussion I had with a lecturer in economics at the Arabian Gulf University, he highlighted the economic and political climate within which the Government is advocating economic activities beyond the oil sector. He offered this critical insight:

> *"It is important to note that the countries in the GCC are in the process of shifting from the oil-based economy towards a more diversified sector. Dubai remains the best example of an Emirate that managed to attract investors and broaden its economic activities to tourism and services… Bahrain, too, is gearing towards a similar path."* (Interview #95)

This aspiration towards a balanced economy is observed in crucial government documents. One of the most referenced and reproduced documents in media articles and official statements is the Bahrain Vision 2030 which stipulates the need to achieve such desirable outcomes. It stated:

> *"Bahrain will strengthen the non-oil GDP growth of recent years. This growth will come from diversified economic activity. Our financial sector will remain our economic engine but will be increasingly complemented by growth in other high-potential industries. The Kingdom will create economic opportunities that are independent of oil by encouraging investment in selected sectors, beyond the financial sector, to diversify non-oil economic growth such as tourism, business services, manufacturing and logistics."* (Bahrain Vision 2030)

The aspiration to transform and expand the Bahraini economy into other sectors requires an expansion in infrastructure to attract investors and facilitate the essential transformation that is already taking place. At the core of these crucial transformations is the provision of water, as highlighted by one respondent from the MICT:

> *"Between 2007 and 2015, the contribution of the tourism sector to the national income has risen from 3% to 5.5%[79], a reflection of both the importance of the sector and the Government's effort to see the sector flourish… associated services such as water supply and wastewater are essential to run a mature tourist sector, and the Ministry [MICT] continues to liaise and share, with EWA, plans and future expectations."* (Interview #38)

Concerns pertaining to water scarcity continue to be expressed in terms of its ability to disrupt the transitional nature of socio-economic development. This is not to negate the pivotal role that water plays in several sectors of the economy. Activities such as tourism, light manufacturing and oil refineries rely significantly on the availability of water. However, constructing water scarcity, in the bio-physical sense, as the peripheral threat obscures other vulnerabilities in the system. For instance, the daily consumption rate is estimated to be between 350-550 l/capita[80] for Bahraini nationals and between 180-400 l/capita for the Bahraini residents (EWA, 2016). It is important to note here that water subsidies to residents were scaled down in 2017. This step was criticised by several academics to be both "discriminatory and problem-solution mismatched" (interview #95, 96 & 98).

There is criticism of overconsumption in the tourism sector, of which EWA estimates that "a tourist consumes twenty times the water consumed by a Bahraini and nearly eight times the electricity". However, another respondent from the same ministry expressed the concern of the MICT about service provision during summer holidays and religious vacations:

> *"The peak of visitors from other GCC countries into Bahrain happens between July and September and during Eid[81] vacations. That is when there is most concern about how ready the sector and all affiliated ones are. The last thing we want is for visitors to go back with a memory of a hot summer with no water to shower".* (Interview #35)

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[79] These figures are assumed to be the direct, induced GDP contribution of the sector. The combined direct and indirect induced contribution of the tourism sector into the economy is argued to be higher, see "Evaluating the role of tourism in the Bahraini economy" report produced by the Bahrain Economic Development Board, 20

[80] The range of consumption value to capture seasonal and socio-economic variances.

[81] Eid is the Arabic name for the celebration associated with two religious events at the end of the fasting month (Ramadan) and pilgrimage (Hajj).

Similarly, other industries, such as Aluminium production (ALBA[82]), have sought alternative water supply arrangements to streamline their production. ALBA owns a desalination plant with a capacity of 10MGPD[83] of which part of the water production is shared with EWA. "ALBA is one of the most intensive consumers of water for industrial production", as explained by WSTA personnel. ALBA's decision to build and operate its desalination plant was made in light of the need "to enforce more accountability on the industrial sector for water production cost recovery" (interview #116).

Overall, both regional and national reports portray water scarcity as an imminent threat to the region, one that could potentially undermine its stability and socio-economic development. As such, the discourse around water scarcity in Bahrain is rooted in broader regional discussions on water challenges, whether within the GCC or wider Arab region. Locally, it is discussed as a form of hindrance to economic growth and in the need for diversification of the economy beyond oil production. The discourse highlights both risks and threats, especially to inaction. To understand exactly what water scarcity means and how it is promoted, I explore, in the next section, the prominent narratives and the elements that are associated with the construction of the discourse and the naturalisation of water scarcity.

5.3 Naturalising Water Scarcity

The natural aridity condition is the most talked-about issue when considering water scarcity. Which prompts the question of how, why and by whom nature is produced in this form of discourse? These are core questions driving the analysis of naturalising water scarcity. As explained in Chapter 2, water scarcity is not merely natural, but also embedded in social and power relations. Thus, portraying water scarcity as a natural phenomenon tends to overlook its social construct. It is worth noting that these questions are more prevalent in elite conversation and in governmental and official reports, in comparison to the public. Media articles also cover this discourse by citing factual local and regional data. This data is usually presented in the form of the annual rainfall and potential evaporation rates experienced in Bahrain. For instance, Dr Mirza referred[84] to

[82] Aluminium Bahrain, abbreviated to ALBA, is one of the largest aluminium producers in the world. ALBA is a state-owned company that was founded in 1968.
[83] MGPD: Million Gallons Per Day
[84] This statement is taken from an interview on a Bahraini TV program called "Al-Mokhtaser" broadcast in December 2015.

the "rainfall endowment of the Levant countries" as something Bahrain does not possess. These statements present what is obvious and what people can relate to in terms of the physical constraint of natural water resources. At the same time, it facilitates the framing of water scarcity into natural and geographical constraints. Having such a statement from the top of the political ladder comes with legitimacy and therefore functions to present water scarcity as a "naturalised state" (Mehta, 2001). As per the media coverage of the 9th GCC Water Conference, this discourse is reproduced in statements such as: "Bahrain is classified as one of the most water scarce countries in the world" (Alwasat, 2010).

Figure 5. 4: News story discussing Bahrain as one of the most water scarce countries in the world (Alwasat Network, 2010).

As will be analysed in this section, the way the discourse evolves around water scarcity in Bahrain is, in a way, through the highlighting of challenges pertaining to aridity conditions and the limitation of conventional water resources. The discourse then compares these challenges implicitly, and sometimes explicitly, to desalination as a non-conventional water resource that can overcome these issues, or at least function independently to the obstacles that are experienced by conventional ones.

5.3.1 Scarcity of conventional water resources.

As discussed in section 5.2, the aridity claim in Bahrain is not only a unique issue, it has a rather regional focus. However, while aridity could be natural, the resulting scarcity is a socially mediated process with diverse social and political ramifications. Regional organisations such as the Arab Water Council, AFED, ESCWA and ICARDA present aridity as the "ultimate challenge facing development in the region" (interview #76). It

generally presents the Arab region in terms of "its acute water scarcity and aridity" (Arab Environment Report, Chapter 2, 2009). In an interview with a retired MoMUP manager, he stated:

> *"The climatic and natural conditions have influenced the water situation in the Kingdom of Bahrain. There is no surface water, and most of the renewable water originates outside the country which threatens its water security and makes it among the most water scarce."* (Interview #24)

The emphasis here is on what little water there is and how the natural limitation on water resources is the primary reason for seeking additional, non-conventional, sources. This naturalisation, through the utilisation of scientific tools to frame water scarcity, aims to shape the discourse to something easily referenced and apparent. The narrative develops into two distinct yet complementary phases. The first one is the establishment of a scientific-based argument to support the prevalence of aridity. It is usually found in statements, seminars and publications administrated by EWA and MoMUP. Whereas, the second, highlights the increasing challenges facing conventional water resources. It questions the reliability of existing water resources to cater for the increase in water demand as a way to favour desalination. Two popular tools are usually referenced and cited when discussing water issues in Bahrain. These are the aridity index and the per capita share of water resources[85].

I observed that when presenting the challenges in the sector, the aridity condition was prevalent in discussions involving EWA and MoMUP officials. Closely linked to their training and professional background, their shared belief was that water as a resource is finite, Bahrain is arid in nature, and therefore water is scarce. The aridity condition is usually presented to describe and classify the drylands phenomena through the Aridity Index (AI)[86]. Since "rainfall is the main source of water on the planet" it is taken to be the most indicative parameter of water shortage (Elagib & Addin Abdu, 1997). The AI is based on the ratio of mean annual precipitation (P) to the mean potential evapotranspiration (EP) of a particular area (Bonkoungou, 2001; Sternberg, 2015).

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[85] The per-capita share is also known as the Falkenmark indicator after the Swedish hydrologist Malin Falkenmark.

[86] Hyper-arid (AI<0.05), arid (0.05<AI>0.20), semi-arid (0.20<AI>0.50) and dry sub-humid (0.50<AI>0.65).

Aridity is therefore characterised by a lack of water, or at least surface water. In a conversation I had with a manger from EWA about water challenges, he started by reminding me of the natural aridity condition of Bahrain. From the onset, he said:

> *"Let us be clear that Bahrain is located in one of the most hyper-arid and freshwater scarce regions of the world…Yes, we are experiencing high population and urbanisation growth, which is similar to other developing countries. Still, the core of the issue is whether there is freshwater readily available, otherwise desalination will be the solution."* (Interview #7)

As is the case in arid regions, rainfall in Bahrain is highly variable on a seasonal and annual basis (Elagib & Addin Abdu, 1997). The data from the Meteorological Directorate at Bahrain International Airport reports that for Bahrain, the mean annual precipitation for the period 1948-2012, was 78.3 mm. With a daily average potential evaporation rate of 5.75 mm, or 2099 mm per year (AI-Noaimi, 2005), Bahrain sits firmly within the hyper-arid category on the aridity index with a score of AI = 0.037. This categorisation indicates that Bahrain is scientifically proven to face acute natural water challenges. What is more critical here is how the presentation of the aridity condition is equated with water scarcity. While the discussion is not about the validity of the data and figures, the naturalisation of the discourse on water scarcity seems to obscure other potential contributing factors that are usually induced and constructed (Bonkoungou, 2001; Mehta, 2010). For instance, critiques on changing domestic water consumption patterns and tackling leakage in water distribution infrastructure are limited to recommendations by local and international consultants, as will be examined in Section 5.3.3.

The other important scientific tool that is usually used to establish naturalised water scarcity is the per capita share of water resources. The per capita share is generally applied to renewable water resources, such as rainwater, and the replenishment rate of groundwater. In other words, it references the renewable freshwater. I have been informed that "this is an international indicator that has been approved by development agencies such as the UNDP and water affiliated agencies" (interview #77). It is presented to measure water scarcity or water stress around the world. Aside from the scientific rigour, the per capita share indicator is very convenient to use because it is relatively easy to gather data related to its computation. The per capita share is obtained by dividing the total renewable water resources by the population (Falkenmark & Lundqvist, 1998).

Therefore, it is argued that the convenience of presenting this information makes it easy to use in recommendations to planners, politicians, policymakers and the general public.

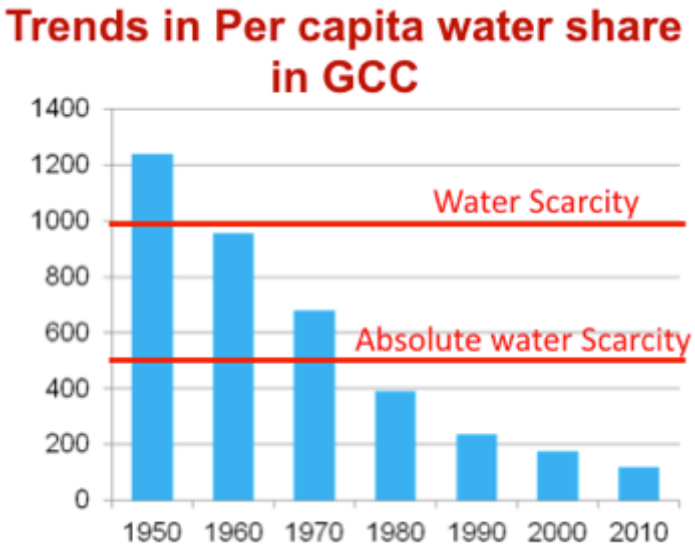

Figure 5. 5: Excerpt from the slide presentation of the keynote speaker (12th GCC Water Conference, 2017).

Reduction in the per capita share of available freshwater resource has been constructed as a "threat to wellbeing and (the) survival of humanity" (von Medeazza, 2004). I have come to notice that EWA participants in local seminars and workshops usually emphasise the scientific explanation for the severity of Bahrain's aridity condition. While discussing the utilisation and reliability of the per capita share tool with an EWA representative at the 12th Gulf Water Conference (Figure 5.5) I asked whether the known critique of the tool could undermine its validity and reliability (Bremere et al., 2001; Xie, 2006). The EWA official argued:

> *"While it is true that the execution of this scientific tool obscures other aspects such as water quality, accessibility and seasonal and spatial variations, the relative usage of this tool is still helpful to measure the general outlook of water stress and track and analyse its development over time. It usually facilitates some useful recommendations for water resource management."* (Interview #14)

What is implied from this framing of the facts is that the only way to improve the per capita share of water is through the sourcing of non-conventional water supplies. The introduction of desalinated water volume into the water budget is seen to enhance the

position of water availability in the country, and therefore it is considered to be favourable. As expressed by a retired manager of EWA:

> *"Bahrain is facing a chronic water deficit with respect to per capita share…the replenishment rate of renewable water resources is limited… thus requires innovation and non-conventional solutions to satisfy existing [and increasing] water demands."* (Interview #16)

A similar voice from MoMUP highlighted and quoted a published report that asserts the disadvantaged position Bahrain and the wider region have in terms of water availability:

> *"The per-capita share of freshwater availability in the region is already just 10% of the world average, according to regional consultancy publications."* (Interview #21)

As such, the way the discourse around aridity is reproduced with scientific rigour, functions to produce water scarcity, in its bio-physical dimension, as the ultimate constraint to the aspired development journey of Bahrain. What is obscured, or at least underplayed, are the other dimensions of water scarcity that are socially and politically constructed. Additionally, these indicators are limited to account for the capacity of institutions, socio-political economic differences that may affect their response to issues of water scarcity, as discussed in Section 5.3.3. Prior to that, in the next Section, I examine how discourse on climate change is [re]produced as a threat to water scarcity and, subsequently, to modernisation and development.

5.3.2 Climate change and its associated uncertainty.

The implications of climate change on the water issue are part of a broader discourse deployed by the Environmental Supreme Council (ESC), UNEP, academics and environmental consultants. The majority of discussants tend to highlight that climate change will bring more challenges to the water sector. The cited argument is usually supported by scientific evidence, like the global or regional General Circulation Models (GCM). These models tend to conclude, on aggregate, that the region will be warmer, and experience decreased precipitation (Sokolov et al., 2005). However, those models tend to overlook Bahrain in terms of scale, as the grid/scale is usually massive, and Bahrain appears as a tiny dot on their maps, as a small island state. "The regional representation is argued to be valid regardless of the variation it contains", as reported by a top official

at UNEP (interview #81). It is worth noting that modelers, and especially climate change ones, are usually constrained by their ability to anticipate results, in the process of building up the model and the later refinement processes (Hastrup, 2012; Hulme, 2013). This has attracted significant attention on the ability of the models to address climate change uncertainties or indeterminacies (Mehta et al., 2019).

However, there is a broad acknowledgement that the issue of climate change is detrimental to Bahrain, as a small island. There are several academic articles, and donor agency reports, both local and regional, highlighting the "immense challenge that Bahrain is facing in comparison to the rest of the Arab countries" (Bates et al., 2008; UNESCO, 2015). The discourse is usually focused on the classification of Bahrain as a *small island developing state (SIDS)* and how this presents challenges of its own on several fronts, one of them is water (interview # 47). What is usually obscured in this type of discussion is the drastic difference in Bahrain's economic standing in comparison to other SIDS.

Furthermore, the level of concern on the effects of climate change in Bahrain revolve around the understanding that "what is at stake are the long decades of development and modernisation that the Kingdom has attained" (interview # 97). An acknowledgement of the uncertainty that climate change has brought, and might bring in the future, is viewed to have an overall impact on the availability and quality of water, which in turn raises the need for adaptation measures. The implied assertion is, as per the highlight from an official in ESC:

> *"The Kingdom, therefore, has limited options to reduce the influence of this phenomenon but to adapt and minimise the implications of the expected future threat and damage." (Interview #67)*

Additionally, the discussion around the climate change threat usually comes in two parts, the first one concerning "the additional burden due to climate change" (interview #3) that Bahrain, and the region as a whole, will experience as a result of a reduction in rainwater and an increase in temperature. The second part of the discussion is formulated around the "uncertainty that climate change brings into the planning process" (interview with EWA and MoMUP officials), due to fluctuations in rainfall and temperature, which eventually lead to listing the benefits of desalination as a protection against such uncertainty.

