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## **Water Scarcity In Lebanon: The Edge Of Collapse**

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# Water Scarcity In Lebanon: The Edge Of Collapse

Gregory Yared

## **Abstract**

This paper discusses the history and future of water in the Republic Of Lebanon, giving general attention to the future of water and agriculture in the Middle East. Chapter One will use several sources to examine a broad section of quantitative data covering water scarcity. Additionally, this chapter will use annual United Nations agriculture reports highlighting the growing risk posed by inadequate agricultural development mixed with water scarcity. These sources will be used to examine both the historical issues surrounding agriculture and the current problems faced. Chapter Two focuses on the history of agriculture and water use in the region in addition to the future possibility of food security. Chapter Three explores the need for novel environmental policies on the part of the government and other stakeholders to address the issue of exploitative and damaging politics. Chapter Four concentrates on efficient design concepts around water use and irrigation. This chapter will also focus on the lack of policy targeted at renewable water collection practices. Chapter Five focuses on tying together the relationship between past failures and the possibility of future regenerative water systems.

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## **Introduction**

Further instability caused by climate change within an already fractured Middle East will only worsen the world's ability to respond to international crises. Water scarcity and food insecurity caused by climate change will lead to direct conflict and humanitarian crises throughout the Middle East in the coming five to ten years. This paper intends to examine the history of water scarcity within one of the countries of this region while providing an outline for a future which avoids the conflict of today. The country used to provide this examination will be The Republic of Lebanon, as its geographic centrality, political complexity, history of conflict, and struggle with the environment allow it to provide ample material for comparison with other parts of the region. Although historically unique in its quantity of rainwater, Lebanon has a plethora of environments that make it ideal for examining the impacts of climate change on agriculture and water. This ecological subject requires study because of the importance it has for human survival and the continuance of agriculture in the region. In relation to Lebanon, the effects of climate change are serious because the majority of its population lives on the coast and will be directly impacted by sea level rise along with the dramatic change in rain patterns on which nearly all the nation's agriculture depends. Additionally, Lebanon's relatively increased supply of water, compared to its neighbors, will bring climate refugees along with the current influx of refugees it already experiences. As with all other states within this region, climate change will negatively impact Lebanon's access to fresh water, making the efficient use of available water resources one of its most significant goals. Examining the current state of water usage within Lebanon, comparing it to other states in the region, and developing an outline for future water security are the key objectives of this paper. This examination will provide a road map for Lebanon to

prepare for climate change, with the hope that a sustainable Lebanon will provide stability in a region known for the opposite.

In order to better understand the complexities of the Lebanese water and agricultural environment an interview was done with a business professional from the agriculture supply sector. This interview took place with Fady Debbane, a board member of a top agricultural supplies company in Lebanon, The Debbane Saikali Group, he spoke on Lebanon's policy, geographical, and business issues<sup>1</sup>. The company he works for, The Debbane Saikali Group, is part of a larger conglomerate with many different entities, however, Mr. Debbane focuses on agricultural supplies such as greenhouses and irrigation. He provided deep insight into many areas of Lebanese industry and agriculture which otherwise would not have been accessible. In particular, Debbane expressed how difficult it has become for Lebanese farmers to compete with foreign imports from Syria and especially Europe. This inability to compete on a level economic basis is made even more difficult by increased prices of water and the inability to access clean water for irrigation. Many citizens, including farmers, have been forced to buy water from unregulated private suppliers due to the failure of the central government. According to Debbane, the central water management firm, run by the government, loses around half of all water from either leaks or mismanagement. Although the private sector has been able to supplement the government's failures, this level of inefficiency will inevitably lead to water insecurity and the suffering of all those living in Lebanon, a prospect that could end in conflict.

Furthering this discussion Debbane spoke on the future possibilities he believes may be in store for Lebanon, along with his fears for the region as climate change becomes an ever-

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<sup>1</sup> Interview with Fady Debbane took place over the phone on October 31, 2022

present issue. The opinions held by Debbane are obviously not supported by concrete scientific evidence but rather by decades of experience in the agricultural business. In an ideal world, Debbane explains Lebanon would stabilize its government, allowing them to focus on increasing the production of specialty products such as wine grapes, olives, and perfuming plants. This would allow the fledgling agriculture sector to become profitable while also reducing water usage on water-hungry vegetable crops or fruit varieties. Debbane spoke on the dire need for the central government to solve the current water crisis or at least work to improve the current situation.

