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Prospects of environmental governance in addressing sustainability challenges of seawater desalination industry in the Arabian Gulf

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ABSTRACT

The hyper-arid climate of the Arabian Gulf makes it an excessively water-deficient region. Ironically, the Gulf States count among the few places with the highest per capita water consumption and low tariff. Since a few decades ago, seawater desalination has been the most reliable source of portable water in the Gulf. Recently, many critical scholars raise concerns about the rising levels of brine discharge, effects of water intake and outfall systems infrastructure, plants' high energy consumption and fragmented regulatory and policy frameworks. In this study, we explore the potentials of environmental governance in addressing sustainability risks of seawater desalination projects. The DPSIR model and the Earth system governance framework guided and supported our analysis of several multidimensional issues that underlie the characteristics of this industry. Thus, we identified 29 cause and effect factors as well as nine environmental governance intervention strategies. The study suggests that the industry's network of stakeholders can develop good ideas for fostering sustainability by using innovative tools such as hackathon—an interdisciplinary, participatory, solution-oriented, and consensus building platform. Finally, this study enjoins policymakers, businesses, and scientists to embrace more transparent, practical and holistic ideas in designing, executing and assessing technological innovations and interventions in national and regional water security initiatives.

1. Introduction

The chronic freshwater shortage around the world deprives over two billion people of the fundamental right to portable water (Axworthy and Sandford, 2012). Obviously, this figure sounds alarming as it implies that a huge proportion of the human population is lacking in this essential commodity. This problem is exacerbated by the increasing population, the changing climate, urbanisation, industrialisation, and agricultural uses. In this regard, Bogardi et al. (2012) identified some of the needed actions for securing scarce water to include protection of ecosystems, and better governance of water use and distribution. In other words, water governance is a critical means of intervention particularly in dryland regions that persistently cope with multiple problems of water

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insecurity. Naturally, the geography of dryland areas such as the Gulf exposes them to critical water shortage. The Ackerman (1969)'s typology of global population-resource-technology regions designates the Gulf region as *Arctic-Desert type*. According to this classification, a technology-deficient region is characterised by a very low population and poor technology. The Gulf region has high water debts (amount of groundwater withdrawal higher than natural inflow) while its absolute water scarcity value was estimated at $<500\ m^3$/capita/year (Eales and Clifford, 2013). This situation makes the Arabian Gulf to rank among the world's regions with the poorest water per capita as well as the highest per capita cost of water supply (Alsharhan et al., 2001). Ironically, water consumption in the region is one of the highest in the world. According to the statistics of the World Bank (2005), the Gulf States have average daily water consumption per capita that ranges between 300 and 750 l. This does not compare with the average daily water consumption of 580 l for the United States or 90 l for China (Chellaney, 2011). Both countries have sizable drylands that experience water shortage. Water is a highly subsidised commodity in the Gulf to the extent that in some of these countries consumers pay less than five percent of water production cost (Ouda, 2013).

The paradox of water overuse in a region identified with perennial water scarcity is largely due to the huge financial resources that governments are investing in water production through seawater desalination plants. Seawater desalination technology was introduced to the Gulf region in 1950s, and since then, it remains the most reliable alternative source of water (Alsharhan et al., 2001). The total capacity of desalination plants in the GCC member states is estimated at more than 11 million cubic metres per day or about 45% of the global total desalinated water production (Latteman and Hopner, 2008). More recently, new figures estimated the total capacity of the Gulf desalination plants at five billion cubic metres per year (Dawoud and Al Mulla, 2012). The sheer size of the volume of water produced by these plants may create an impression that there are strong institutional and policy frameworks. Indeed, there are many such bodies and regulations; however, inter-agency overlaps and fragmentation hinder their efficacy to address a number of sustainability issues. It is not surprising that the UN World Water Assessment Programme (2014) concludes that poor coordination of water and energy sectors in the Arab region hinders the promising sustainability innovations in the regional desalination industry. Other governance related gaps in the region include wrong decision making and planning in respect of suitable locations for desalination plants and lack of good monitoring system (Merwe et al., 2013; Grubert et al., 2014).

The problem of the Gulf desalination industry is complicated by lack of regional integrated approach to this challenge. All the states in this region use the Gulf waters for desalination. Some countries have functional regional initiatives such as the EU's Water Framework Directive which aims at maintaining quantitative and qualitative status of water bodies with the region (Borja et al., 2006). Similarly, there are a few international initiatives that offer templates for developing integrated water resource management at local and regional levels. A good example of this is the Dublin Principles which underscores the need for countries to adapt integrated water management approach (United Nations, 1992). The first, second and third principles are particularly important in the context of this research because they underline the need to recognise water resources vulnerability, conservation, and the role of planning and policy. Importantly, the Dublin principles share the visions of water resource governance principles enshrined in the water related aspects of the MDGs/SDGs.

The Gulf Region provides an interesting case on the dire need for water resource governance. More importantly, the future of the region's rapid urbanisation and economic growth depend heavily on the desalinated water. Unlike the conventional water resources development technologies, desalination plants depend significantly on sea and brackish waters which they contaminate in a number of ways. For instance, the tear and wear of the desalination plants through corrosion of condenser tubes and direct discharge of concentrates all threaten the Gulf waters (El-Dahshan, 2001; Merwe et al., 2013). As a result, there are calls for inclusion of innovative procedures that can effectively address the sustainability challenges of the seawater desalination plants (Lattemann and Amy, 2013). Apart from the desalination industry pollution, the oil industry and a number of coastal cities around the Gulf marine ecosystems underlie the reason why fragmented management is unacceptable (Trevors and Weiler, 2013). At present time, there is no pragmatic and integrated governance framework that comprehensively addresses the sustainability crisis of this industry.

The advocacy for an integrated approach for managing water resources has increased in recent years (World Bank, 2005; Khan, 2008; UNEP, 2012). An integrated approach to the management of water resources on its own may not suffice without anchoring it to the concept of environmental governance. Parkes et al. (2010) suggested that governance of water resources fosters sustainability within socio-ecological prism. The term governance according to Biermann (2013) may refer to ''decentralised policies, non-hierarchical decision-making, and the involvement of both public and private actors'' for the purpose of steering a society towards sustainability. He added that social scientists are not comfortable with notions like environmental policy because it does not adequately address human interactions with planetary system, just as the term environmental management connotes technocratic, top-down and centralised management. As an alternative to the traditional management concept, the new paradigm of the Earth system governance underscores the need for engaging formal and informal rules, rules making systems, holistic approach, conflict resolution, transparent decision making, and collaboration with all stakeholders in order to achieve efficient, legitimate and equitable transitions to sustainability (Biermann, 2012; Carvalho and Fidélis, 2013; Schroeder, 2014).

The present study seeks to identify environmental governance strategies that can effectively transform the Gulf region's seawater desalination projects towards sustainability. The study draws heavily from the Earth system governance paradigm and other environmental policy frameworks because of their promising potentials of embracing wider socio-ecological perspectives. Findings of this study can potentially help in understanding gaps in policy and institutional frameworks associated with water crises and technology