There is unanimous consensus on the severity of climate change, with experts calling for the Kingdom to "think globally, act locally". As will be discussed in this section, there are two main issues for Bahrain with regards to climate change and its role in affecting water scarcity. They are increasing temperatures and decreasing rainwater. These potential threats will be discussed in terms of how they influence water issues. The narrative is usually assigned alongside the previous sub-section on the aridity condition. It mainly revolves around the notion that "water is the first, or probably the worst, sector to be affected by changes in climate" as highlighted by Dr Haddad[87]. He explained that:

> *"Climate change phenomenon will add another challenge and burden, of which demand on water resources will increase beyond natural patterns, on the one hand. On the other hand, a reduction in the quantity of available freshwater is expected."* (Ibid, 2016)

Additionally, the role climate change will play in intensifying the hydrological cycle is often discussed. Several UNDP and UNEP reports on Bahrain, and the region more broadly, highlight the potential manifestations of climate change, such as "serious effects on the frequency and intensity of extreme events; increased evaporation; unpredictable precipitation and prolonged droughts" (UNESCO, 2015; UNDP, 2013), as highlighted by two environmental consultants stating that:

> *"Another primary concern of climate change is its influence on the hydrological cycle. The global and regional general circulation models have indicated that there will be an increase in global temperature and subsequently evaporation rate out of the surface of soil and plants. This will eventually lead to an increase in air humidity and drastic rainfall patterns and hurricanes."* (Interview #68)

> *"Climate change will result in rapid changes in the atmosphere that will escalate and extend flash flood and drought periods. Future stochastic models predict that climate change will inevitably increase water scarcity by 20% in the future. This will lead to greater challenges in water resource management across the globe, but more severely in arid regions."* (Interview #69)

[87] United Nations Development Programme Director, Regional Office for West Asia (ROWA)

At the 12th Gulf Water Conference that I attended in Manama in March 2017, there was a clear assertion of the direct and expected climate change impact on water. Al-Rashed[88], for instance, highlighted that "climate change is likely to make the Arabian Gulf region more susceptible to extreme hydrological events". The uncertainty in climate change modelling and predictions is viewed to be integral to any modelling effort. Yet, the anticipated results and recommendations are still viewed to have some validity, at least indicatively. Several speakers at the conference cited international reports emphasising the adverse effect of climate change on water resources in the Arab world, and in the Arabian Peninsula in particular. Climate change discourse is used and reported to highlight "alarming events that are not fully understood yet require preparation" (Interview #53) in the form of adaptation measures, such as desalination. A Bahraini academic participating in the conference asserted:

> *"Locally, this [climate change] phenomenon carries substantial future challenges to the Kingdom of Bahrain in various sectors such as economic, social and environmental. Although Bahrain's contribution to greenhouse gases is trivial… it is still considered among the worst affected by this phenomenon. This is due to its natural geographic condition as a small island state, with limited land and natural resources, and characterised by low level from the sea."* (Interview #93)

Moreover, the reproduction of discourse around water scarcity and climate change-induced rainfall variation evolves in two parts. Firstly, the quantity is insignificant for any potential rainwater harvesting investment (interview 16,17,19,23). Secondly, the fluctuation in rainfall levels adds another layer of uncertainty to any planning that relies on this type of water resource (interview # 15,22 & 23). As highlighted by Almasri, in several of his consultancy reports, rainfall has never attracted a significant share of the water budget in Bahrain for planning purposes, as the quantity of rainfall is minimal (Almasri, 2011b). The official recorded data on the average annual rainfall rate shows between 70-80 mm per year over the last century (BCSR[89]2009). As such, there has never been any emphasis placed on rainwater as an important source for utilisation in Bahrain. Moreover, water usage, historically, relied on natural spring water or abstraction from groundwater. However, it is important to remember that the intensity of water usage has changed dramatically in recent decades, especially since independence.

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[88] Mohammed Al-Rashed, Executive Director of Water Research Centre at KISR
[89] Bahrain Centre for Studies and Research

Regardless of the minimal share rainwater holds in the national water budget, it seems that the rate has increased gradually in the last three decades from 77.2 mm/year in the 1960-1990 period, to 88.3 mm/year in the 1990-2012 period (BCSR, 2009). This shows that there is a potential increasing trend in Bahrain's rainfall rate that could continue. However, several EWA and MoMUP officials argue that the increases in the last few decades have occurred in the form of intensified rainfall incidents over short periods of time, usually days, which make it "extremely challenging to predict or utilise" (interview #19). I came to notice a public interest around the idea of utilising rainwater. The most prominent views came from a representative of the Capital Municipality Governate during an interview with Alwasat in 2017:

> *"Rainwater should be valued and utilised instead of dumped. This can happen through the construction of ground reservoirs to collect (harvest) rainwater and then inject it into groundwater via special and scientific procedures… or connect these reservoirs with the existing stormwater drainage system."* (Altamimi, 2017)

Although the proposal of utilising rainwater and injecting it into groundwater reservoirs has several benefits, such as rehabilitating groundwater quantity and quality, the usual response from EWA and MoW is that:

> *"Bahrain's rainfall pattern fluctuates in temporal and spatial aspects, and therefore there is no guarantee that rainwater next year will follow this year's pattern."* (Interviews #6 & 21)

Moreover, the deciding factor on the potential utilisation of rainwater is based on the rate of evaporation[90] which is considered to be high due to Bahrain's hot and dry climate. The potential evaporation rate in the country is 3-9.4 mm/day, which translates to be an average of 2500 mm/year (BCSR, 2009). This could render any rainfall quantity lost to evaporation greater than any potential utilisation. Such figures frame the annual evaporation rate to undermine any useful usage of rainwater. Other views, such as those of Al-Zubari[91], emphasise the need to appreciate every drop of water and argue in favour of "thinking pragmatically to value every water resource". Al-Zubari highlights the

[90] Evaporation is defined as the process by which water is transferred from the land to the atmosphere by vapour from soil, plants and other surfaces.
[91] Academic, Head of the Technical Advisory Committee (TAC), Water Supreme Council.

reoccurrence of water stagnation incidents in Bahrain every rainfall season. This problem of stagnant water, he explained, could be an opportunity, if viewed pragmatically, to channel it to pre-determined injection well locations that could potentially help in groundwater storage recharge.

In the same vein, (interview #101) criticised the "*madness* of spending millions of Dinars on projects to pump stagnant water out to sea" and not potentially recycle it for use. As explained by a former MoMUP official, there are "no government plans to utilise rarely occurring rainwater, such as collection and injection into deep wells" (interview #18). However, when I discussed this issue with officials in the MoMUP, they stated, among the many reasons that they have ruled out rainwater harvesting schemes is the "uncontrollable pollution hazard of the catchment area" (interview #20, 21 & 23). Sources of pollution could be due to diverse land use including "industrial, chemical or usual[92]" (interview #27). Uncertainty surrounding the potential contamination of land surfaces and the passageways interacting with the water lower the inclination to utilise this source, it is therefore seen as preferable to dump it into the sea. Eventually, the difficulties associated with rainwater harvesting measures, coupled with pollution issues, are usually assimilated into the argument around the unpredictability of the rainfall rate and pattern. Framing the debate in such a way serves to reduce the potential of any sound investment in plans pertaining to the use of rainwater as a resource.

Furthermore, the relevance of temperature in the discussion of water is its influence on the water consumption pattern on the one hand, and the "potential increase in evaporation on the other hand" (interview #23). For the evaporation part, it refers to outdoor gardening and farming practices which eventually feed into the water consumption patterns. During the summer, the climate in Bahrain is characterised by high temperatures. The temperature usually reaches 40-degree Celsius during July and August. This is associated with extended daylight hours. As several academics and EWA officials (interviews #6, 7, 8, 13, 14 & 15) highlighted that there is a close correlation between the increase in temperature and household water consumption. "As the temperature increases, the individual requirement for water increases as well, for drinking and bathing" as stated by

[92] Usual land pollution refers to the domestic uses and deposition of solid and liquid waste materials.

interviewee #13. It is also interesting to observe how discourse and logic are presented to further support desalination, as can be seen in the following statement by a retired EWA official:

> *"It is expected that the increase in temperature will put pressure on water resources in Bahrain… In the municipal sector, for instance, the per-capita water demand will increase, which will accelerate the already growing water demand due to population growth and urbanisation. This will eventually lead to an additional need for building desalination plants to bridge the gap induced by a temperature rise."* (Interview #3)

Therefore, the discourse around increasing temperatures tends to emphasise the direct implications of climate change on conventional water resources. In essence, it implies the need for adaptation measures, usually beyond traditional resources. These non-conventional resources generally refer to either the process of desalination or the use of water from treated sewage effluent (TSE) plants to substitute any degradation of conventional water resources. Desalination and TSE plants are favoured for their ability to withstand climatic shocks in a resilient way. The discourse, however, tends to emphasise the implication of climate change, in comparison to other factors, in a way to "externalise the blame" and signal a disturbing scene that requires urgency and an immediate response, usually in the form of capital intensive projects. Furthermore, the discourse, emphasised by several academics, highlights the importance of engineering and technological measures to adapt: "Bahrain is a small country, that needs more adaptation and less mitigation" (interview # 96 & 103).

As discussed in Chapter 3, Bahrain, like other GCC countries, has experienced rapid economic and social development accompanying the windfall of oil revenue (Beblawi, 1987). Many researchers have attributed the increase in water demand to the rise in population, urbanisation, and the drastic shift towards modern lifestyles (Al-Rashed & Akber, 2015; Isa, 1989; Zubari, 2014; Zubari et al., 1993). At the 12th Gulf Water Conference, I had an interview with an academic who had an interest in water and food issues in the GCC. The academic stressed his concern of how rapid population growth and urbanisation could affect the per capita share of water resources and therefore necessitates the sourcing of non-conventional solutions. He explained:

> *"Considering the substantial increase in population, the per-capita share of freshwater is in continuous decline. It is currently estimated, in Bahrain, at approximately 100 m^3 per year, which is way lower than the international acknowledged figure of 500 m^3 per year…this situation is also expected to worsen by 2030, when the per-capita share could drop to 50 m^3 per year as the population peaks at 2 million."* (Interview #101)

As such, the emphasis on population growth tends to obscure other effects of Bahrain's development and urbanisation model. Key effects that are uncritically obscured include overconsumption and lifestyle changes.

Overall, the way the data is presented in the form of facts and figures tends to naturalise water scarcity, by highlighting the natural condition of aridity. In other words, water scarcity is a natural phenomenon and not human-induced. The approach is methodical and scientific, in a way to externalise the problem beyond the water sector and, therefore, naturalise water scarcity. Therefore, this dominant articulation of the water scarcity discourse, in the form of natural aridity and climatic challenges, is constructed to facilitate the particular deployment of a solution [desalination]. In the next sub-section, I examine an alternative framing of the discourse on water scarcity.

5.3.3 Other dimensions of scarcity (visible and hidden discourses)

While scarcity of conventional water resources and uncertainties surrounding climate change influence how the Government present the threat of water scarcity, there exists an equally important discourse around the consumption rate of domestic water and the exploitation of shared groundwater aquifers. This discourse is taken for granted, with no objection or question, at least in official spaces. Yet, it functions to obscure other forms of institutional and political scarcity. There are two components to this discourse: firstly, the visible discourse on the high domestic consumption rate of water obscures the need for EWA to repair leakages in the distribution network and implement water by-laws. Secondly, the exploitation of groundwater in KSA obscures similar activities in Bahrain. The key actors for this alternative framing of water scarcity are water resource managers, academics, independent consultants, retired officials and regional and international think-tanks.

Unsustainable rate of consumption

It seems that a common critique of the domestic water situation in Bahrain, and in the GCC more broadly, is the high consumption rate: ranging between 300 to 450 l/c/day (Abu Qdais & Al Nassay, 2001; Al-Otaibi & Abdel-Jawad, 2007; Zubari, 2014)[93]. In Bahrain, the average consumption rate is 500 l/c/day (EWA, 2017). While the figures are not disputed, the complication remains in what they obscure and how they are estimated. While the framing of water scarcity and unsustainable rates of consumption is important, and a valid depiction of reality, the way it is reproduced in official discourse greatly functions to allocate the criticism to non-state actors. As discussed with a retired EWA official, "the way EWA estimate consumption rates is by how much water is channelled through the distribution network over the official stats on population" (interview #12). In other words, the way EWA views the consumption rate is based on the amount of water leaving their storage tanks and not by how much water each household receives (see Section 3.3). While site inspection of water meters is carried out every three months for calibrating readings, these readings do not influence how the water consumption rate is estimated. Subsequently, other aspects of institutional scarcity are obscured, in a way, to allocate and focus the shortcomings beyond EWA.

These other aspects are the high leakage rate in the water distribution network and the absence of water by-laws. As these dimensions are usually suppressed and only discussed as alternatives or complements of the dominant state hydraulic apparatus, they tend to receive less coverage and remain as recommendations. Though less hegemonic, institutional constructs challenge the naturalisation of water scarcity and EWA's emphasis on high consumption rates, serving to highlight dimensions of scarcity that are otherwise obscured.

Critiques of non-revenue water[94] (NRW) are usually given by academics and parliamentarians when criticising the performance of EWA. This is generally customary, in the case of the parliamentarians, when discussing annual budget plans, especially when

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[93] Kuwait, Qatar and UAE records higher water consumption rate of 550, 650 and 700 l/cap/day

[94] Water that is lost before it reaches the customer. There are two parts to the NRW - real and apparent losses. Real losses are the volumes lost through all types of leaks, bursts and overflows on the mains water supply, service reservoirs and service connections, up to the point of customer metering. Whereas apparent losses consist of unauthorised consumption and all types of metering inaccuracies. For more details, refer to the International Water Association website (https://iwa-network.org).

the 2016 annual administrative and financial audit report highlighted significant loss in the form of NRW. Two recent critiques have highlighted the increasing pressure on EWA to improve efficiency in the distribution system. The first was evident in the *Annual Administrative and Financial Audit Report*[95] of January 2016 which estimated losses due to non-revenue water to be as high as 30%. The second took place during the "*GCC Parliamentarian Conference on Water and Food Security Issues"* in Manama in April 2017, of which a substantial emphasis was placed on improving efficiencies and reducing losses both in the form of water leakage and, food wastage in the form of post-harvest losses. The following extracts are evidence of the critique:

> *"We pay great attention to the administrative and financial audit report, and at the same time we are required in electricity and water to implement the recommendations…..[such as] replacement of parts of the old leaky network, at a cost of BD 2.4 million."* (Dr Mirza in Alwasat article, 2006)
>
> *"Average per capita consumption of municipal water in each country of the Gulf Cooperation Council, (calculated after deducting actual leaks) is expected to be a maximum of 250 litres / person / day, by 2035."* (Presenter in the GCC Parliamentarian Conference on Water and Food Security Issues, 2017).

As the distribution network experiences up to 30% leakage, especially in older towns, the way the facts and figures on domestic water consumption are reproduced is inaccurate (Al-Zubari, 2015). Furthermore, there is another issue, when water enters residential houses there are no water saving devices or by-laws for such provision within the building code. For instance, the existing building by-laws require the installation of thermal insulation to reduce the use of electricity needed for heating and cooling. In contrast, similar water by-laws do not exist, which means more water is used than necessary and potential savings are lost in the absence of proper regulation.

The primary demand is for water management to be introduced into building by-laws for water related applications. "The adaptation of water saving devices claims to conserve (15-20%) of household water consumption. This procedure is argued to also be easy to implement" (interview #51) by the modification of the current building by-laws to include

[95] There was no public access to the report as it was meant to be only reviewed and discussed in Parliament. Nonetheless, a few extracts from the report were widely circulated in the media.

water regulations for future projects. A typically cited success story is the implementation of electricity by-laws through mandating the instalment of thermal insulation to reduce air-conditioning power requirements, especially during summer. When I discussed this with EWA staff, they argued that "setting up building regulations is beyond their mandate as a service provider" (interview #11). Nonetheless, there have been some improvements, businesses in the hotel and hospitality sector are now required to install water saving devices in order to receive new working licenses.

Exploitation of shared groundwater reservoir

The discussion also extends to the exploitation of shared groundwater which forms part of the reasoning as to why Bahrain is at a disadvantage when it comes to water resources. The discourse, that is usually articulated within the Agricultural Directorate of the MoMUP, highlights the unsustainable logging of groundwater on the KSA side. However, the exploitation of groundwater in Bahrain is obscured, or at least downplayed. It is also important to note that this critique of over abstraction of groundwater is not visible in the political domain, rather it is very much associated with technocrats in describing the groundwater outlook in Bahrain.

According to hydrological reports such as the GDC report on groundwater resources in 1979 and recent BAPCO logs of deep stratigraphic wells, it is indicated that the annual natural groundwater replenishment in Bahrain is about 112 MCM, which is considered to be the safe extraction limit. As explained by a hydrologist from MoMUP:

> *"The Dammam aquifer system forms a small part of the extensive regional aquifer system, termed the Eastern Arabian aquifer, which extends from central Saudi Arabia in the Al-Dahaa Desert, where the main recharge area of the aquifer is located, to the Arabian Gulf waters, including Bahrain."* (Interview #24)

Additionally, as it has been explained above, the amount of groundwater recharge received, in Bahrain, is also affected by the extraction rate on the KSA side. It is the case that groundwater extraction on the KSA side has always been criticised for over-exploitation, illegal and undocumented extraction, and uncontrolled usage (Ouda, 2014). There are official critiques on the Saudi side of the illegal and uncontrollable digging for groundwater in the Eastern provinces of the KSA which has reduced the quantity and

quality of groundwater replenishment to Bahrain. As indicated, the complication is that it is challenging to regulate the amount of extracted water, as one informant told me (interview #141, Alsharqua Water Association). "Illegal wells are usually used for private farming and could be concealed from the Government and regulators unless they have access for inspection". The other reason, as described, is the " dispersal of those wells in remote areas" which makes it challenging for official inspection (interview #19).

Middle-level managers at the Water Resource Department of the MoMUP (interview #26, 27 & 28) argue that there is a direct relationship between the uncontrolled mining on the KSA side and further deterioration of groundwater aquifer in Bahrain. Though the critique about the reduction of the Bahraini share of the groundwater is due to the human-induced over-exploitation on the KSA side, it is also the case of over-extraction on the Bahraini side as well. It is estimated that in 1995, a total of 218 MCM[96] of groundwater was extracted, which exceeds the safe extraction limit and subsequently contributed to groundwater degradation (Almasri, 2011b). As one official from the Department for Agriculture, MoMUP, stated, "it is not only difficult to regulate wells but also not feasible as it is part of the Government's vision for food security" (interview #19).

Therefore, other dimensions, such as institutional and political framings, on how to deal with water shortages and physical scarcity are hidden discourses that are obscured by externalising the blame to external actors. In the domestic sector, users are accused of water-intensive lifestyles, in the agricultural sector the exploitation on the KSA side is critiqued to overshadow the internal exploitation of the same aquifer. While this alternative framing is critical of what water scarcity entails, there is still some agreement on the complexity of the Bahraini case and the need for a holistic approach to address water development in the Kingdom. Yet, the way the problem is framed necessitates endeavour into non-conventional water sources for solution, as will be examined in the next section.

[96] These estimates are produced as part of an academic hydraulic modelling of groundwater hydrology and include both legal and illegal groundwater abstraction quantities.