As climate change worsens, the population grows with refugees, rural farmers lose their only source of income, and poor water management continues there is a high potential for crisis. The international community must work to stabilize the Lebanese central government, pushing “to develop a framework of water governance that provides for the three principles of equity, efficiency, and sustainability.” creating a framework for other countries to follow (Ward & Ruckstuhl, 38). When this has been recognized and the proper aid has been put in place then real work may begin to prepare Lebanon and the region for a much hotter and harsher world.

### **Chapter One: A Desperate Nation & A Heating World**

*Climate, Water & Ecosystem Services.* The impact of climate change on access to water in the Middle East will cause hundreds of farms to fail and threatens the water and food security of hundreds of millions. Lebanon has already begun to experience these issues as rainwater and snow melt begin to diminish in tandem with a generational economic crisis. As examined in the Sixth Assessment of the Inter-Governmental Panel On Climate Change, the effects of increased temperatures and less fresh water will lead to “[crop] yield variability in less productive regions [with] severe impacts on local food availability and livelihood (high confidence)” an issue which

directly affects the heavily import-dependent country of Lebanon (IPCC, 16). This variability in crop yield will put Lebanon in a precarious situation where available arable land cannot produce large amounts of cash crops such as wheat, corn, or rice, pushing Lebanese farmers into a corner with climate instability at one end and political chaos on the other. In tandem with this, a broken water utilities system which already fails to meet the demands of the population will struggle even more if not collapse as water supplies continue to drop. Furthermore, as desertification of arable land has become a serious issue “Moridnejad et al. (2015) identified newly desertified regions in the Middle East based on dust sources, finding that these regions accounted for 39% of all detected dust source points.” Concluding that most new environmental dust storms are caused by newly desertified land (IPCC, 264). This desertification leads to an increased albedo effect from the lack of vegetation. In support of these findings the IPCC further revealed that “Increasing surface albedo in dryland regions will impact the local climate, decreasing surface temperature and precipitation, and provide a positive feedback on the albedo (high confidence) (Charney et al. 1975) ... Similar albedo feedbacks have also been found in regional studies over the Middle East (Zaitchik et al. 2007),” essentially that as land becomes desert it will increase its albedo effect causing further desertification (IPCC, 269). These two negative feedbacks caused by climate change will hurt Lebanon but also the whole region’s access to fresh water.

These issues of crop instability due to climate change will not be exclusive to “less productive regions” such as the Middle East. The IPCC report goes on to describe how “Drought-related yield losses have occurred in about 75% of the global harvested area (Kim et al., 2019) and increased in recent years (Lesk et al., 2016).” making the issue of building water and food security in especially vulnerable areas of supremely high importance (IPCC, 16). Some may argue these losses are a result of poor crop choice or planning on the part of farmers and



although in certain circumstances a different crop may fare better the main issue resides in less water along with increased heat. This means in simple terms that even with better heat-resistant crops there will not be enough water to grow the quantities needed. Again, in relation to Lebanon, this has immense significance as “smallholder food producers are more vulnerable than large-scale producers to climate change impacts (high confidence)” and Lebanese crop production almost solely relies on small-scale farming (IPCC, 22).

The ecosystem services provided by freshwater cannot be taken for granted, especially in an arid region such as the Middle East. A supply of fresh water is not only a human right under international law but indirectly provides cultural services which cannot be replaced. Human culture and society as a whole, from politics to fishing, rely on a stable supply of freshwater. Although Lebanon may have relatively large amounts of freshwater compared to its neighbors this does not represent access to said water. The sad reality is that over 50% of Lebanese do not have access to clean drinking water even though the hydrology and geography of Lebanon could theoretically support the demand (Lebanon In Danger). Clean drinking water is not consistently provided by utility companies and the water purchased on the free market is not regulated. These realities along with Lebanon’s minimal wastewater treatment at roughly 29% mean that the majority of the population is exposed to unsafe drinking water (Capital Investment Program).

Lebanon’s need for wastewater treatment has grown exceptionally over the past several decades. An increase in the population of Syrian refugees along with an almost non-existent wastewater treatment system has led to serious cholera outbreaks over the past several years (Cholera – Lebanon). Pollution from industrial and agricultural runoff has led to fish die-offs. Yet even more importantly, wastewater is a source that can and should be utilized to increase the supply of fresh water for the overall system. These waste treatment plants essentially act as

miniature versions of the natural environment. Material is first filtered through large and fine-sized filters, it is then held in a settling tank where waste sludge can be dredged out. The remaining liquid goes through another series of particulate removal processes before being disinfected with chlorine or another chemical. The water remaining is clean enough to be safely pumped into a large body of water like the Mediterranean or processed again to be used in the water supply (Hancock). There are plans made to increase wastewater treatment in the Capital Investment Program but without proper oversight, they will likely never be completed. The only alternative to building wastewater treatment facilities would involve the regulation of water runoff and the investment in ecological catchment areas, both of which are unlikely to be pursued.

