

Lebanon

Impact of Climate Change on Water Resources of Lebanon: The Way Forward

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1 Introduction

Global warming is expected to affect Lebanon heavily, in particular through increased flooding and creation of desert areas as the country is located near desert regions (El-Fadel, Jamali and Khorbotly 2002). The country is expected to witness a decrease in precipitation and an increase in surface temperature because of global warming (Sowers, Vengosh, and Weinthal 2011). According to Lebanon's Second National Communication (SNC):

By 2040 temperatures will increase by around 1 °C on the coast to 2 °C in the interior, and by 2090 they will be 3.5 °C to 5 °C higher than the present temperature averages. Rainfall is also projected to decrease by 10–20 % by 2040 and by 25–45 % by the 2090, compared to the present. Temperature and precipitation extremes will also intensify. Over the whole country, periods of drought will become 9 days longer by 2040 and 18 days longer by 2090 (Trærup & Stephan 2015, p. 438).

In this context, the interplay between water resources and climate change in Lebanon has been widely debated in recent decades where the main focus is on strengthening the adaptability of water management systems. Climate change poses serious problems when it comes to this adaptability as the global hydrological cycle will be affected by the increase in the temperature (Bou-Zeid and El-Fadel 2002).

2 Impact of Climate Change on Water Resources

According to some experts, Lebanon—a country considered to be part of the Fertile Crescent—may lose this fertility in the near future because of the deterioration of the water supply from the rivers (Göll 2017) despite the fact that it has a milder and wetter climate in comparison to other states in the region (Droogers et al., 2012). Lebanon is experiencing increasing water demands given the steady population growth. This reality has affected the economic development of the country forcing authorities to take measures to ensure more efficient water management practices

(Aulong, Bouzit, and Dörfliger 2009). In fact, Lebanon is already experiencing water scarcity in the summer because of “very low water storage capacity, correlated with the old deteriorated infrastructure and limited water storage systems, such as dams and water collection pools” (Khatib, Moukadam, El-Hajj, and Jawhary 2015, p 3). The state is also experiencing numerous difficulties in the management of the water sector given the civil war that ended in 1990 which affected the governance practices of the government (Bou-Zeid and El-Fadel 2002).

Climate change adds more stress to the water resources of the country which are already under stress as a result of other factors mainly “growing population, rapid urbanization, economic growth, mismanagement of water, pollution, and ineffective water governance” (Farajalla, Kerkezian et al. 2015, p. 8). It has been stated that climate change would lead to a decrease in the water resources of the country (Karam and Sarraf 2011) because of changes in runoff patterns and evapotranspiration (Gregoire 2012), affecting many sectors such as agriculture that will suffer due to decreased water availability (Trærup and Stephan 2015). It is expected that water demand will increase while water availability decreases causing pressure on the water supply and affecting water quality. The increasing need for water resources will lead to further exploitation of aquifers already highly exhausted. Seawater is expected to further affect the aquifers located near the coast due to saltwater intrusion (SNC 2011). The impact of climate change can be summarized in the following manner:

- *Water demand and consumption per sector would increase with increasing temperatures;*
- *Renewable water resources available per capita would decrease with declining precipitation;*
- *The average water deficit and unmet demand (in the form of rationing) would consequently increase;*
- *Salinity of groundwater would increase due to lower recharge rates of aquifers coupled with potentially higher rates of abstraction, in addition to rising sea level that is projected to reach 12 to 25 cm by 2030 and 22 to 45 cm by 2050 (SNC 2011, p. 1-42).*

3 The Way Forward

Lebanon is looking to minimize its significant water loss by increasing water availability through artificial recharge. The country is also looking to improve wastewater collection and treatment to be used principally for sanitation purposes. The government is seeking to invest in a water resource network to reduce water loss and install water meters (Shah, Wirkus, and Swatuk 2018). The authorities are focusing on making structural adaptation plans including the creation of new water structures (Karam and Sarraf 2011) by making investments to secure future water supplies by building dams, reservoirs and using new catchment technologies (Sowers, Vengosh, and Weinthal 2011). The country has also adopted nonstructural adaptation plans that comprise different legal and political measures (Karam and Sarraf 2011). The government has started looking for adaptation technologies to protect the water and agricultural sectors. These technologies include “efficient irrigation systems, early warning systems for water supply management through

snowpack monitoring, and the use of treated wastewater in irrigation” (Trærup and Stephan 2015, p. 443).

Despite the acknowledgement of the existing problem and the promising measures taken by the government, this matter cannot be solved simply by adopting such measures. To tackle the impact of climate change on water resources, the country has first to solve many other issues. Indeed, there is a need to ensure the enforcement and implementation of water laws in the country which are lacking due to many factors including the poor coordination between the ministries, the political situation of the country, the lack of financial and human resources at existing water institutions. Moreover, it has been noticed that the roles and responsibilities of the existing institutions overlap, while the lack of reliable water service provision leads to an increase in the number of illegal wells despite the existence of laws and procedures to obtain permits from the state. Additionally, unlicensed water suppliers also cause a problem as they over-extract water given the financial incentives for doing so. What is more, water data and information are lacking in the country because of the civil war that ended in 1990; many data sources are considered a matter of national security and hence not disclosed to the public. These many issues cannot be dealt with if the budgetary constraints of the government, which is under great debt, are not solved. Furthermore, qualified personnel and competent contractors are needed to establish water infrastructure and avoid the inequitable distribution of water resources (Farajalla et al. 2015).

4 Final Remarks

Climate change poses a real threat to the water resources of Lebanon which are already under increasing stress because of bad governance practices, civil war and lack of awareness of the importance of these resources. The country is also suffering from numerous issues that also affect the ways through which the government can take concrete measures to adapt the water sector to the impact of climate change. Tackling this issue requires a holistic approach through which other problems and factors previously mentioned are also taken into consideration. Implementation of best practices for tackling the impact of climate change on the water resources of the country is required to solve the problems that hinder the effectiveness of the authorities and public administration in dealing with this issue.

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