5.4 Desalination as the Only Option to Overcome Water Scarcity

5.4.1 Depoliticising Desalination

As discussed in previous sections, water scarcity in Bahrain is constructed as a potential threat to the public, socio-economic achievements and stability of the Kingdom, and emphasise the need for protection. The previous two sections laid the ground, firstly to establish how critical the water scarcity issue is in Bahrain's ability to sustain growth and socio-economic development. Secondly, the discourse was further deconstructed to elaborate on the elements that constitute and contribute to the framing of water scarcity. In this section, I examine further how desalination was framed against the constructed causation of water scarcity and the challenges facing the water sector in Bahrain. As these challenges were characterised by the apparent limitation of conventional water resources and the additional burden of climate change and its uncertainties, desalination was favourably presented as the protagonist and the only option to counter these threats. As such, this section is presented as a dialogue between what constitutes water scarcity and the ostensible certainty that desalination offers. Furthermore, as will be discussed in this section, the construction of desalination as the only option obscures the many challenges that face the desalination sector as seen through the experiences of sectorial practitioners.

To further understand the unique and strategic position attained by the desalination sector, I explore how the industry has been presented in both the official and non-official domains. Mainly, the discourse revolves around the capability of desalination to overcome the apparent limitation of conventional water resources and functions as a reliable source of municipal water supply. Additionally, desalination is also presented as a weather-proof water option that can satisfy plans and targets with limited uncertainty (Feitelson & Jones, 2014). The following quotations, from current and former EWA officials, capitalise on the reliability of desalination in providing a quality and plentiful municipal water supply:

> *"The expansion of desalination aims to secure the sustainability of the water supply to all parts of the Kingdom."* (Interview #8)

> *"In simple terms, desalination addresses all the significant concerns; be it the dwindling per capita water share, the challenges of an arid environment or unreliable precipitation."* (Interview #13)

While the latter statement promotes desalination as an innovative solution to overcome the combined problem of growing demand and unreliable supply, the former statement reconstructs the position of desalination as the only option to ensure sustainability in current and future water supplies. Desalination is further celebrated against the backdrop of the Kingdom's achievement in meetings its Millennium Development Goal of ensuring a comprehensive water supply to the whole population. Thus, desalination fits nicely into the approach of mainstream sustainable development and the recently introduced SDGs. This idea is supported by Dr Mirza, Minister of MoEW, when he states "the Kingdom of Bahrain, similar to the rest of the GCC countries, has achieved all required targets in the provision of a safe water supply and sanitation well before 2015. It is estimated that 100% of the population has access to water and more than 90% have access to sanitation"[97]. Obviously, this is accomplished through the building and expansion of desalination schemes. It therefore [re]constructs the importance of ensuring sufficiency in water provision to the public. More specifically, as can be seen, by the EWA mission statement, there are determined efforts to work towards supply-driven management:

> *"Provide a reliable and quality supply of electricity and water for the sustainable development of Bahrain"* (EWA mission statement, Excerpt from EWA 2013-2017 Strategy).

The ostensible certainty desalination brings to the planning process is one of the main reasons it is favourably discussed and presented in the policy domain. Desalination plants are built to manufacture given quantities of water with little constraint from the environment and have been labelled a "turnkey solution" (Williams & Swyngedouw, 2018a). As a former EWA official reflected:

> *"To build a desalination plant is to know for sure the quantities that will be available when the plant is operating…for instance when the Al-Hidd station planned a second extension in 2008, its capacity doubled to over 100 million cubic meters… The [desalination] industry has attained a vital position in the Kingdom. That is because of the scarcity of freshwater resources… Desalination has become a strategic option… The country expanded in the construction of desalination plants over the years to cope with development needs and the ever-increasing demand."* (Interview #11)

[97] The statement is quoted from an interview the Minister had with Alwasat newspaper in 12th of May 2011.

Furthermore, there are other reasons why the expansion of desalination is favoured. Primarily it is because it serves to provide "Bulk Quantities" as one EWA official stated (interview #16). This bulk quantity not only solves the current increase in demand but also provides a "buffer for the next few years" as another EWA official asserted (interview #15). A consultancy report for EWA, prepared by British consultants Mott MacDonald, concluded that Bahrain would need an increased 400,000 cubic meters per day of potable water by the year 2025. This recommendation by Mott MacDonald was based on a linear projection of population and consumption rates and therefore safeguarded "business-as-usual" (BAU). Additionally, as one of the leading global infrastructure and engineering consultancies, Mott MacDonald is biased towards building big infrastructure rather than looking into smaller alternatives. Yet, the report is viewed with high regard. In light of that, desalination has become a means for revenue accumulation, where international players position themselves to generate stable long-term revenue. When I discussed this report with EWA officials, they expressed their confidence that desalination is the only option to achieve significant quantities of potable water. This convenience of managing the status-quo, and being able to project it into the future without any disruption, makes desalination the best fit for any policy discussion.

Therefore, desalination implicitly functions to maintain the BAU projection, in a way to enforce and facilitate the sanctioned discourse around "provision" and "abundance" (Rende, 2007; Turner, 2008). This begs the question of whether desalination is the only option to ensure a reliable municipal water resource or merely a political fix to maintain the BAU (Williams & Swyngedouw, 2018b), especially as it is expected to dominate the water sector for years to come. This notion was supported by one EWA manager:

> *"It is expected that a reliance on desalination will continue into the future and will be the main source for the supply of municipal water, which is already covering over 94%."* (Interview #15)

Indeed, the uncritical acceptance of "a mode of water resources management system that understands water as scarce is, to a certain degree, a requirement in enabling desalination as a plausible option" (Williams & Swyngedouw, 2018b). In summary, desalination is framed as the only option to solve a particular set of problems. These problems were articulated to be natural, external and also urgent. The framing of desalination as the only option to address these problems functions greatly to depoliticise and justify the capital-

cost endeavour. The argument for desalination adoption is emboldened by the claim that conventional water resources are unreliable, further supporting the promotion of desalination technology as imperative. The consequence of closing down of options by asserting TINA, desalination is, then, juxtaposed as independent and reliable in comparison to fluctuating rainfall and deteriorating springs and groundwater. Desalination is positioned as part of the country's effort to achieve sustainable development, both in terms of reliable water provision and supporting other sectors. Desalination is articulated as problem-free, weather-proof and most importantly, nature-proof. Therefore, desalination brings ostensible certainty to production and planning, when discussed with EWA officials. However, desalination does not come without its challenges and is "far from free of constraints" (Ibid). These challenges, as will be discussed in the next sub-section, question the *protagonist* position of desalination as experienced by desalination plant practitioners.

5.4.2 Physical Threats to Desalination Plants and Pollution of the Gulf

As discussed earlier, desalination has emerged as an increasingly reliable and secure water management option, in part as a response to the inability of conventional water resources to deal with increasing demand. In simple terms, desalination has been promoted to have all-around positive attributes as a strong contender for a water management strategy in Bahrain. As the number of large-scale desalination schemes have increased, however, physical security of desalination plants and pollution threats of waterways have attracted greater attention. This sub-section looks at the security issue to its full extent and according to the classic notion of the term. This concern is held by desalination plant practitioners, former EWA officials and parliamentarians, all of whom share an understanding that water security revolves around the physical safety of desalination plants and their protection from physical harm. In other words, the ostensible certainty that desalination is promoted to have, by planners and managers, is a massive infrastructure security concern to others.

Security concerns refer to physical damage to the infrastructure that could render the plant non-functional. This could have devastating consequences, because the amount of time and money needed to restore the desalination plant into service after being affected could be significant. These consequences could be severe since the alternatives in supply are not readily available. This framing of the security and the safety of desalination plants

echo well with how water security is broadly viewed in the region. Al-Otaibi and Abdel-Jawad charted water security as sufficient "available and secured quantities of freshwater to meet normal/rationing demand under an emergency situation until water production facilities are constructed or rehabilitated" (2007. p.302). Similarly, Darwish et. al., argue that desalination plants in Qatar are vulnerable to unforeseen conditions such as oil spills that can force desalting plants to shut down (Ibid, 2014). He continued to indicate that "infrastructure security, as well as inefficiency of the used desalting methods, threatens water security or requires large investments to ease shortages" (Ibid).

It is, therefore, a reflection of the actual security of the infrastructure that could undermine operations, due to potential sabotage of the desalination plants. This could be in the form of human-induced or natural incidents that could result in damage to the plant. There are increasing concerns about the position of desalination plants and their potential "to be a target of terrorist attacks either from armed groups, such as Al-Qaeda, or unfriendly countries such as Iran and Israel" (interview #119). Desalination is viewed to be an "obvious target should anyone want to cause tragic consequences that are wide-spread" (interview #105). Additionally, there are other forms of physical threats that could affect the operation of the desalination plant, for example naturally occurring incidents such as earthquakes and hurricanes. These events could partially or entirely damage the plant and put it out of service. As highlighted by Clark et al.:

> *"Utilities are adept at maintaining and repairing damage to aging infrastructure related to normal day-to-day operations. However, acquiring the expertise and funding to build the capability to effectively respond to a catastrophic natural disaster or terrorist attack (or to prevent one) that could wipe out an entire water system is a significant challenge."* (Clark et al., 2011, p.30)

This is the dilemma of relying on desalination to provide the majority of the municipal water supply. However, other views argue that this is justifiable, and is in-line with the country's vision of maintaining groundwater to tackle supply during emergency incidents.

Another avenue of discourse pertains to the challenges of seawater rise and the indirect impact on desalination and wastewater plants. The implications for desalination infrastructure, as highlighted by several EWA personnel (interview #12,13 & 15), is the

possible submersion of the main components of the plants in proximity to the seashore. These components are the inlets and outlets of desalination plants and the potential attenuation of the effluent outfall to the sea from wastewater treatment plants (interview #105,106 & 107).

The greater threat, however, is within the main source of water. The Gulf is a semi-closed body of water with very minimal circulation. There is general concern about the level of salinity of Gulf water in comparison to other bodies of water such as the Red or the Arabian seas. This means "more effort, in terms of raising the thermal pressure, is needed to extract the salt" (interview #117). As it was pointed out to me, "this is another reason why MSF still governs the production along the Gulf coast" (interview #111), RO is preferable with moderate-to-high salinity levels that can be found in brackish water. Additionally, there are other critical concerns on the potential of pollution in the waters of the Gulf that could affect the intake of the desalination plants and therefore stop production. These concerns fall into two categories: one is chemical and oil pollution from the marine traffic in the Gulf, and the second is the potential nuclear pollution from the nearby nuclear plants in Bushehr, Iran.

The first category of concern relates to the potential pollution of the Gulf waters due to incidents of spillage, or the dumping of contaminants from the shipment tankers that circulate the Gulf waters every day. As one informant stated, "the Gulf is the highway of tankers" (interview #95). "There are over forty-eight thousand tankers that travel the Gulf waters every year", and the majority of them are oil and chemical containers (GCC UWS, 2016). The risk of spillage or accidental dumping of contaminants into Gulf waters remains a significant concern for the region and the desalination sector more specifically. That is because any potential pollution could not only prevent water intake at the desalination plants but could potentially cause damaging effects to the components of the plants.

The other source of concern comes in the form of pollution from the nearby nuclear power stations at Bushehr, Iran. The concern is that any leakage of radioactive materials into the waters of the Gulf could have damaging consequences on desalination plants in terms of the long period needed to reverse nuclear pollution. This concern comes from claims of the "relatively poor safety practices that surround the nuclear plants in Iran" (interview

#93), or even the potential harm that the plant could face in the event of a natural disaster such as an earthquake. There is also concern about the possibility of the "nuclear power station being a target should Iran be involved in a war" (interview #14) with countries in the region such as Israel or due to the extended US military presence in the area. Concerns about the potential pollution of Gulf waters due to the leakage of radioactive materials from the Bushehr plant are a daily concern to practitioners at the desalination plants and to officials at EWA. These concerns, however, are usually overshadowed by the extreme enthusiasm of "*the only option"* rhetoric.

5.5 Conclusion

In this chapter, I assessed two central components of the promotion of desalination as *the only option*: the construction of water scarcity as a threat to socio-economic development and deploying natural aridity and climate change as signifiers of water scarcity. The strength of the discourse relies on scientific arguments that assert water scarcity as a given natural condition, as part of the outlook of the *Third Paradigm of Water Resource Development* in Bahrain.

Furthermore, this chapter discussed how the framing of water scarcity around natural aridity played a role in influencing decision-making around water politics. As I explained in this chapter, I use the term 'discourse' both in analysing the power exercised by key stakeholders in the generation and in the interpretation of knowledge (Section 5.2). Moreover, it is also used in plotting the narratives and storylines around the way desalination was framed as the only option to overcome a particular framing of water scarcity (Sections 5.3 and 5.4). More importantly, the discourse is underpinned by a unique perception of reality that is expressed by shared beliefs of natural scarcity. This perception was suppressed during the *First Paradigm of Water Resource Development*.

Official statements have clearly charted water scarcity to be a detrimental factor to Bahrain's aspired development journey. These statements represent the ideas and arguments of people with a certain level of material and educational resources, with access to current information. As such, they potentially produce and reproduce a particular representation of reality and focus. A reality that is perceived in a technical and scientific manner and stems from their background, training and previous experiences (North, 2005). In the case of Bahrain, the pursuit of socio-economic development has

been constructed as a transitional phase and water scarcity as a peripheral threat. This specific framing of water scarcity, nature and reality, through public and official statements tends to have significant reach and can be read by a broad range of people. Therefore, there appeared to be homogeneity in how the discourse was constructed and realised.

Subsequently, I analysed two dominant narratives of the water scarcity discourse. The first one capitalises on the aridity condition of Bahrain and the limitation of surface water. Framing the issue of water scarcity as a consequence of Bahrain's aridity condition has projected desalination, like a bullet-proof solution, to be the most competent counterbalance and assurance of water abundance. The second one emphasises the role of climate change and the uncertainty it brings in spatial and temporal scales, for both precipitation and temperature. Climate change was another significant explanatory factor in the framing of the scarcity narrative, suggesting a discourse that presents the hydraulic cycle as operating within a broader shift in regional and global climatic patterns. The discourse of "climate change" surfaced as central within the scarcity narrative, leading to the claim that rainfall patterns were unreliable and consequently supporting the adoption of desalination as an imperative techno-fix (Scheba, 2014). These narratives focus on constraints facing the conventional water resources of surface, rain and groundwater.

However, the naturalisation of water scarcity obscures other factors and dimensions that contribute to the reduction of water in its bio-physical form and the per capita rate. Other alternative framings of water scarcity, such as high consumption rates of domestic water and the exploitation of the shared groundwater aquifer on the KSA side, tend to obscure the institutional and political aspects of scarcity.

There is always a tendency to conceptualise water scarcity as 'naturally occurring' in Bahrain. I argue here that this is done to externalise the problem of water shortage beyond the traditional stakeholders' responsibility and consequently establish space to source funding for technical-based solutions. Furthermore, I discussed the reasons why assigning the failure to nature prevails in the discussion of water scarcity and serves to depoliticise desalination as a strategic option. Lastly, this chapter explored the inherent vulnerability of the desalination sector. The analysis is presented through the views and experiences of

desalination plant practitioners on the numerous challenges that face the sector. This analysis directly engages with, and critiques, the "only option" framing.

The combination of constructing water scarcity as a threat and desalination as the only option to overcome such a threat, resulted in a large-scale expansion of the desalination industry. Consequently, such expansion necessitated institutional reforms to address and adapt to the increased hydro-investment. Desalination becomes implicated in the political economy of water services, and in broad trends towards neo-liberalisation, commercialisation, commodification and financialization. I continue, in the next chapter, to explore the institutional dynamics of the *Third Paradigm of Water Resource Development* and how “lock-in” and path dependency in a water sector that is dominated by desalination is an attribute of a *hydro-trap.*

Chapter 6:
The Hydro-Trap: Self-Rearranging Processes and the Path to Desal-Dependency

Chapter Summary

Building on the prominence of the scarcity narrative to legitimise hydro-investment, this chapter furthers the inquiry into the resultant institutional processes that facilitated the path to desal-dependency. Path dependency and self-rearranging processes are the focus of the analysis. Building on prior research on the role of technologies, policy lock-in and institutional path dependency, this chapter explores 1) the evolution of the municipal water sector to accommodate reforms and address desalination in Bahrain and 2) the role of self-rearranging processes to forge a compromise in complex and time-sensitive technological and institutional settings. Through the following of key milestones in the *Third Paradigm of Water Resource Development* in Bahrain, the aim is to reveal how the formation of EWA and the increased participation of the private sector marked a distinctive and changing role of the State resulting in entrenched development trajectories around desalination.

6.1 Introduction

In Chapters 4 and 5, the emergence of desalination in Bahrain was examined as "a mere fever", and at a later stage, its position was elevated and promoted as "the only option" to overcome water scarcity. Critical junctures were identified and analysed in order to understand the external factors and politics that had an influence on the water sector. As the new King was crowned and a new heir to the crown was appointed, a new vision for Bahrain's present and future emerged. "The key driver to this transformation is indeed the Crown Prince: young, energetic and liberal thinking" (interview #125). This moment of history encapsulated a lot of hopes[98], especially of reforms, as one historian labelled it "to shake up the boat" (interview #126). As will be discussed in Section 6.3, strategic plans and reforms were rolled out, seeking improvements in all sectors of the economy, of which the water sector is the focus of this chapter.

As illustrated in Section 4.4, a *Third Paradigm* of water resource development was shaped and stands in stark contrast to the belief structures and perceptions of reality that existed around water a few decades ago, in Bahrain. Water as a resource is now proven politically and scientifically scarce (see Chapter 5 on how narratives of water scarcity

[98] Significant progress was witnessed with the appointment of the new ruler in 1999. Hamad bin Isa Al Khalifa became the Amir of Bahrain in 1999. He instituted elections for parliament, gave women the right to vote, and released all political prisoners.

developed and were deployed to legitimise hydro-investment). While the notion of water scarcity is widely accepted in the current paradigm of water resource development, there exists apparent divisions and strong contestation on the response.