This failure to provide one of human's basic needs for survival puts unnecessary stress on already present political tensions as well as on society as a whole. A nation under water stress can lead to worsened political tensions, conflicts, and economic instability all of which Lebanon continues to suffer from today. Following through on the several plans already developed may not create a perfect solution but it will stave off a humanitarian disaster. Solving the water scarcity crisis in Lebanon offers the opportunity to abate a multitude of other issues facing the state and society.

*Climate Change and Lebanon.* The common small-scale farms in Lebanon are reliant on bank credit loans to purchase farming inputs and with the economic crash of 2019 and the COVID-19 pandemic, farmers have been unable to purchase seeds or equipment to continue farming land. In the most recent annual report by the Food And Agriculture Organization Lebanon's financial crisis has been named as a key issue regarding agricultural productivity "It is estimated that the total value of Lebanese agricultural production in 2020 will be 38 percent

lower than it was in 2018, with the value of plant products shrinking by 47 percent, and the value of animal products shrinking by 26 percent.” making it nearly impossible for farmers to take out credit (FAO, 7). The damage to freshwater ecosystem services reveals the main key element in this decreased productivity. The cultural services provided by the freshwater ecosystems regulate local climates, allow agricultural development, and simply clean the drinking water. An area where these cultural ecosystem services are broken will struggle to provide for its population. According to the Lebanese Ministry Of Environment in the IPCC report, it has been found “Another effect [of climate change] is on the rainfall pattern which is expected to decrease by 10-20% in the year 2040 which will later on reach to a decrease of 45% in the year 2090” a stark reality which places Lebanon on a nearly impossible timeline (Vulnerability and Adaptation). Such a large drop in water supply could spell disaster for the already fledgling government but even more so for the majority of the population already living in poverty. Painting a full picture of the situation, water scarcity has made it more difficult to grow crops while economic disaster has made it financially improbable to support farms. This will lead to further dependency on imported goods and vulnerability to food and water scarcity inside Lebanon. These devastating realities will only become worse as climate change reduces rainfall and increases the temperature of the region.

*Effects On Agriculture.* Water security has slowly become a serious issue within Lebanese agriculture but especially for the everyday citizen. Access to clean drinking water has become increasingly difficult with broken water management systems and unreliable rains. The Food and Agricultural Organization of the United Nations released a 2019 sector review which reveals “water is generally only available at a high cost and water control and conservation are necessary to ensure the long-term sustainability of agriculture.” a reality that does not consider

the ever-increasing demand associated with urbanization and climate change (FAO, 53). A full revamp of the Lebanese water utility service would be required as vast portions of water are lost from poorly maintained systems. This has led to the unregulated drilling of groundwater and the privatization of freshwater supplies. These realities are discussed in the FAO report in addition to the near future issues related to climate change and water scarcity. The report lays out several elements which must be addressed to protect from climate change-related water scarcity, the first being expanding water resources such as dams and reservoirs. Secondly, the management of water resources must improve. Finally, the reuse of wastewater has the potential to aid in maintaining Lebanon's access to water. At the most recent measurement, Lebanon only treats between 8 - 29% of its wastewater, a dramatically small amount and an entirely different environmental issue on its own (Ward & Ruckstuhl, 2017; Capital Investment Program). Allowing wastewater to go untreated pollutes watersheds, poses a health risk for water-poor populations, and damages the environment. The treatment of wastewater, as will be discussed further, has the potential to markedly increase freshwater supplies. Though ultimately climate change-related shifts threaten the viability of the agricultural sector more importantly it threatens the health of Lebanese citizens. Creating a more feasible water management system would greatly aid the agri-food sector while protecting the population from major resource scarcity. Solving this issue of water and thus food insecurity in Lebanon not only protects the nation from famine but also brings stability to a fractured country, creating an example of potential methods and futures for all of the nations in the region. There is a massive potential for new and improved systems throughout the water and agriculture sector within Lebanon and the Middle East in general.