Even within the municipal water sector, divisions were evident in how best to deal with increasing water demands as a result of urbanisation and changing consumption patterns. On the one hand, reformists, such as former EWA CEO AlAwadhi, understood water as a finite resource that needed to be managed holistically by exploring and understanding the linkages of water with other sectors. The conservative camp, with members such as current EWA CEO, Sheikh Nawaf, on the other hand, lean towards underestimating the significance of the interlinkages between water and other sectors. The focus is always on the augmentation of more water to silence discussion on the *importance* of water interlinkages with other sectors.

These two points of friction, which manifest between the technocrats working in the public sector, are a true reflection of the divergent visions of the Prime Minster and the Crown Prince on Bahrain's development path. While the young Crown Prince, Sheikh Salman, is famous for strategic planning and neoliberal thinking, as will be discussed in Section 6.3, the established conservative camp headed by Prime Minister Sheikh Khalifa is more in favour of centralising power. The prominence of the conservative camp's position is further examined in this chapter, especially in how their position reinforced the desal-dependent path.

Contestations and compromise between different actors on how best to overhaul government institutions meant that it took a few years before concrete reforms materialised. In the water sector, "the list of requests for reforms were lengthy and specific, but not all of them were recognised" (interview #9). To explore how and why specific reforms were fortunate enough to be addressed while others were side-lined, I explore common factors exhibited by the conservative camp, related to political and institutional path dependency. These factors are: managing political risk, prominent technical and professional agency within the water sector, and lack of institutional flexibility. In other words, how the conservative camp managed pressures for transition and change, and subsequently maintained their competitive position (Hamidov et al., 2020; North, 2005).

As such, this chapter aims to present the reformist agenda as processes of rejection of the established conservative institutions, with their focus on the water sector and the desal-dependent path. In return, the way in which the conservative camp operated could be viewed through processes of counter-reactions to the rejection of the desal-dependent path (Nem Singh, 2014).

The chapter is structured into an additional four sections. Firstly, I analyse emerging water resource management systems in the T*hird Paradigm* of water resource development. Local, regional and global alliances are outlined, and positions and contestations of competing camps are examined. Secondly, I analyse how the water sector reacts to claims for reform, transition and change by examining 1) the interplay between reform and self-rearranging processes; 2) the establishment of EWA as a compromise in the face of complexities and 3) the private sector role in desalination production. Thirdly, I consider the changing role of the Government in the critical junctures since 1999. The municipal water sector has evolved, and parts and responsibilities have been redistributed in a way to externalise blame and responsibility to non-state actors, and in the process the municipal water sector has been locked-in around desalination. Accordingly, considering the current interplay between EWA and the private sector, I argue that the current position of desalination, therefore, denotes a hydro-trap. Finally, Section 6.5 concludes the chapter.

6.2 Analysing Emergent Management Systems in the Third Paradigm of Water Resource Development

In 2017, as part of the development of the National Water Strategy (NWS) in Bahrain, various stakeholders including water managers, educators, local consultants and NGOs participated in a series of meetings and workshops[99]. The purpose of these activities was to gather information and prepare an assessment report on the Kingdom's water resources. I attended these events as a spectator and a note taker (Figure 6.1 and 6.2). At the end of the workshops each unit[100] presented a self-appraisal of strengths and weaknesses alongside suggested ways of collaborating. Interestingly, as part of this

[99] The meetings and workshops were conducted as part of a consultancy engagement to the Arabian Gulf University, sponsored by the Ministry of Work and Ministry of Electricity and Water.
[100] These units consist of wastewater, municipal supply, groundwater resources, agriculture production

exercise the municipal water supply unit implicitly indicated the need to go beyond the supply-oriented path when they indicated potential areas of improvement. The key areas noted by the municipal water supply unit included 1) leak management and control; 2) demand management; 3) water-conscious building by-laws and 4) development of a long-term unified water strategy.

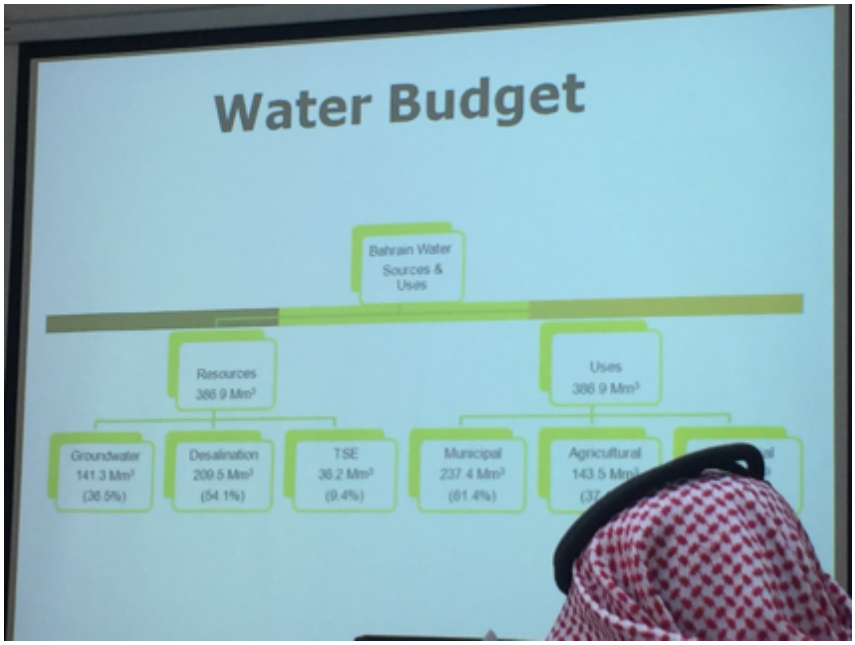

Figure 6. 1: From the development of the NWS event
source: author

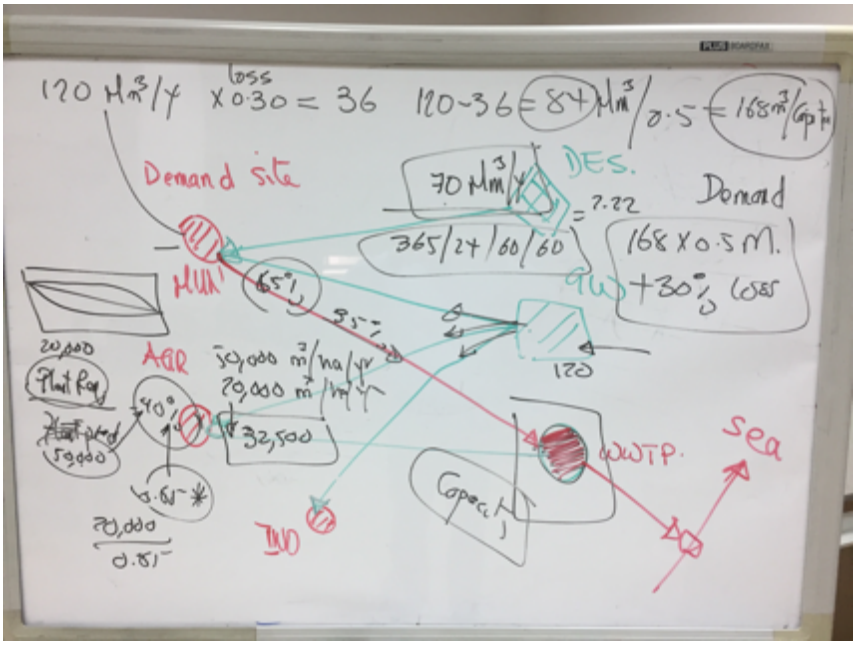

Figure 6. 2: From the development of the NWS event
source: author

In response to the areas of improvement presented by the municipal supply unit, a local consultant participating in the workshops, who used to be a government official, argued that these recommendations have always been on the table but lacked implementation. He stated:

> *"While these solutions [recommendations] are not new, implementation has to overcome a political risk assessment within decision making… [The] current economic model and steady supply through desalination triumph any potential for these solutions to see the light."* (NWS workshop, 2017)

Therefore, whilst in the *Third Paradigm* of water resource development in Bahrain[101] consensus is formed around scarcity of water resources, how water resources are to be managed is greatly disputed. The contention evolves around both how to engage with the water question and who should undertake, or be allowed to, address it (Savenije & van der Zaag, 2002). The clear divide between the reformist and conservative camps is examined here in this section, along water management paradigms.

As a development policy, desalination represents the hard approach to water management. In another words, desalination is *a trodden trail* that has been tested and is proven to deliver (Ebbinghaus, 2009). In a country like Bahrain with increasing water consumption and economic activities, prominent water practitioners and politicians favour desalination projects for the certainty in delivery, as examined in Section 5.3. Additionally, as discussed in Chapter 3, regional GCC ties and development trajectories have also played a significant role in the promotion of desalination in Bahrain.

Regionally, the 5th GCC Water Conference in Qatar in 2001 entitled "Water Security in the Gulf", followed suit with what has previously been articulated in international conferences and conventions (Section 2.2). The conference emphasised *1) the importance of water resource planning; 2) sustainable development of water resources; 3) implementing integrated water policies in nation countries and 4) investing locally in desalination technology development* (WSTA online conference archive). Locally in Bahrain, soft approaches to water resource management gained increasing traction over

[101] For analysis on the evolution of the water resource development paradigms in Bahrain, refer to Chapter 4.

the dominant supply-oriented path. In several interactions with academics and retired officials, the main message representing their view on the water issue was "water, and not water supply, should be a national priority". (interview #101). As indicated by an academic presenting a paper on the "Development of Water Management Paradigms in the GCC" stated:

> *"GCC countries have spent billions of dollars on infrastructure to supply water, be it desalination plants, treatment stations, dams or digging artisanal water to provide water supplies. However, little attention has been given to improving the efficiency of available waters, recycling or reusing."* (Presenter in the 12th GCC water conference, 2017)

As such, the water question for the reformist camp is a managerial issue. For them, the increasing water challenge cannot be addressed by techno-engineering solutions alone, but rather through institutional reforms that overcome sectorial planning for water resources. Central to this paradigm is the notion of water allocation in achieving sustainable results (Allan, 2003). The whole idea of a holistic and integrated approach to water resource management was clearly articulated by several presenters in the 12th GCC Water Conference that I attended in Manama in 2016. Several studies deployed WEAP[102] models in which different types of information could be integrated and different values and preferences could be managed and weighted in a single framework. The presented models project trajectories of individual and combined interventions to assess sustainability of water resources. Alaradi (2017) presented his research[103] on the sustainability of the municipal water sector in Bahrain by analysing potential savings in overall water production should multiple interventions be implemented. The research focused on evaluating integrated water resources through WEAP modelling and compared projected model scenarios to 2030. In comparison to the BAU scenario, the findings inferred a 38% water saving if 1) leakages reduced from 38% to 15%; 2) the consumption rate stabilised at 250 L/day through price signalling mechanisms and awareness and 3) the use of water saving devices is mandated to all new construction.

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[102] The Water Evaluation And Planning (WEAP) system is a software tool that takes an integrated approach to water resource planning. The software is developed by the Stockholm Environmental Institute.

[103] The research was also covered in an Alwasat article in October 2017, entitled '*A researcher in AGU proposes a model to reduce water consumption by 38%'*.

The conservative camp, however, is more engaged in the hydraulic mission of the state, in the form of building more desalination plants and digging deeper wells to satisfy the increasing water demand. The setting of the traditional water management system mainly comprises of technical elites who work in a particular regulatory framework. A statement from a current manager in EWA explicitly expressed this paradigm by stating:

> *"In my opinion, under current conditions, we do not have an option but to desalinate. Massive urbanisation projects in the Kingdom will continue at the same rate, as per all current indicators… expanding desalination to meet such demands is both a necessity for a functional Bahraini economic model and an imperative for future planning."* (Interview #13)

It is, therefore, a rational planning focus on managing risk and dependent on physical variables such as available quantities and projected water demands. Brown et al. argue that "risk-based management underpins a government's requirement for stability, control, security and safety; hence the dominant cognitive response is to promote the status quo" (2011, p.4044). In government quarters, individual technical and professional agency may sometimes be less visible. My experience in trying to ask current water practitioners, especially those in middle-management, about their views on the implementation of best practice is that the interest of the organisation prevails above personal preference. Retired officials, on the other hand, were found to be more open in their views in critiquing the supply-oriented management system. It is worth noting that these retired officials tend to move to academia or local consultancies and therefore do not have an official status. This is evidence in the following quotations:

> *"Whilst completing my PhD, I studied the effectiveness of demand management mechanisms in reducing consumption and therefore the need to upgrade and build desalination plants, it is incredibly difficult to voice these views within EWA[104], as the direction is pretty much set."* (Current EWA manager, interview #11)

> *"Repeating the same mistakes, maintaining the same path and expecting different results is the exact definition of unsustainable management. Issues such as leak detection and infrastructure repairs have been raised several times and yet minimal changes or*

[104] The current CEO of EWA is Shaikh Nawaf Bin Ibrahim Al-Khalifa. He is part of the Royal Family. My experience in dealing with water practitioners at EWA is that there are limits to critiquing the Authority and the Government. The concern is that critiques of EWA are directed at the Royal Family, represented in this instance by Shaikh Nawaf.

> *improvement are seen."* (Former EWA manager, freelance consultant to UNDP and other organisations, interview #16)

As such, while there exists contention among water practitioners on the appropriate management paradigm for water resources, the desal-dependent path continues to dominate. Notably, engaging with the economic model and development path of the country is less visible, socio-political aspects are unchallenged, and therefore only institutional processes are more prominent (Beblawi, 1987). Nonetheless, improvements in efficiency and cost recovery materialised as a realistic compromise. In the next section, I examine the institutional dynamics in responding to claims for reform that were triggered with the appointment of the new Ruler and Crown Prince in 1999.

6.3 Managing Transition and Path Dependency

6.3.1 Creating Institutional Barriers and Path Dependency

As an infrastructure system, desalination's self-reinforcing dependency path has been observed since the commissioning of the first desal plant at Sitra in 1974. This was followed by an "escalating commitment" to the sector in the following decades, witnessed in the increasingly dominant share of the municipal water supply held by desalination, currently peaking at over 94% (EWA, 2017). While generating desirable and rewarding results at first, desalination plants are viewed to be difficult to reverse and "become a burden to any meaningful transition towards an integrated and sustainable water sector" (Interview #43).

It is essential to understand the local political climate of this era if we are to fully appreciate the nature of the introduced reforms and their aims. Reforms accompanied the change in leadership of the country in 1999, and as one historian noted "it was a once in a generation chance for hope and change" (interview #125). Seemingly everyone in Bahrain welcomed the appointment of the new King, as one elderly interviewee narrated "King Hamad was known for being kind and compassionate, and in the following years after his appointment he improved a lot, especially economic and political participation" (interview #56). This section, therefore, addresses the reforms that were initiated by both the new King and Crown Prince at the beginning of the Millennia.

The period after 1999 can be considered development rich and a turning point in modern Bahraini history with very significant changes taking place within national politics. Actors, interests and coalitions were [re]shaped in response to the new vision for the country. Conflict over institutional choices on the design of reforms led to a delay in implementing change. Therefore, within the water sector, the way in which the conservative camp operated could be viewed through counter-reactions to the rejection of the desal-dependent path (Nem Singh, 2014), specifically, by analysing the shortcomings of the desal-path and showing flexibility for improvements and reforms. In other words, they were in favour of more a limited overhaul of the system that targeted inefficiencies and cost recovery. As a result, a prevailing pattern of institutional readjustment manifested.

As discussed in the previous section, an emerging paradigm sparked a process of rejection of the dominating supply-oriented management system. “Inspired and influenced by international and regional thinking on sustainability and good governance, the reformist camp, dissatisfied with the dominance of the desal-dependent path, staged a reaction aimed at designing new institutions in such a way that desal-dependent path could not operate. They pressed for a logic inspired by IWRM principles and the like” (edited excerpt from fieldwork notes, Manama, 2017).

The task of this section is to review the empirical evidence concerning the period since 1999, to further our understanding of how conflict-negotiation in institutional reforms played out in the subsequent years, and consequently, how it shaped the municipal water sector path, at this critical juncture. During this time, and as Bahrain emerged from the food self-sufficiency trap, “we had ambitions that both the municipal and agricultural water sector would need to be overhauled”, a former EWA manager explained the disappointment (interview #40).

The critical empirical evidence reviewed in this chapter concerns mainly two legislative measures that were passed, as part of reforms to the economy in general and the water sector more specifically, affecting institutional design. The first one pertains the neoclassical economic vision of the Crown Prince to liberalise the economy. Privatisation has taken a clear path since 2001 with the creation of the High Council for Privatisation in December of that year. Subsequently, Government Decree No. 41 in the year 2002

sought to regulate privatisation policies in the country. The first Article of the decree stated that "privatisation is part of the economic policy of the Kingdom". Additionally, there had been an increased interest in privatisation within the service and production sectors, who were explicitly targeted within the decree. The fourth Article of the decree stated that the "privatisation program is to include production and service sectors", especially the tourism sector, telecommunications sector, transport, electricity and water sectors.

The second measure pertains to the institutional rearrangement experienced by the municipal water sector. The Ministry of Electricity and Water (MoEW) was transformed into the Electricity and Water Authority (EWA) in accordance with Royal Decree No. 98, issued on the 11th of December 2006. As reforms were prepared for issue, hopes and aspirations of meaningful changes were also present in government institutions. As a former EWA manager stated:

> *"It was a golden opportunity to overhaul the municipal water sector towards a more integrated water management system, that addresses both sides of the system (supply and demand) as well as efficiency, leakage identification and repair and try to achieve a sustainable and favourable solution."* (Interview #5)

Reactions to the reforms were evident in both employees and across official quarters. The reactions manifested in suspicion of laying-off workers and increases in prices of services. These concerns are reflected in two Alwasat articles that covered the reform period:

> *"Employees in the authority [EWA] currently demand assurance of their livelihood. They expressed that staying within the Ministry was a legitimate assurance for workers."* (Alwasat, December 2007)

> *"…privatisation of the water sector is a way for the Government to relinquish its responsibilities towards citizens. It implies a lot of protocols that are not popular such as cancelling subsidies, raising tariffs, debt collection, reducing labour, etc... Private companies will enforce this, on behalf of the Government…thus privatisation is a way to avoid political risk and people's anger, while implementing an already agreed agenda."* (Alwasat, August 2006)

Although with some opposition, there were determined paths that were already set, and all stakeholders eventually settled on a compromise. Critics of the desal-dependent path highlighted the need to overhaul the water management system to improve usage efficiency and not only rely on expansion in the desalination sector. A former manager in the water and electricity directorate elaborated that:

> *"We raised a full list of issues that were worth addressing as part of the Government's reform efforts. We were conscious of the need to be concise and specific about what the sector required, and we asked for:*
>
> 1) *Repairing and replacing broken infrastructure.*
> 2) *Installing water meters.*
> 3) *Developing a long-term water plan.*
> 4) *Building greater adaptive capacity.*
> 5) *Incentivising water conservation.*
> 6) *Improving the efficiency of water use.*
> 7) *Desalination as a last resort.*
> 8) *Leakage mitigation, demand management, renewable uptake."* (Interview #49)

As will be discussed in the next two sub-sections, this list of requests was politically undesirable to water resource planners and managers and was subsequently negotiated. Apparently, the will was there, along with the Government economic reforms, yet institutional processes restricted the outcome and reflected "reproduction sequencing" (Mahoney, 2000). Generally, the response to calls for reform was refocused on improving efficiency and maximising the utility of government assets (EWA). However, it fell short of addressing the holistic concerns of the water sector, while maintaining desalination as the primary source of water supply.

Scholars argue that, unless exogenous shocks occur, systems will continue on the same path regardless of optimality (Mahoney, 2000; Pierson, 2000). Although the critical juncture that accompanied the appointment of the new King and Crown Prince in 1999 was perceived to have revolutionary and reformist attributes, "off-path reforms were restricted" (interview # 94). As such, I identify self-rearranging dynamics as an analytical approach towards understating change during transition and reform period. I argue that

hidden and emergent dynamics of self-rearranging processes are of particular importance. These processes unfold their dynamics, realigning a possibly exogenous derailment shock to feed into the same path and reinforce it further. The identified key features of the self-rearranging dynamics include their facilitation of 1) "*a compromise in the face of institutional and technological complexity*" and 2) "*a rush for results*" "as the Crown Prince was literally chasing solutions or something to announce" (interview #11).

As such, the establishment and refinement of EWA to its present form, and privatisation, in its Bahraini format, are examined further as institutional processes (Mahoney, 2000). The following sub-sections trace trajectories of institutional development within the municipal water sector and try to connect these developments to the rejection of the desal-dependent path and its subsequent counter reaction (Nem Singh, 2014).

6.3.2 The Establishment and Refinement of EWA: A compromise in the Face of Complexities

EWA was born in 2007 amidst a conflict between elected officials, friction between the Royal Family and water practitioners wishing to detach desalination from government bureaucracy, and those who pressed for a more limited scope of decentralisation. The Ministry of Electricity and Water (MoEW) was transformed into the Electricity and Water Authority (EWA) in accordance with Royal Decree No. 98, issued on the 11th of December 2007[105] (Figure 6.3). In conversation with an economic academic at the 12th Gulf Water Conference, he elaborated on the establishment of EWA as follows:

> *"As per the institutional restructuring in December 2007, the Ministry of Electricity and Water was transformed into an authority after approval from the cabinet. The aim was to align this direction with the general economic path for the Kingdom, which is turning [service provision] ministries into authorities so that they can operationalise as per private entities and their competitive nature. This flexibility of operation, in terms of managing and regulating, is almost an international norm that has been proven successful in several developed nations."* (Interview #6)

[105] Prior to that the ministry was run by Sheikh Abdullah Bin Khaled Al Khalifah.

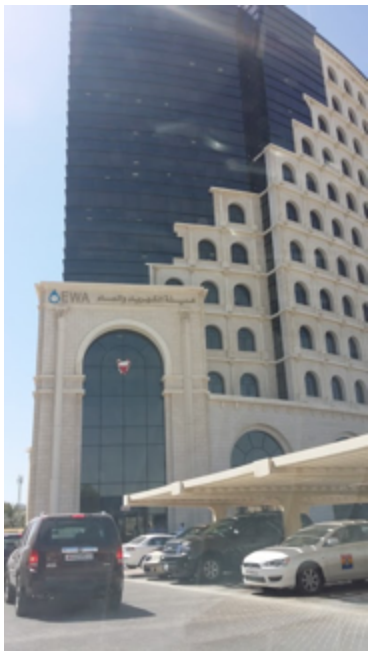

Figure 6. 3: Headquarters of the Electricity & Water Authority (EWA), Manama, Bahrain

The Royal Decree No. 99 of December 2007 delegated the responsibility of overseeing EWA to the Minister of Works, Fahmi AlJawder. The task of monitoring and overseeing EWA's administrative team was just one of his delegated responsibilities. Moreover, Dr Abdulmajeed Alawadhi[106] was appointed as CEO of the newly formed EWA and continued in this post until February 2012. In the course of my interview research it became clear that Dr Alawadhi is known as an excellent technocrat, unafraid to speak his mind. While the Government was celebrating development and prosperity, Dr Alawadhi was critical, warning of service shortages and blackouts in electricity and water should the current trends continue. This can be seen in his statements below:

> *"Should the rate of bill [debt] collection remain low, the Ministry will struggle to continue the infrastructure maintenance program...the request for BD 700 million from the Government would help modernise the electricity and water infrastructure network over the next 4 years"* (Alwasat, August 2004)

> *"The undersecretary to the Ministry of Electricity and Water, Dr Alawadhi confirmed that Bahrain would continue to face electricity blackouts…due to extreme demands during the summer season"* (Alwasat, August 2007)

[106] Prior to his appointment as CEO of EWA, Dr AlAwadhi was undersecretary to the MoEW and has worked in the sector since 1973.

Notably, the establishment of EWA was not an endogenous process per se, "it was rather triggered by local and regional calls for reforms in the municipal water sector" (interview #93). For instance, a decade before the EWA was established, Abu Dhabi and Qatar underwent reforms in the water sector. In 1998, the Abu Dhabi Water and Electricity Authority was formed to oversee government policies pertaining to water and electricity. Similarly, Qatar established "KAHRAMAA"[107] in 2000. As such, Bahrain's experience with EWA could also be attributed to a regional trajectory and influence in a sector that is dominated by desalination. These reforms denote "exogenous shocks" that are meant to alter the status quo for the sake of improvement (Mortimore et al., 2009).

Supporters of this move considered the formation of EWA to be "the natural result of a water sector that is heavily reliant on desalination investment" (interview #35). The purpose of EWA's evolution from Ministry to Authority was to ensure an efficient day to day operation[108] and to address the implications of maintaining desalination as a primary water supply policy. When I asked, *"why is this milestone important?",* I was told that it was a recognition of the need for an active government-related body that functions as a private sector company that paved the way for EWA to form. The need sparked from the considerable investment that the water sector attracted over the years in the form of significant infrastructure projects. The accumulated assets of the water sector increased rapidly and were reported to be underutilised. Therefore, "an independent entity that would function with a business-oriented mindset was deemed favourable to champion the handling of the electricity and water sector" (interview #97). Yet, the establishment of EWA manifested as a liberal decentralisation of service provision. Although it was aligned with the new vision of the country there existed a strong contention on power sharing.

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[107] KAHRAMAA is Qatar Electricity and Water Cooperation.

[108] Operationally, EWA manages the monitoring of water quality at every stage (production, transportation and blending, and distribution), of which water samples are taken from desalination plants, and blending and distribution stations, and then tested at EWA's Chemical Assessment Unit. EWA has three directorates whose responsibilities are as follows:

1) The Water Production Directorate, which is responsible for producing desalinated water, and operation and maintenance of production plants.
2) The Water Transmission Directorate, which is responsible for transmitting distillate and groundwater from desalination plants and boreholes and is also responsible for blending distillate water with groundwater, then treating and storing it in tanks before distribution.
3) The Water Distribution Directorate, which supplies water from storage tanks through the distribution network, directly to customers' storage tanks. (http://www.ewa.bh)

[108] Prior to that the ministry was run by Sheikh Abdullah Bin Khaled Al Khalifah.

In the first few years after establishment, hostility towards EWA surfaced through intervention in recruitment and public statements from elected officials. These concerns were covered in the following three media articles:

> *"Some managers [in EWA] were surprised with new departmental recruits without any consultation or representation in the recruitment interviews. This has discontented these managers."* (Alwasat, February 2008)
>
> *"Two years since Parliament raised a constitutional appeal against transforming the Ministry of Electricity and Water to an Authority...a concern about legislative oversight on providers of essentials such as electricity and water."* (Alwasat, 2011)

As such, traditional stakeholders mobilised to regain ground within the newly formed EWA, or at least to object to its existence as per the parliamentarians' constitutional appeal. These reactions show the extent to which the institutional trajectory was steered towards the conservative camp. To put it into context, the early conflicts come in direct contrast to what EWA was meant to deliver. A former manager summarised EWA's purpose as follows:

> 1. *"To handle the increasing hydro-investment to optimise efficiency.*
> 2. *To function like a private sector organisation yet remain a government-related company.*
> 3. *To fire and hire, and manage the salary scheme, land investment and underinvestment.*
> 4. *To impose requirements and regulations on other sub-contractors (E&W production), primarily environmental rules."* (Interview #101)

Nonetheless, the Minister in-charge of Electricity and Water, Fahmi Aljawder ordered, in February 2008, all recruitment to go through his office or the office of the CEO in order to implement direct oversight. This consolidation of power of Aljawder-Alawadhi was short-lived and only continued for a couple of years before the Ministry of Electricity and Water was reinstated in November 2010[109]. The Aljawder-Alawadhi nexus was tolerated

[109] See Royal Decree No. 59 of November 2010.

because of the significant improvement in service provision that was witnessed. However, at the end of 2010, Aljawder was removed[110] from the Ministry of Work and was appointed as the Minister of Electricity and Water Affairs. Three months later, in February 2011, MoEW was dissolved and merged with Oil and Gas to form the Ministry of Energy (MoE), under Dr Mirza[111].

The Royal Decree to merge E&W under MoE exacerbated an already difficult situation and sub-optimal institutional arrangement that prompted water practitioners within EWA to raise their voice and demand a swift solution. The second re-instatement of MoEW and the separation of the EWA from MoE, in July 2012, was a result of such demands. However, the appointment of Dr Mirza as Minister of Electricity and Water Affairs brought different dynamics to EWA. A former EWA manager illustrated the objective of the sector and how positions are filled to accumulate alliances, he said:

> *"The rapid increase in urbanisation and population made the water sector lucrative, with opportunities, and of course challenges. EWA is therefore entrusted to maximise these opportunities and minimise [overcome] challenges…the appointment of Sheikh Nawaf in 2013 as CEO of EWA has helped to alleviate concerns."* (Interview #11)

Sheikh Nawaf has been working in the sector since 1999 and his close relationship with the Prime Minster facilitated his appointment. This move was seen as a trade-off to influence proposals for institutional reforms in order to limit the loss of power of the conservative camp. In other words, the conservative camp was in favour of limited reforms within the MoEW whilst maintaining a presence in decision making processes. The newly formed Nexus between Dr Mirza-Shikha Nawaf granted the conservative camp a new power. Both appointments were claimed to be "hand-picked" by the Prime Minister himself[112]. Furthermore, elected officials, such as the Parliamentarians, enjoyed a degree of audit and legislative oversight within the MoEW.

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[110] Media articles indicated that the removal of Aljawder from his post as the Minister of Works relate to the delay and cost over-run in key infrastructure projects such as the King Hamad Hospital. However, this could not be verified.

[111] The Cabinet re-shuffle of February 2011 coincided with a period of limited social unrest in Bahrain during the Arab Spring.

[112] In her blog, Kristin Diwan (2019), argued that during the civil unrest that accompanied the Arab Spring in 2011, the Crown Prince's association with reforms and his inability to deliver political compromise weakened his political position. By contrast, the Prime Minister survived demands for his resignation and proved the value of his long-standing connections with Saudi Arabia, who sent elements of its national guard, as part of a larger Gulf Peninsula Shield Force, to defend the Monarchy.

EWA, as an independent entity or in association with MoW or MoE, had already seen conflict in its efforts towards decentralisation and in differences of opinion with stakeholders. As such, the 2012 re-instatement of MoEW emerged as a strong compromise. It is worth noting that the 2012 law to re-instate MoEW passed under the Government held by the Crown Prince as the First Deputy Prime Minister. This indicates that even one of the leading figures in favour of decentralising EWA from governmental bureaucracy was not able to resist pressures to change course. Nonetheless, a view to "re-ministerialise" EWA, within the reinstatement of MoEW, was still seen as a favourable or acceptable compromise within the reformist camp, an optimal institutional arrangement given the circumstances.

Gradually, the role of the Ministry shrank to house only a minister and his team on the 12th floor of the EWA headquarters. The transition of the Ministry of Electricity and Water (MoEW) to the Electricity and Water Authority (EWA) was viewed to be a natural evolution stemming from the need to have "a flexible arm to run as a private sector organisation in service provision" (interview #52). Such transformation is also viewed as a response to the increasing role of desalination and the need to handle massive investment projects beyond the cumbersome governmental bureaucracies. The role of the Minister overseeing electricity and water affairs became a customary position since it did not require any involvement in day-to-day operations. The period leading to the establishment of EWA on December 2007 and the revised role of MoEW in July 2012, is therefore a classic example of "reactive sequencing" on a path heavily dependent on technological infrastructure (Mahoney, 2000).

As discussed, EWA was formed as a private entity that functioned separately from other government bureaucracies, with greater flexibility to get things done, from a business point of view. However, the establishment and refinement of EWA could also be seen to reinforce certain dynamics (Mahoney, 2000). In term of results, these dynamics can also explain puzzling organisational and inter-organisational states such as "rigidity, inertia and decay" (Sydow & Schreyögg, 2013). Mahoney (2000) postulate that an institution may initially empower a particular group, at the expense of other groups, and that the advantaged group uses its additional power to expand the institution further in a continuous, self-reinforcing and self-sustaining cycle (Ibid, 2000).

"There was a spectrum of raised reforms" (interview #7), with the shape of the outcome depending on the level of path dependency. A former EWA manager illustrated the spectrum by stating:

> *"There are six goals for restructuring the water sector, which are, (1) ensuring the sustainability of electricity and water provision; (2) improving economic efficiency and service quality; (3) promoting private sector investment and participation; (4) creating jobs and training opportunities; (5) increasing cost recovery and the Government's income stream by selling out assets and (6) managing, planning, regulating, and monitoring the sector in the country."* (Interview #5)

He continued his critique by highlighting the constrains faced when inheriting a sector that is heavily dependent on desalination, namely the limited nature of reforms that can be brought to fruition:

> *"Although one of the primary responsibilities of the Authority is to plan for water resource management strategically, this has unfortunately not materialised. EWA has been desal-dependent."* (Interview #5)

Notably, EWA was formed against a backdrop of ongoing challenges such as electricity blackouts and water shortages, especially during summer season. There is a unanimous consensus from academics, former and current EWA officials, desalination plant managers and practitioners on the vital role that EWA is taking upon itself to streamline services and ensure continuity with minimum disruption. However, some challenges remain, for example, in how institutional structures function within local contexts and subject to social, political and economic constraints. Furthermore, the rearrangement that the sector experienced with the establishment and refinement of EWA transformed the water sector. This transformation, although favourable on paper, still reproduces the same institution with an increasing commitment to desalination as a singular path. Next, I explore the context and the role of the private sector in Bahrain's desalination industry.

6.3.3 Privatisation and the Rush for Results[113]

In 1999, Dr Alawadhi published an article[114] in the Desalination Journal, entitled "*Privatisation of the Power and Desalination Industry in the Gulf Region-Bahrain's Experience"*. He narrated the reputed engagement of an international company, anonymised and labelled "AA", by the Government of Bahrain in 1993, for the development of a privately-owned power and water complex. The Government was seeking an Independent Water and Power Producer (IWPP) for a turnkey Engineering Procurement and Construction (EPC) project. The company requested a twelve month period of exclusivity to complete negotiation with authorities, gain financial assurance and then confirm base prices. Alawadhi criticised AA's closed book methodology and lack of transparency in estimating capital and developer costs and return on equity. In the conclusion, Alawadhi recommended that:

> "*It is necessary for the Government to seek competitive bids for power and water projects instead of privately negotiating them...for proper legal, commercial, technical, financial and economic review, it usually takes about a year to conclude power/water purchase agreements and reach financial closure.*" (Alawadhi, 1999, p.107)

Over 10 years later, in 2006, the Hidd Power Company (HPC) (Figure 6.4), a consortium of International Power (IP), Suez Electrabel and Sumitomo, bought the Al Hidd plant from MoEW, for USD 738.2 million. The deal was Bahrain's largest privatisation to date. HPC assumed operation for 20 years from November 2007, upon completion of the phase III expansion. The privatisation of Al Hidd as a Public-Private Partnership (PPP) is a long-term contractual relationship between MoEW and HPC. Phase III, however, is considered a Build-Own-Operate-Transfer (BOOT)[115].

In an interview with PEI[116] in March of 2007, HPC's Managing Director, David Hadfield stated:

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[113] Privatisation in Bahrain is a very lucrative market that attracts corruption. In a statement published in April 2017, Transparency International has called on Bahrain to stop harassing anti-corruption activists.
[114] The article was also presented at the WSTA 4th Gulf Water Conference in February of the same year. At that time, Dr Alawadhi was the Undersecretary of MoEW.
[115] For more discussion on this and other forms of utility restructuring arrangements, see https://ppp.worldbank.org/public-private-partnership/agreements
[116] Power Engineering International magazine focuses on mega structures and has a commercial orientation.

> *"In July 2005, MoEW issued a request for proposals, on the 14th December 2005 MoEW awarded HPC and in January 2006 a deal was signed."* (Hadfield, 2007).

He continued to illustrate the reasons behind the speedy and smooth process by stating:

> *"The very short period between preferred bidder status and signing the deal was down to high quality documentation and a consistent approach."* (Hadfield, 2007).