As the effects of climate change begin to become more severe the importance of water management to protect the hydrological cycle cannot be understated. Lebanon will likely suffer from severe swings in weather patterns disrupting both the hydrological cycle and agricultural harvests. Chapter Four of the Sixth IPCC report explains “that anthropogenic climate change has... increased terrestrial ET (medium confidence) and contributed to drying in dry summer climates including in the Mediterranean,” a reality which has not yet been addressed by the Lebanese government (IPCC, 563). As climate change worsens in the region, water scarcity and security will become a source of conflict and suffering. This cannot be avoided without a unified response implementing efficient systems of water management, preservation of groundwater resources, and the treatment of wastewater. These suggested actions reveal how “Future water security will depend on the magnitude, rate and regional details of future climate change and non-climatic factors, including agricultural practices, water demand, and governance.” the key in this statement being “governance” without which no response is possible (IPCC, 563). These projections made by the IPCC underscore the severity of the water security situation both worldwide and in Lebanon. Several authors have examined this relationship between water resources and conflict in the Middle East, as water has not become the key argument for war but has become a prime example of the tensions placed on social & governmental responses to poor water supply.

*Water Conflicts & Instability.* Over centuries of government intervention, the historical importance of water in the Middle East has led to massive control measures with the hopes of maximizing water usage. The experiences of the past and the historical rarity of water in the Middle East have led to centuries of water manipulation and tensions over control. This manipulation has allowed the region to thrive during times of stability yet in times of conflict this

balancing act for water has hindered peace. In Christopher Ward's and Sandra Ruckstuhl's book *Water Scarcity, Climate Change And Conflict In The Middle East* these topics and the impacts they may have on Lebanon are examined in thorough detail. In the analysis of water usage in the region, the authors found "Today, taken together, countries in the region withdraw almost 80% of the available water: this compares to less than 30 percent for the next region...and to a worldwide average of just 10 percent." highlighting the precarious nature of the middle east due to climate change (Ward & Ruckstuhl, 14). There are essentially no sources of freshwater that have gone untapped and with the prospect of the current supply decreasing with rising demand "Global hydrological models (Herbert and Döll, 2019) show that human-induced groundwater depletion at rates exceeding 20 mm yr<sup>-1</sup> (2001–2010) is occurring in the major aquifers systems such as the ...Arabian aquifer (Middle East), North-Western Sahara Aquifer System (North Africa)" the threat of conflict will rise with it (IPCC, 581). One example of a possible future conflict over water involves Egypt, Sudan, and Ethiopia three countries that all share water from the Blue Nile. Ethiopia the country at the mouth of the Blue Nile has built a massive dam to produce electricity and supply water (Michaelson). This dam, The Grand Renaissance dam, holds the potential to dramatically reduce the flow of the Blue Nile and endanger the lives of those downriver in Egypt and Sudan (Ibid). Egypt sees the dam as such an existential threat it has openly flaunted the idea of bombing the dam (Ibid). After many attempts at an agreement between the three countries, none currently exists. As the dam begins to reduce water flow fears of conflict continue to increase.

An example of an armed conflict over water can be found throughout the 1950s and 1960s with the Israeli occupation of Palestinian territory and the Arab – Israeli conflicts of this time. In 1964 Israel began pumping water from the Sea of Galilee, this was met with an Arab-

funded dam in Syria. These competing diversion projects escalated to guerilla fighting from the Palestinian Liberation Organization against Israeli construction and eventually “culminat[ing] in an Israeli tank and aircraft assault that terminated Syria’s diversion project and a decision by Arab states to dismantle a dam site on the Yarmuk River.” (Solomon, 402). These skirmishes heightened tensions and played a role in the eventual 1967 Six Day War. The once prime minister of Israeli Ariel Sharon claimed, in reference to the Six Day War, “While the border disputes between Syria and ourselves were of great significance, the matter of water diversion was a stark issue of life and death.” (Solomon, 402). This quote offers a stark reflection of the serious nature that water independence carries when the resource does not come in abundance.

In a related conflict, the Palestinian-occupied territory has had its water aquifers depleted continuously since Israeli settlement. In fact, the rapid depletion of the Gaza Aquifer and the aquifers then pollution by seawater created such water scarcity that water became a major point of diplomatic talks. In discussions with the PLO leader Yasser Arafat Israel included “water [as] one of the five central issues, and one of Israel’s top priorities, in the Israeli-Palestinian Oslo peace process. The September 1995 interim accord affirmed the unequal four-to-one sharing of the mountain aquifers.” highlighting the water disparity and the purposeful depletion of the Palestinian water supplies (Solomon, 404). Events such as this were the first of their kind and will likely only become more common as water scarcity spreads throughout the region. Lebanon has been lucky to be granted large supplies of surface water but as its neighbors become more desperate the border rivers of El Kebir and Orontes could become flashpoints. Ultimately the political maneuvering required to protect one’s water resources may be equally as important as any type of physical guarding.