Figure 6. 4: Al-Hidd Power Company (HPC), Muharraq, Bahrain

At first glance, it seems counterintuitive, and a form of political and professional entrapment, that Alawadhi would advocate the careful embracing of private sector participation in the water and electricity sectors, while at the same time be seen to rush award approvals and the finalising of privatisation projects (Brown et al., 2011). Alawadhi was actually trying to balance the kind of optimum reforms that would enable a high performing arrangement for the sector in the *Third Paradigm* of water resource development in Bahrain. While the transition of Al Hidd from a state-owned utility to private-operated company in six months is a remarkably quick transition, the role of the Crown Prince was crucial. For many reasons, the political climate was in favour of such a move, with pressure exerted to escalate the privatisation process. The water sector was under fierce criticism for its delay in adapting to the new government agenda of privatisation. "The Crown Prince expressed his discontent at delays in the privatisation of desalination plants several times" (interview #5). Two critical aspects accompanying the rush for the privatisation of Al Hidd were: 1) redundancy of staff and 2) financial and legal guarantees.

To elaborate, a critical aspect in the process of privatising Al Hidd was that of its employees. As is commonplace in any for-profit arrangement, with the need to drive-down cost, employees at the plant were negotiated under a secondment agreement with MoEW. The terms of the agreement included the provision for HPC to choose which staff they wanted to keep after the first six months. The HPC website marked December 2006 as an important milestone for the termination of the employee secondment agreement with MoEW. Of the 155 staff at Al Hidd, only under 100 staff were retained. Over a third of the workforce was terminated. The Ministry subsequently offered them severance pay or relocation. A water engineer who was relocated to the Sitra desalination plant recalled his experience as below:

> *"At first, we thought that the Government would be able to impose some quotas to ensure Bahraini locals were represented in HPC...while some continued working there, there were no guarantees of representation and many were forced out eventually."* (Interview #105)

An academic at the University of Bahrain argues that for a sector as important as desalination, the Government must ensure a long-term plan in developing the local talents in the field instead of outsourcing the whole sector to international companies. He stated:

> *"I would agree that private companies provide a quality service with competitive prices, however, should any dispute happen with these companies, replacement is time consuming and therefore the Government has the lower hand in any negotiation. In Bahrain, we rely on three main foreign providers and the majority of workers are foreign…. Let me reiterate that what is at stake is a vital sector and it is unacceptable to leave it entirely in the hands of others [private international providers]."* (Interview #99)

Therefore, what is at play is an issue of national security (framed as critical infrastructure). The quotation above illustrates the result of engaging foreign providers in desalination operations. In the past, criticism was mainly focused on the development of the technology and the increasing reliance on international technological providers. With the privatisation process, the "know how" and operation skills are now being largely transferred to external actors who are only motivated by profit. Public perception, although not as visible, is less supportive of the privatisation project. A local researcher reported that "public opinion in Bahrain feels that such utilities [electricity and water]

should either be monopolised by the Government or owned by an open public company, and not foreign owned" (Al-Alawi, 1998, p. 133). In an interview with a resident in the Muhareq area, he stated that "neither the tariff nor the quality of service had changed" (interview #128), in a way to indicate that the privatisation project did not impact on him personally. More importantly, privatisation in Bahrain appears paradoxical to what the rentier state entails, of strong centralised government. While, Sheikh Salman belonged to a reformist generation that proved himself as eager to reform urban water services (Lambert, 2014), this gradual shift towards privatisation has been influenced by recommendations from the World Bank and other multilateral organisations (World Bank, 2005).

Additionally, as the Government maintains complete control on the tariff it charges consumers, depending on the level of subsidy, it therefore functions as a middle-man between the private sector and the consumers. The private company finances and develops the infrastructure and sells the product at a pre-arranged price. As such, the Government provides the necessary financial and legal guarantees for the private operator. Compared to other sectors, such as tourism, transportation and telecoms, water as a social commodity initially persisted with the privatisation process. The total water asset, in the form of desalination plants, surpassed the capital cost of any other sectors. "Terms of negotiation were modified several times as evidence of the Government's undertaking" (interview # 42). Specifically, by de-risking investment within the terms of the agreement, "the Government gave positive terms that it would continue to be a guaranteed client for contracted quantities" (interview #44). A former EWA manager elaborated on this era:

> *"At the beginning of the year 2006, the Government initiated the selling of the Al-Hidd electricity and water production plant to a multinational consortium (of three companies British, Japanese and Belgian) for a total of USD 738.2 million. However, the actual capital cost of the plant was around USD 1250 million in 1999."* (Interview #3)

However, as customers are not paying the real prices for electricity and water, prices continue to be distorted as part of the Government's economic model. As such, Alawadhi argues "if privatisation is made without curtailing subsidies, this will only increases the burden [financially] on the Government" (Alawadhi, 1999, p.107). On current plans and

projections, Bahrain will be able to increase desalination capacity to meet municipal water demands up to 2030, but this will entail heavy financial and economic burdens (Zubari, 2014). Therefore, the continuous pressure to escalate the privatisation process in "a rush for results", coupled with the de-risking of private investment through the positioning of the Government as "a guaranteed client" are critical processes in the transition phase of the water sector. Notably, private sector participation, within the Bahraini context, appears to be contradictory. On the one hand, privatisation is projected to improve efficiency and alleviate the financial burden of the Government. On the other hand, intensive water subsidies and consumption rates result in a significant governmental financial obligation. In an article entitled "The cost of a Municipal Water Supply in Bahrain", Zubari indicated that the desalination bill "between 2013 and 2030 would result in cumulative costs of US $11 billion and consume 15.9 billion m^3 of Bahrain's gas" (Zubari, 2014). Thus, global discourse of "efficiency" and "relief of fiscal burden" are not entirely achieved within the complexity of the water sector (Mehta & Mirosa Canal, 2004)

While the Government celebrate the free or heavily subsidised offering of utilities, things are changing for expats. As recently as 2017, the Government indicated its intention to impose higher tariffs on non-Bahraini residents in order to achieve greater cost recovery in the electricity and water sectors. Critics, including academics and independent consultants, have argued that water intensive behaviours are more apparent in the Bahraini population than in the expat, and therefore not only should the privatisation bill not be borne by expats, but it would also have little effect on the total consumption rate.

Nonetheless, water privatisation should be viewed in-line with the emerging economic reforms that the Government has undertaken[117]. While the State retained the ownership and operation of two existing stations, construction of new stations was assigned to the private sector (Table 6.1). The private sector is assumed to run more efficiently on a for-profit business model. It can more easily implement full-cost recovery pricing, achieving a higher cost recovery, and eliminate the need for subsidies in the water sector (World Bank, 2005). However, the existing administrative and socio-economic realities could

[117] For more details, see Government Decree No. 41 for the year 2002.

hinder any top-down scripted privatisation (Mehta & Mirosa Canal, 2004). Generally speaking, and as outlined by an economic academic at the 12th Gulf Water Conference, the benefit of privatisation is as follows:

> *"There are several reasons for the participation of the private sector, as voiced by proponents: (1) increasing efficiency in water supply and sanitation services, (2) decreasing [unit] cost and optimising cost recovery. The decrease in cost will subsequently reduce tariffs and subsidies. On the one hand, cost recovery would enhance the service, improve maintenance and sustain the service in the long run. Decreasing the Government's burden [subsidies], on the other hand, would free the Government's fiscal resources to be targeted to other core services."* (Interview #92)

Table 6. 1: Desalination Plants in Bahrain

Plants	**Year of Operation**	**Ownership**	**Water Source**	**Production Capacity (MGPD)**
Sitra	1975	Government	Sea Water	25
Ras Abu Jarjur	1984	Government	Brackish GW	16.5
Al-Hidd	1999	Private Sector	Sea Water	90
Alba	2001	Private Sector	Sea Water	9.5
Al-Dur	2012	Private Sector	Sea Water	48

Source: Marzooq et al. (2018)

However, even before the establishment of EWA in late 2007, MoEW was side-lined in the privatisation discussions. As a matter of fact, one official pointed out "All privatisation projects in the Kingdom are run by a single entity in the Finance Ministry" (interview #39). As such, most privatisation projects in Bahrain denote "a top-down approach and a rush for results" (interview #46). While privatisation needed both a healthy regulatory body and individuals trained in issues related to privatisation, it was not until the formation of EWA that water practitioners had a say on privatisation projects as stakeholders.

Currently, the majority of desalinated water is produced privately with little aggregation between the privately-owned plants and those owned by EWA (Table 6.1). While EWA functions as a guaranteed client to the private desalination plants, it holds its plant

function to balance demand during seasonal peak and therefore usually functions under-capacity. This means that a pre-approved, contracted, quantity is supplied into the main grid regardless of demand.

Additionally, among the reasons for the introduction of the private sector are the complications that desalination production brings into the operational arena. Private sector companies were sought to provide solutions for these complications and were given incentives for their endeavours. Therefore, the private sector is then presented as a reliable player in the reduction of desalination complications. Improving efficiency was highlighted as an essential reason for allowing the private sector to participate, as explained by a former EWA official, "the introduction of the private sector in the desalination industry started in 2006 to help facilitate the production phase and achieve higher efficiency" (interview #9). The frequent technical complications that faced multiple desalination plants incentivised this decision. It is recorded that the running costs of desalination plants came down after ownership was transferred from the Government to private companies. A study by a local water resource academic showed that the:

> *"Per unit cost [of desalinated water] considerably dropped when engaged in the private sector. One clear example is seen in the selling of the Al-Hidd desalination plant in 2006, which marked the start of the private sector in the desalination market. Though the selling undercut its value, it provided relief to the financial drain in running it publicly."* (Zubari, 2014).

Overall, desalination can be viewed as a private monopoly of a limited number of providers. Long concession contracts to desalinate water for 20 years, or more, are now part of the water landscape in the Kingdom. All forms of Public-Private Partnership (PPP) are considered with a view to securing more water and electricity, bearing in mind lessons learned so far. Nonetheless, the initial processes that enabled private companies to participate in the Bahraini municipal water sector, for example: 1) a forced top-down agenda 2) a rush for implementation, and 3) the political branding of reforms, still persist. Subsequently, these processes operate, along with self-reinforcing processes, to lock the water sector into a supply-driven orientation. In the next section, I analyse how the changing role of the State facilitates the entrenched position of desalination.

6.4 Hydro-Trap: The Changing Role of the State and an Entrenched Position for Desalination

As discussed in the previous section, the market-led approach to water management has the twin-goal of providing ribbon-cut opportunities for politicians to celebrate reforms, improving efficiency and reliability in water provision through EWA-private sector partnerships. Yet, this EWA-private sector configuration tends to lock institutions into a desal-dependent path. Subsequently, the rearranged water landscape gave shape and context to how the State apparatus dealt with the water question. As expressed by an academic "water has been reimagined as a service that needs to be managed, instead of a source that needs to be protected [sustained]" (interview # 92). The following quotations illustrate, broadly, how different actors engage with the water sector:

> *"His highness the King emphasised that EWA and the private sector should adopt best regional and international practices….[be] held accountable….the current investment and financial climate reinforce the trust in the ability of the Kingdom to sustain a strong economy based on solid foundations."* (Alwasat, April 2012)

> *"By 2017, EWA is a model of excellence in the provision of electricity and water services with minimum disruptions."* (EWA Vision, excerpt from EWA Strategy 2013-2017)

> *"We want to cooperate with Bahrain University to help the students, from the engineering faculty, by providing internships and technological expo opportunities."* (HPC Managing Director, Hadfield, in a visit to Bahrain University in 2006)

> *"Aligning higher education graduates to the demand of the local economy in areas such as desalination, banking and finance."* (Crown Prince, 2017)

Actors, such as system managers, wishing to maintain their control over affairs, may seek increased efficiencies and profits, but do not want new and disruptive policies introduced (Méndez et al., 2019). Other layers, including political regulation and educational institutions, can also come to protect the status quo. They can all co-evolve with the focal system in such a way as to reinforce a particular trajectory and its associated institutional structures. In a sector as vital as the municipal water sector, these political, technological, and institutional forces can serve to "lock-in" otherwise diverse solutions into similar kinds of structural configuration (Pierson, 2000).

This unique set of "hydrocracies"[118], and their views of water and its provision as a service, is the direct consequence of the self-arranging dynamics accompanying reform and transition (Molle & Mollinga, 2009). More importantly, what this means to the municipal water sector and desalination is that, firstly "private desalination plants are one less thing for EWA to worry about" (interview #101). While water resource management, in general terms, can benefit from the participation of the private sector in the supply and production of water, the position of desalination gets further entrenched. Secondly, "the municipal water institutions have transformed from supplying the service to regulating, managing and monitoring it" (interview #96). An observer of the Bahraini urban water landscape will notice that a heterogeneous network of actors emerged, "one powerful enough to assure sufficient support for the realisation and dominance of the desalination option" (Swyngedouw, 2013). While water provision remains the Government's responsibility, sourcing and production has been allocated to other non-governmental players.

As stressed by the above statement from the King, the private sector is expected to maintain the highest quality in servicing the needs of the economy and people. Such scrutiny was not apparently visible when the desalination sector was state-run. Therefore, privatisation appears to be not so much an instrument for improving efficiency, as it does for legitimising ways for the State to transfer the financial and politically charged burden of water management to non-state actors. It is clear, as outlined by a top official that "EWA was happy to delegate desalination production to a third party" (interview #11). Others believe the private sector brings greater accountability, "you can regulate and impose any quality and environmental regulation" (interview #43). In other words, "outsource the problem and reap the fruitful outcomes" (interview #44). What is often overlooked is the role the private sector plays in influencing the expansion of desalination. Players in the private desalination sector present themselves as "the cornerstone of the provision of reliable municipal water supply" (interview #16), or as per the below quotation from a SIEMENS marketing brochure:

[118] The usage of the term "hydrocracy" here refers to water practitioners and technocrats within EWA and private desalination plants, academics involved in water studies, NGOs, and researchers, in addition to other stakeholders interested in water politics and policies.

> *"The system in brief:*
>
> *Al Hidd, Phase III is in many regards a project of superlatives. Phase III is not only the largest plant ever working, according to the MED process, it is also the largest privatization project in Bahrain.*
>
> - *Extension from 30 MIGD to 90 MIGD (408,000 m³/d)*
> - *Multi Effect Distillation (MED) with ten evaporator units*
> - *Operating contract for 20 years"* (SIEMENS Brochure, 2009)

This dynamic of interaction between the private and public water sectors consolidates the water management institutions into a supply-driven and technical path arrangement. Notably, since the private sector functions to facilitate and strengthen the Government's projection of abundance, then it is a best fit. In other words, the private sector functions to solve the production problem for EWA and strengthen the Government's projection of a strong and centralised State that can provide.

As discussed in Section 6.3, prior to the establishment of EWA all privatisation projects originated from an entity within the Ministry of Finance, with limited participation from water practitioners and stakeholders. As such, there emerged a breed of practitioners that were management-savvy and, to some extent, with a limited capacity of technical "know-how". Technical knowledge was, subsequently, entrusted to private operators of desalination plants. Managerial and organisational competencies were preferred in EWA's recruitment strategy, as outlined by a former EWA manager, when he states, "the salary scheme in EWA prefers people with management skills, people with MPA and the like" (interview #117). In contrast, private desalination operators attract most of the technical engineering graduates. Gradually, the technical "know-how" skill set moved towards private desalination operators due to their attractive remuneration packages. The flexibility that was given to EWA to carry out work as a private entity, as per their mandate, made the focus primarily "on regulating supply and demand" (interview #119).

Long-term PPP desalination projects in the water sector that span 20-25 years, coupled with an independent entity (EWA) that is explicitly supply-focused influence how water is perceived and provided. Therefore, entrenchment of particular institutional arrangements necessitates further steps along the same path. In essence, large-scale technical systems, such as desalination plants, are renowned for path dependency

(Pierson, 2000). It is not only their physical structures, with their high sunk costs and material embeddedness that limit future positions for adaptation, also, the institutional arrangements developed over time to manage them reveal a high degree of persistence.

This underscores the relevance of theoretical material concerning the profoundly political nature of the processes of lock-in, path dependency, inertia and momentum (Committee on Advancing Desalination Technology, 2008; Méndez et al., 2019). Understanding these processes helps unpack and explain how an entrenched technological infrastructure may come to influence the political discourse and knowledge environments within which it is appraised. In this regard, the development of desalination infrastructures can easily yield a distinctive kind of positive feedback under which commitments are inherently self-reinforcing (Arthur, 1990), with indefinite implications from which it can look like there is no way to turn back.

I attended a series of workshops in 2017 that were run by AGU in collaboration with UNDP and ESCEW, on Water and Food Securities in the GCC. The workshops were attended and delivered by academics, water officials, affiliates and practitioners, NGOs, and donors. Whilst there were diverse views on water challenges across individual parties, there were also common challenges that every party seemed to agree upon, including those relating to the municipal water sector in Bahrain. Highlighting these challenges here is beneficial to appreciate how the water question is perceived and framed. Reflecting on my participation and fieldwork notes, the problems that are facing the Bahraini municipal water sector can be broadly summarised as follow:

I. *Meeting the escalating water demands under the current rapid growth rates of population and urbanisation and high per capita consumption patterns. The increase in water demand will require the construction of more desalination plants and further exploitation of groundwater.*

II. *The low water efficiency of the municipal water sector on both the supply side and the demand side undermine sustainability in the sector*

III. *The lack of a price-signalling mechanism to influence water use in the majority of the GCC countries is problematic.*

IV. *Moreover, the current high rates of subsidies for municipal water services and consumption result in very low-cost recovery percentages. This creates a heavy*

> *municipal sector financial burden on the fiscal budget and also holds the sector captive to Government allocations, which might impact its performance in some countries.* (Edited excerpt of fieldwork notes, February – April 2017)

Therefore, the large-scale expansion of desalination in Bahrain appears to be "bittersweet". On the one hand, it is there to supply municipal water, of a sufficient quality, to satisfy current and forecasted water demands. On the other hand, the sector as a whole has evolved and become entrapped around desalination. What can be ascertained from the challenges mentioned earlier is that desalination is highly critiqued and does not come without issue. Indeed, there are genuine concerns expressed about Bahrain's continued trajectory on the desalination-path, at least in its dominant form, across all participants. However, these critiques are undermined, usually by the same people who expressed them, with concerns regarding the social, political and institutional setting that constrains the Bahraini case. Accordingly, considering all these challenges and the current interplay between EWA and the private sector, I argue that the current position of desalination, therefore, denotes a hydro-trap.

6.5 Conclusion

In this chapter, the role of path dependence processes in [re]shaping Bahrain's water sector institutions, effectuating a hydro-trap, were examined. As such, the hydro-trap is examined as an interplay between reforms introduced at historical junctures and self-rearranging processes that forge compromises while entrapping institutions into the same path. Critical features of self-rearranging processes were examined: how they usually facilitate "a rush for results" and "enable and brand compromise promptly". Subsequently, the way in which Bahrain's water institutions evolved in response to the expansion of desalination reinforced a greater dependency on it that is difficult to change. Notably, implementation of water reforms in Bahrain has been largely shaped by power struggles between the reformist and conservative camps.

To examine the hydro-trap, I analysed how the water institutions responded to the increased hydro-investment during a critical-juncture, which posed reforms for development. Specifically, I analysed how the Bahraini municipal water sector absorbed "calls for reforms" by rearranging institutions and further maintaining a supply-driven development trajectory. Thus, these responses in the water sector, to a specific path of

development, have reinforced the position and dominance of desalination in the water sector.

At face value, the processes of partnership implemented in the Bahraini water sector were to balance private sector efficiency and public sector enforcement and regulations. However, these management processes were inevitably political, involving competition for power and alliances. Competing actors and camps contested and negotiated the institutional processes and outcomes of reforms in the water sector. The rejection of the desal-dependent path by the reformists was met by the conservative camp reacting to such rejection. Eventually, the outcome was a negotiated compromise of limited change to the system.

Additionally, while reforms, in terms of institutional reshuffle, facilitated the externalisation of blame to other non-government actors within the private sector and, to some extent, EWA, little has been done to address pricing regulations, leakages and NRW improvements. This set of self-rearranging activities has resulted in some improvement of streamlining service provision, yet they may well represent a way to reduce scrutiny in the water sector. Therefore, the hydro-trap can be understood as a co-evolution of complex *institutional and technological factors*, *supported by hydrocracies*, to accommodate reforms and consequently mandate a specific path of development. As such, desalination appears deeply woven into the politics of modernity, fundamentally conditioning modalities for the exercise of power.

Chapter 7: Synthesis and Conclusion

"We learned desalination as we went about it since the 1970s. The knowledge, the technology and the justifications have evolved drastically since we started. Desalination and us (Bahrain and the GCC) will continue to be friends for a while"
Former EWA Manager, (2016)

Throughout history, water megaprojects in drylands have been focused on the ability to find and use water. Most recently, technological advances have significantly increased the ability to find, extract and deliver water (Sternberg, 2015). The extent to which drylands are able to reshape their water environment and resources is highly dependent on both financial capacities and the availability of engineering skills. Due to their relative political stability and financial wealth, GCC countries have endeavoured to desalinate and currently have over half the global capacity (Dawoud & Mulla, 2012). At a local level, desalination in Bahrain was delayed until 1970s due to the persistent perception of water abundance (Section 4.2). As per the above statement, desalination has been a journey in Bahrain, that will continue through. In this research, I explored the Bahraini motivations for embarking on a journey to desalination and evaluated the challenges of this for the country. Notably, the journey is marked by a desire to modernise infrastructure and improve socio-economic activities, similar to other GCC countries.

In the literature, desalination is usually analysed as a means to address a specific managerial concern in a particular geographical context. The singularity of this analysis usually oversimplifies other contributing factors as to why desalination is being favoured (Bremere et al., 2001; Darwish et al., 2014b; Dawoud, 2005). An essential contribution of this thesis is the rejection of the singular, oversimplified and contemporaneous presentation of desalination. Instead, I explored the multiplicity of forms and guises that desalination could emerge through by examining the historical and political context of different desalination adaptation milestones. Additionally, most of the literature on desalination adaptation concedes that water scarcity is usually a primary prerequisite to the desalination proposition. While desalination in Bahrain is currently articulated as *the only option* to overcome water scarcity, I argued that earlier phases of the desalination project in Bahrain were motivated by water abundance and the modernisation mission of the State, which is still under-studied. Hence, contributing to Alatout's argument that

"water abundance is a category in its own right" that should not be relegated as a second-order element in resource politics (2009, p. 363).

On a substantive level, the presented research explored the interplay of technology, politics and discourse on two scales. Firstly, in light of how broader local and regional development trajectories and political climates influence water policies. Regionally within the GCC, the 1970s OPEC oil embargo, Kuwait's war of liberation and political instability during the Arab Spring have had a tremendous influence on how water and food are perceived and provided. Locally within Bahrain, the change of rulers and the prominent rise of Sheikh Hamad in 1999, as the new ruler, has brought a new dynamic to how water resources are viewed, managed and augmented. Secondly, how the entrenched position of desalination, as a large-scale hydro-investment, restricts reforms in water policies and subsequently mandates path-dependency. It is therefore argued, that examining desalination as a sustainable water augmentation strategy is better understood through unpacking the dynamics between politics, policies and locked-in institutions.

This chapter starts by summarising the thesis, synthesising the findings and making concluding comments on Bahrain's journey from abundance to scarcity and desalination (Section 7.1). Next, Sections 7.2 and 7.3 engage with the theoretical and practical contributions of the thesis to better understand the interplay between hydro-politics and large-scale adaptation of desalination. In Section 7.2, I present an interdisciplinary analysis to unpack the diversity of forms through which desalination could emerge, within a particular geographical context, and through different milestones. Then, in Section 7.3, I discuss and highlight the dynamics of path-dependency and water reforms. I end with reflections on the journey of the thesis, potential area for future research, implications on Bahrain and broader contributions to literature on desalination and development debate and practice (Section 7.4).

7.1 From Abundance to Scarcity and Desalination

This thesis is about the interplay of technology, politics and discourse in influencing large-scale desalination adaptation in the Kingdom of Bahrain. It draws on nine months of fieldwork carried out from September 2016 to May 2017 in Bahrain. In this thesis, I have examined the dynamics of adopting large-scale desalination. I have explored the context through which desalination was introduced and followed that with an analysis of

significant milestones in Bahrain's desalination journey. I situated desalination in the broader framework of national and regional politics, within which close correlation has existed between water and food policies since the 1970s. Then, I analysed the water scarcity discourse and its influence in shaping politics and policies around desalination. Subsequently, I examined and investigated how water sector institutions cope and react to increasing reliance on desalination and the consequent dynamics of water reforms.

Contrary to the other GCC countries, and significantly because of limited and plain land terrain, hydraulic works in Bahrain never encompassed large-scale conventional hydraulic activities such as the establishment of dams, reservoirs or aqueducts. This was mainly because of the presence of natural springs that used to support agricultural and social activities. In the early 70s, however, desalination, "our river in the desert" (interview #124), marked the transformation of the domestic water supply system into new frontiers of mega infrastructures that aligned it with the State's hydraulic mission. Needless to say, Bahrain's conventional water resources were under pressure, naturalising the content that related to this causation only served to distance government departments from questioning the root causes of the problem. As discussed in Chapters 5 & 6, externalising the cause of water scarcity to nature absolved the Government (and other powerful actors) from any responsibility and further legitimised its tools, i.e. desalination.

Since 2001, the water sector in Bahrain has undergone a number of reflexive reviews to rationalise operations and expenditure. This follows local criticism of inefficiencies and regional momentum towards building a more comprehensive approach to water issues in the GCC. Locally, increasing fiscal allocation for the water sector was accompanied by calls for greater accountability, which brought some tension between members of parliament and the Ministry, for instance. In 2016, for the first time, domestic water tariffs were revised up. Although only applicable to residents (non-citizens), it is still viewed as a significant step towards demand management. Regionally, as water became more prominent within policy discourse, countries in the region charted a GCC Unified Water Strategy (GCC-UWS), the 2016 plan sets non-binding targets for the member countries to achieve. This triggered, in Bahrain, a review of sectoral master plans and strategies in the water sector. The outcome of the review was the National Unified Water Strategy (NWS) which aims to align local efforts to the GCC-UWS.

These recent events are essential and relevant to the *Third Paradigm*[119] of water resource development currently being experience within the water sector (Section 4.4). As desalination continues to provide over 94% of the domestic water supply, contestation of its dominance is under greater scrutiny. However, as examined in Chapter 6, the institutional transformation that the water sector has undergone to deal with, and as a result of, desalination precludes any meaningful reforms.

Furthermore, the projection of abundance through desalination, achieved through the selection and distortion of information to instil confidence that the economy has not run out of water, is found to be counterproductive (Allan, 2001). It is argued that implementing a technological fix on top of a water management system that is plagued with systemic and structural problems does little to improve long-term water management (McEvoy, 2014). Consequently, in this analysis, I argued that the grounds for the adoption of desalination in Bahrain were greatly influenced by hydro-politics and political aspiration and not merely the natural constraint of water resources (Chapter 4). Moreover, I highlighted that the current connotation of water scarcity that dominates the discourse around desalination denotes a way to naturalise the problem and depoliticise desalination to be the apparent solution (Chapter 5). I continue in the next section to explore the spectrum of justifications and roles that desalination is deployed to satisfy, along a changing water resource management paradigm.

7.2 The Multiplicity of Desal-Fixes

As mentioned earlier, an important part of the scope of this research is to understand the diversity of desal-fixes through a historical analysis of how desalination has dominated water policies. This is achieved by identifying the milestones of expansion that corresponded to wider movements in national and regional hydro-politics. Understanding the diversity of justifications that desalination satisfies is crucial in unpacking relationships between politics and large-scale technological adaptation. Through this historical analysis, this study challenged the current dominant narrative of the natural

[119] First and Second Paradigms of water resource development are discussed in Section 4.2 and 4.3 outlining water policies and project from pre-independence era up until 1999, in Bahrain.

scarcity of conventional water resources. It then emphasised the significant influence of the broader politics of development on the water sector.

Desalination as part of the modernisation project (The hydraulic mission of the state)

As discussed in Chapter 3, Bahrain's transformation necessitated the need for supportive services such as desalination. While these mega infrastructures constitute the hydraulic mission of the state, to control nature and modify the state of water "from salinity to sweetness: limitless supply", it also provides "ribbon-cut opportunities" for the Government to promote its accomplishments (interview #122). The construction of a centralised and robust state was, without a doubt, one of the strongest arguments of the proponents of desalination through the articulation of water scarcity. Although this negates the theoretical and historical perception of water abundance in Bahrain, it was secondary to the realisation of the modern Bahraini State.

Subsequently, a specific discourse and breed of technocrats emerged around policies on strengthening supply-sided management, state-building, and the state's legitimacy (Molle & Mollinga, 2009). As examined through historical records (Chapter 4), the general perception in the 1970s was governed by Bahrain's water abundance, as seen by a massive expansion in agricultural production. Hence, desalination was introduced in Bahrain as part of a modernisation project. Both respondents in domestic and agricultural water sectors attested to a joint consensus in the presentation of desalination to service the municipal water sector. Not only that, there appears some criticism of the delay, citing that Bahrain was the last of the GCC countries to adopt desalination (Zubari et al., 1993). In other words, Bahrain's introduction of desalination can be seen as an attribute of membership to the wealthy GCC club.

Desalination as an innovative fix to 20th-century water challenges

Desalination is usually promoted as an innovative solution that offers certainty to planning, is conflict-free, and independent of climatic variances. Although this depiction is partially accurate, it obscures the complexities and challenges of operation. While desalination is considered a successful method of adaptation in regions of chronic water scarcity, there are other critical security concerns in the desalination sector. This cautious view of desalination was observed in my interaction with practitioners of desalination plants and academics working in the sector. Issues of infrastructure security and water

intake safety are challenges and daily concerns of desalination plant operators. As the Gulf water is a semi-enclosed body, any chemical or nuclear pollution would severely impact plants and water production. As such, the ostensible certainty that is promoted by certain desalination stakeholders, such as politicians and EWA managers, is a continuous daily struggle for the operators and practitioners of desalination plants.

Additionally, desalination is far from being free of constraints and consequences. Desalination plants are capital-cost projects with massive energy and capital commitments throughout their life span. Institutional and technological complexities associated with desalination skew and reconfigure the conventional water sector, which is usually burdened by the increase in hydro-investment. In Chapter 6, I examined enactive and performative practices that the State employs to manage the increasing hydro-investment. Specifically, I identified the self-rearranging processes that stabilised the claims for radical, transformative and sustainable reforms that Bahrain experienced after 1999.

Desalination as a fix to water scarcity

While the emergence of desalination could be labelled, in Bahrain, as *a mere fever*, the status-quo tells a different story. A new paradigm of water development emerged, with desalination very much embedded in the Bahraini water landscape. In fact, desalination is promoted as the *only option* to overcome water scarcity. In Chapter 5, I examined the interplay between water scarcity discourse and desalination more closely. I identified the narratives, actors and coalitions that facilitated the framing of desalination as the *only option* for the Government to pursue to overcome water scarcity and safeguard socio-economic development. The analysis showed that water scarcity is presented as a natural phenomenon to, on the one hand, normalise the tension between different actors and various interests and, on the other hand, to ensure the continuity of business as usual (BAU). Additionally, in the process of naturalising scarcity, I examined how issues of resource allocations and market forces are at the core of understanding water scarcity beyond conceptualising it as a natural phenomenon (Mehta, 2000; Mehta et al., 1999; Sen, 1998).

Furthermore, the use of desalinated water as a base flow increases the reliability of the water supply system (Feitelson & Rosenthal, 2012). Desalination is promoted as

independent and reliable in comparison to fluctuating rainfall and deteriorating springs and groundwater. This contrast of what desalination can offer compared to conventional water resources obscures other dimensions of water scarcity that are socially and politically constructed. Other aspects of water scarcity such as unsustainable domestic consumption, water leakage and exploitation of groundwater resources are viewed as justified due to the Government's vision of modernity and projecting abundance.

Drawing on the above insights, I argued that the mobilisation of desalination in Bahrain denotes a political fix primarily to facilitate the evolution of sanctioned discourse and maintain the Government's political vision (BAU). Thus, I view the provision of water through desalination as distorted water security, to use Allan (2001), Cohen (2000) and Xenos (1989) articulation. I am using it here to highlight the fact that water provision through desalination is capital and technology-intensive and therefore not produced without extensive effort. Hence, as unique as the Bahraini experience with desalination is, it still resembles a traditional hydro-politics case, contestation of water resource distribution and allocation of different waters for different users. Yet, this experience also reflects the significant dominance of desalination as a viable water resource strategy that is unquestionably here to stay and thus constitutes a hydro trap.

7.3 Desalination is Here to Stay: The Vicious Cycle of Path-Dependency in Large-Scale Hydro-Investment

One of the objectives of this thesis is to explore the desalination hydro trap. Specifically, to understand how desalination has been used to sustain sanctioned government discourse on a distorted projection of abundance, and the implications of this for water institutions and decision making. As discussed in Chapter 6, path dependent processes significantly influence the entrenched position of desalination in the Bahraini municipal water sector. They can also be described as self-reinforcing or positive feedback processes that side-line alternatives (Pierson, 2000). In short, the more intense the general desalination commitments, the higher the apparent overall suppressive effect on other management options such as leakage mitigation, demand management and renewable uptake.

Hence, when large-scale hydro-investment is coupled with a sanctioned discourse on the threat of water scarcity and the need to overcome it, policies become restricted. When this happens, any policy reform outcome rarely deviates from *a trodden trail* that has

been tested and is proven to deliver (Ebbinghaus, 2009). As examined in Chapter 6, the reformist camp's rejection of the overreliance on desalination faced a counter-reaction in the conservative camp. The contention between the two camps resulted in addressing symptoms such as deficiency in operation and inefficiency in production, resulting in the establishment of EWA and a preference for privatisation. However, the entrenched position of desalination and the influence of established stakeholder interests made any water reforms very limited. Not only does desalination continue to dominate the domestic water supply, but the private sector has also been incentivised by the Government to become a guaranteed client. As such, the position of desalination is reinforced.

Finally, this thesis found that although desalination presents as a unique water management option that offers a seemingly unlimited and steady supply of quality water, there are trickle-down effects that desalination, in its current form, has on enabling unsustainable social, economic and institutional transformations. As such, in this thesis, I contributed to a better understanding of the dynamics of adopting large-scale desalination as a water augmentation strategy in Bahrain. While some have aligned desalination with the mythical God of freshwater, *Enki,* cited in the *Epic of Gilgamesh*, others view desalination as a "glowing promise that continues to fade" (interview #13).

7.4 Reflections, Implications and Broader Contributions

Reflections and Areas for Future Research

When I first started this PhD, I wanted to accomplish a comparative study of the desalination experiences of two GCC countries. Whilst this is ambitious, I still believe that a second country could provide an insightful comparative analysis of the Bahraini case. A study of the Kingdom of Saudi Arabia or the United Arab Emirates would give an extreme example of desalination investment, with each having a long tradition of actively promoting modernisation projects. The findings of this research could benefit significantly by relating to another context, which would improve our understanding of regional factors, partnership, and the implications of micro-policy. Yet, I have found great satisfaction in what I have achieved. My supervisors' advice to situate my analysis along historical trends provided the comparative context that I wanted. While my Yemeni passport restricted my ability to obtain visas to enter other GCC countries, in hindsight, this restriction in freedom might have helped to deepen the focus of my work.

An extended research placement would have helped to navigate cross-sectionality and access to a more diverse social demographic (see Section 2.6). While Bahrain is still considered an authoritarian state, of which it is taboo for the public to criticise or even voice concerns freely, I found that the time and effort needed to establish relationships worked very well in enabling access to information. Challenges in approaching expats, women, and government workers continued throughout my research placement and was only facilitated through my established contacts within AGU (gatekeepers). I acknowledge that due to budget constraints and fieldwork schedules, the study's content was limited. Hence, the research findings could be further enriched by multiple rounds of interactions to analyse the interest, perception, and position of a broader interview sample.

Finally, this research has only focused on one particular interplay of technology, politics and discourse and its role in influencing the expansion of desalination in Bahrain. Other aspects and interplays, such as socio-ecological or economic power relations, are also important to broaden our understanding of the role of techno-infrastructure in human wellbeing. Additionally, while desalination is proposed as an innovative solution to issues with transboundary water resources, regional dimensions remains a strong factor in the selection of technology and cooperation. Hence, examining regional policy processes of social, political and economic drivers of water governance would shed light on similarities, differences and water cooperation. Furthermore, it is important to acknowledge that desalinating the Gulf water is likely to intensify the water-energy nexus. While some research has addressed this interdependency, what this means to the environment is still under-researched. Since desalination relies on fossil fuel energy, the interlinkages between water-energy-climate is, by extension, intensified with the increasing reliance on desalination.

Implications on Bahraini Water Security and Sustainability

The conversion of the Gulf water into potable water represents a profound shift in the interplay between state-water-people and their relationship with nature. The shift symbolises the human endeavour to tap into a seemingly limitless supply that is independent of resource scarcity, drought and other climatic variances. However, the new limitless supply also requires an institutional, managerial and technological shift. The transition is radical, mobilising new knowledge and engaging a different set of social and

economic factors. As a result, water becomes manufactured. The challenge arises when desalination becomes the main supply of domestic water, shrinking the intellectual horizon of conventional water resource management options and necessitating path dependency. Subsequently, the position of desalination is reinforced through tailored water policies that curtail alternatives.

For Bahrain to aspire to a broadened view of water security (beyond the provision of water), desalination will need to become part of a diverse management agenda that addresses both aspects of supply and demand. This need stems from Bahrain's socio-economic complexities; public anticipation; and the aspiration of the ruler to modernise services. Hence, alternatives (soft paths) are imperative, for a sustainable water sector, as a complementary set of institutional and demand management policy tools.

Broader Contributions to the Desalination Literature and Development Debate and Practice

This thesis engaged with broader debates around the use of the water scarcity narrative to chart fixated pathways to large-scale hydro-infrastructure through the case of desalination. In particular, how scarcity is used as a totalising discourse that is powerful in influencing politics of development (cf. Mehta et al., 2019). While dealing with water scarcity is at the top of the development agenda in dryland GCC countries, the expansion in large-scale desalination schemes does not yet provide clear answers as to how the claimed water scarcity has been overcome. Yet, these schemes proceed as national expressions of power and capacity, and to promote development, social stability and economic growth. Therefore, this thesis argues that while desalination infrastructures proceed to provide short-term solutions, satisfy current demand and offer political expediency, they are very efficacious in projecting a sense of water abundance while continuing to perpetuate other scarcities. Hence, large-scale expansion in desalination obscures issues of sustainability and undermines institutional capacity to consider pathways for water resource development.

Additionally, this thesis contributes to the growing debate on the global diffusion of large-scale desalination schemes, by politicising and situating their trajectory within broader regional and national contexts. Instead of focusing only on the contemporary presentation of desalination, I argue that the historical and political context of various milestones in

any desalination journey will have motives that are central to understanding its position and are thus worthy of investigation.

Moreover, this thesis also contributes to sustainability theory and development practice through examining the lock-in dynamics of capital intensive infrastructure. The failure of the water sector to consider alternatives beyond desalination undermines the potential for reforms in the sector and its sustainability. This thesis critically examines the underpinning processes of path dependency and the enmeshed political contestation over water resources. In doing so, this thesis highlights how efforts to comprehensively overhaul the water sector fade away against the established promise of water abundance through desalination. Consequently, this study calls for a diverse water development policy that opens up a more pragmatic approach to addressing water issues, beyond the singular techno-managerial solution. The approach should consider other soft-path infrastructural investments to enhance the flexibility of the sector, such as, fixing leaks, re-investing in deteriorating infrastructure, installing water meters, incentivising the installation of water-saving devices and promoting water conservation.

To summarise, the assemblage of a scarcity discourse with a hard approach to water resource management has significant repercussions. This simplistic and narrowly defined rhetoric forgoes socio-material connections and political contingencies of water, infrastructure and their control. Yet, it circumvents nationally difficult political decisions and masks how water resources are misused (Feitelson, 2018; Sternberg, 2015). A critically important aspect of posing water scarcity as a threat and desalination as a solution is the suppression of alternatives and the closing-down of pathways that could have been pursued. These alternatives, as noted earlier, are side-tracked due to the unique articulation of the problem (water scarcity) and the scale and promise of water abundance through desalination. Nonetheless, recent movements to prepare a National Water Strategy (NWS) can be seen as a ray of light to comprehensively address Bahraini water security and sustainability.

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Appendix I: List of Archives Materials

Year	Author/Department	Original Title	Type	Pages	Language
1921-1926	British Political Agent, Bahrain Ruler	Bahrain: Initial assessment of increasing water shortages, search for new ground-water sources, and boring operations, especially those undertaken by Eastern and General Syndicate,	Correspondence	60	English / Arabic
1924	Sir. Dr. Arnold Heim	Preliminary Geology Report: Question of Poring for Water on Eastern Islands (BRN-001-045)	Consultancy report	13	English
1953	British Political Agent	Assessment of shrinking water table at Bahrain	Correspondence	6	English
1953	BAPCO, Dr. Godfrey	Artesian Well Survey (BRN-001-050)	Consultancy report	22	English
1992	Bahrain Centre for Studies and Research	Proposal for studying the role of reducing water tariffs on consumption (BRN-001-003)	Consultancy report	16	Arabic
1997	Ministry of Works and Agriculture	Alternative Fodder Crops Agriculture (Jaat)	Government Report	11	Arabic
1971-2000	Ruler-Government	Laws, regulations, royal decrees and ministerial orders	Laws	38	Arabic
2000	Ministry of Works	National Report on the Implementation of the Unified Nation Convention to Combat Desertification	Government Report	33	English
2005	Ministry of Municipalities and Agriculture	Water Use and Management in Bahrain: An Overview	Country Paper	25	English
2005	EWA	Water Stats	Brochure	13	English / Arabic

2006	MoEW	Electricity and Water 15 year Master Plan: 2006-2020	Executive Summary	45	English
2006	MoEW	Electricity and water 15 years master plan: 2006-2020	Volume 1, master plan Basis	94	English
2006	MoEW	Electricity and water 15 years master plan: 2006-2020	Volume 2, New power and water plants	118	English
2006	MoEW	Electricity and water 15 years master plan: 2006-2020	Volume 3, new water transmission	195	English
2006	MoEW	Electricity and water 15 years master plan: 2006-2020	Volume 4, new electricity transmission	188	English
2006	MoEW	Electricity and water 15 years master plan: 2006-2020	Volume 5, costing and cash flow	38	English
2006	MoEW	Electricity and water 15 years master plan: 2006-2020	Volume 6A, Water Treatment Study Report	69	English
2006	MoEW	Electricity and water 15 years master plan: 2006-2020	Volume 6B, Environmental Impact Study	62	English
2006	MoEW	Electricity and water 15 years master plan: 2006-2020	Volume 6C, Telecommunication study	114	English
2006	MoEW	Electricity and water 15 years master plan: 2006-2020	Volume 7, Preliminary studies report	285	English

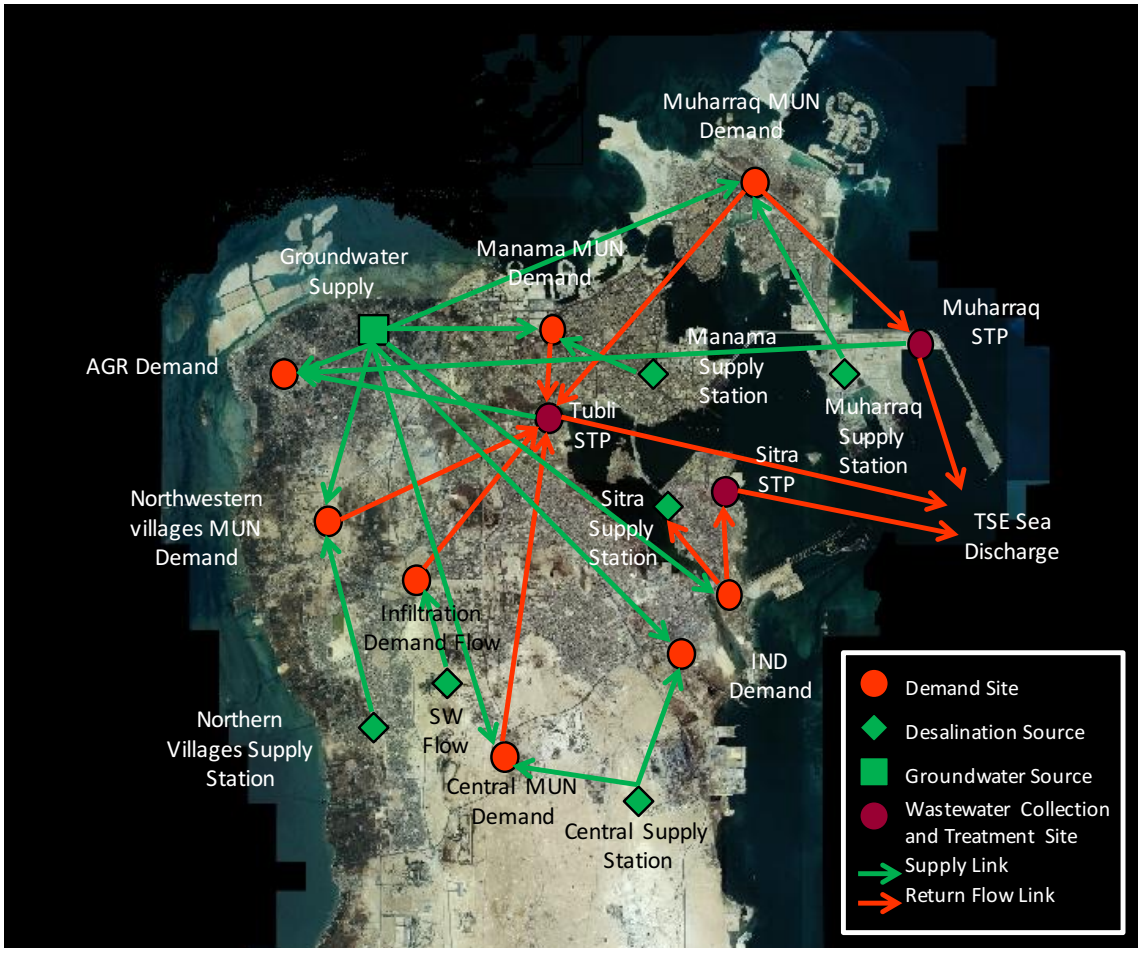
2008	Ministry of Municipalities and Agriculture	National Strategy for Water Resources Management: 2009-2014	Strategy	37	Arabic
2010	Ministry of Municipalities and Agriculture	National Strategy for Sustainable Agricultural Development in the Kingdom of Bahrain	Strategy	9	Arabic
2010	Ministry of Municipalities and Agriculture	Strategic Plan for the Ministry of Municipalities and Agriculture: 2011-2016	Strategy	25	Arabic
2011	EWA, Almasri	Water Uses in the Kingdom of Bahrain	Consultancy report	132	Arabic
2011	EWA, Almasri	Water Balance: Evaluation of water consumption patterns	Consultancy report	207	Arabic
2011	EWA, Almasri	Identifying water issues: The current and the projected	Consultancy report	150	Arabic
2011	EWA, Almasri	Improvement in water transmission and distribution in the Kingdom of Bahrain	Consultancy report	98	Arabic
2011	EWA, Almasri	Evaluating water resources: The current and the projected	Consultancy report	151	Arabic
2012	EWA, Almasri and Almurbati	Performance assessment of potable water desalination plants in the Kingdom of Bahrain	Consultancy report	64	English
2012	Metrological Directorate	Precipitation, Daily Total	Row Data		English
2012	Metrological Directorate	Temperature: Daily Mean derived from hourly temps	Row Data		English
2012	EWA	TOR for consultancy services for new master plan: 2015-2030	TOR	20	English

2013	EWA	Strategy Management Framework: EWA Strategy 2013-2017	Strategy	34	English
	EWA	Brief Description of Power Generation and Water	Brochure	42	Arabic
	GDC	Umm Er Radhuma Study: Bahrain Assignment, Vol 3	Consultancy report	312	English
	Ministry of Works	National master plan for sanitation engineering services, state of treated sewage effluent system and treated sewage effluent infrastructure- future scenarios	Master plan, Chapter 11-12	116	English
	Ministry of Municipalities, Agriculture	Utilisation of treated wastewater in irrigation, in the Kingdom of Bahrain	Government Report	14	Arabic
	Ministry of Municipalities, Agriculture	Water Resources in the Kingdom of Bahrain	Government Report	22	Arabic
1969	Geoffrey Bibby	Looking for Dilmun			English
1996	Charles Belgrave	Personal Column, A History of Bahrain (1926-1957)	Biography		English
1992	Peter Vine	Bahrain National Museum			English
1986	Shaikha Haya Ali Al Khalifa & Michael Rice	Bahrain through the Ages: The Archaeology			English
2008	Prime Minister Office	Vision 2030	Government Report	26	English

Appendix II: Profile of Respondents

Group of Respondents (Association Name)	Number
Electricity and Water Authority	16
Ministry of Works, Municipalities and Urban Planning	12
Ministry of Housing	6
Ministry of Industry, Commerce and Tourism	4
Water Resources Council	8
Water Science & Technology Association	6
Jawalat Al-Malekhia (NGO)	4
Bahrain Women Association-Environmental Citizenship Program (NGO)	10
Supreme Council for Environment	4
National Assembly (elected Parliament and appointed consultative Councils)	4
Donors (UNEP, UNDP, ESCWA)	7
Schools and Mosques	10
Academics	12
Water Practitioners	18
Historians	5
Citizen Groups	8
Media	5
Gulf Water Conference	5

Appendix III: Map Showing Location of Desalination Plants in Bahrain



Source: (Al-Aghbari & Al-Zubari, 2016)

Appendix IV: List of Stakeholders and their Contexts

NO.	Actors	Context
1	Ministry of Electricity and Water Affairs (ME&W)	Municipal Water Supply, desalination
2	Electricity and Water Authority (EWA)	Municipal Water Supply, desalination
3	Ministry of Works, Municipalities and Urban Planning (MWMUP)	Agriculture, wastewater, reuse
4	Ministry of Housing (MH)	Urban Supply
5	Ministry of Industry, Commerce and Tourism (MICT)	Commercial and Industrial Supply
6	Water Resources Council	Deputy Prime Minister Office, Member Ministries, Resources, Technical Advisory Committee (TAC)
7	Water Science & Technology Association (WSTA)	Regional NGO
8	Jawalat Al-Malekhia	Local Environment NGO, Consumer Protection
9	Bahrain Women Association-Environmental Citizenship Program (NGO)	Local Environment NGO,
10	Supreme Council for Environment	GHG, Air Pollution
11	National Assembly (elected Parliament and appointed consultative Councils)	Legislative
12	Donors (GCC marshal plan for Bahrain and Oman, Islamic Development Bank, Arab Fund for Economic and Social Development, Kuwait Fund, UNEP, UNDP)	KSA+GCC=Marshal Plan ($10B)
13	Private sector (Alba, BAPCO)	
14	Schools and Mosques	
15	Academics, water practitioners, historians	
16	Media	Alwasat, Gulf Daily News,
17	Citizen Groups	Youth, women, Sunnah, Shi'a

Appendix V: List of Events Attended

Event title	**Date**	**Convening Institution**	**Type of Event**	**Type of Engagement**
Integrated Water Resource Management (IWRM) Graduate Diploma	September 2016-May 2017	AGU	Graduate Diploma Course	Student
Water and Food Security in the GCC, Past, Present and Future Directions	October 2016	AGU	Seminar	Attendee
WSTA 12th Gulf Water Conference	March 2017	WSTA	Conference	Organiser and speaker
National Unified Water Strategy workshop	November 2017-April 2018	AGU/WSTA	Workshop	Organiser and observer
Heritage Festival 2017, Springs' Tales	April 2017	Bahrain authority for culture & antiquities	Heritage exhibition at Bahrain Castle	Visitor

Appendix VI: Confirmation of Fieldwork Placement

Arabian Gulf University
DEANSHIP OF STUDENT AFFAIRS
OFFICE OF THE DEAN

جامعة الخليج العربي
عمادة شئون الطلبة
مكتب العميد

2016/12/ 12

إلى من يهمه الأمر،،،

نفيدكم علماً بأن السيد أحمد عبدالرزاق الأغبري هو باحث زائر في كلية الدراسات العليا في قسم الموارد الطبيعية والبيئة بجامعة الخليج العربي، في الفترة من أكتوبر 2016 ولغاية شهر يونيه 2017.

ولقد أعطيت له هذه الشهادة بناءاً على طلبه.

د. عبدالرحمن يوسف إسماعيل
عميد شئون الطلبة

P.O. BOX: 26671 - KINGDOM OF BAHRAIN - TEL.: 17239999 - FAX: 17239805 ١٧٢٣٩٨٠٥ ، فاكس : ١٧٢٣٩٩٩٩ ، تليفون : مملكة البحرين ، ٢٦٦٧١ ص . ب :

Appendix VII: List of Famous Submarine Springs

1. Shawsheb Saleh
2. Aum Alsawali
3. Shawsheb Karia
4. Aum Aljarajeer
5. Ain Aljasr
6. Ain Jurdi
7. Abu Maher
8. Shawsheb Mameer
9. Ain Sharbia
10. Aleyadi
11. Shawsheb Alker
12. Halat Sitra
13. Khourfesht
14. Ain Shamal Sitra
15. Bukalem
16. Alsaiah
17. Alfouarh
18. Shawariba Sofli
19. Awaida
20. Ain Mudrasah Arad
21. Shawsheb Samaheej
22. Ain Qualat Arad
23. Shawsheb Khasifah
24. Shawsheb Reya

Source: Agricultural Affairs Directorate, Bahrain