A final example of a water conflict is the shared Indus River Valley between India and Pakistan which has historically been a flash point of tensions. As both nations see rapid population growth and thus higher demand for water, the tensions around the shared watershed will rise. There is historical precedence for these tensions “In 1948, the two states came to the brink of war when India’s East Punjab halted the flow of water through two large canals that fed crops on Pakistan’s side of the border in a bid to demonstrate its sovereignty over the river.” (Solomon, 428). India with now over one billion people contains only four percent of the world’s water resources. According to the World Bank, this makes India one of the most water-stressed countries in the world (How Is India). The poor management of India’s current water resources does not help the nation as it looks to supply a growing demand. In fact, due to poor management, most parts of India only receive three to four hours of water per day (How Is India). Likewise in Pakistan, extreme exploitation of groundwater resources has led to water scarcity, especially in the south. It has heightened tensions between ethnic divides and has even gone so far as to cause deadly water riots (Solomon, 428). When people become desperate enough to riot over access to clean water, that desperation might be enough to support a war over resources. As internal tensions rise between both countries, climate change worsens, and water begins to dry up the chances of conflict over the use of the Indus River Valley rise.

In Lebanon the threat of conflict has only grown in the past five years as refugee populations increased rapidly, calculated by the European Civil Protection and Humanitarian Aid Operations roughly 1.5 Syrian refugees have entered the country and 2.2 million Lebanese are in need of humanitarian assistance (Lebanon). If the concerns of this population are not addressed the threat of conflict will rise exponentially. As has been seen in the examples discussed, water pressures have historically pushed nations and groups toward armed conflict. Although a large-



scale conflict based solely on water resources has not occurred with increasing desperation, high tensions may boil over into conflict. Lebanon has been fortunate in its relative abundance of rainwater in addition to having the only snowpack in the area, but with rising temperatures, the rain will become inconsistent, snow will disappear, and the country's inefficient water management will no longer be effective. Tensions are already high because of economic failure, political corruption, and the Syrian refugee crisis any added issue holds the possibility of conflict. The country must recognize the existential threat climate change poses not only because of drought or famine but also of the increased potential for violence.

## **Chapter 2: History Of Water Infrastructure In Lebanon**

*Birth Of A State.* Chapter Two focuses on the current state of Lebanon's water infrastructure, the key actors and institutions involved, the groups most vulnerable to its total collapse, and what can or should be done. The previous chapter focused on the regional history of water scarcity, water control, and the issues conflict has caused. The first chapter took into account Lebanon and its unique position in the area, especially relating to how climate change and internal migrations will affect its access to water. The sixth edition of the Intergovernmental Panel On Climate Change (IPCC, 2022) and a country-specific examination of Lebanon by the FAO were the main sources for this discussion. In addition, an interview with Fady Debbane and the book *Water Scarcity Climate Change And Conflicts In The Middle East* by Christopher Ward and Sandra Ruckstuhl provided more insights which will continue to be covered further. The main elements which can be taken away from this chapter include the danger of agricultural collapse caused by water scarcity in Lebanon, the vulnerability of Lebanon to climate change, the importance of the government in staving off this crisis, and finally the already precarious nature of the Lebanese water system. These elements combined make for an

incredibly dangerous scenario with Lebanon teetering on a total water collapse without yet experiencing the worst impacts of climate change.

The following chapter will examine the history of water access in Lebanon, what infrastructure has failed, the parties involved, and what needs to be done to prevent catastrophe. Currently, the government agencies charged with providing clean water do not have the funds or electricity to complete system-wide fixes. This failure has forced NGOs and the private sector to fill the void. In order to provide a realistic plan of action, the point of failure must be understood, this is the reason for covering such a technical area. Likewise, to actually facilitate the fixes necessary one must understand the political and social actors on the ground, including the government, Hezbollah, the economic crisis, and the lack of electricity. These factors have all become incredibly relevant within the last four years as a financial crisis was followed by the COVID-19 pandemic and the Beirut port explosion. All combined in a short period of time these crises nearly dissolved the already teetering Lebanese water system.

*Effects Of War.* A history of the Lebanese state and thus its water utilities reveals continued crisis, dependency on international aid, and a government which has never been granted a reprieve. The region known as the Levant, which includes Israel, Lebanon, Syria, Jordan, Palestine, and a part of Turkey, has been home to civilization since before written language and thus history itself. The region has a long and complex history involving the Roman Empire, Ottoman rule for hundreds of years, and most recently semi-colonization by the French (William Harris). Lebanon gained full independence in 1946 after the withdrawal of French troops following World War Two. Directly after gaining independence, Lebanon experienced relative stability for several decades. It became the secular economic hub of the region, international banking boomed along with major tourism (William Harris). During these two

decades, water infrastructure was built throughout the country, laying the foundation for the country's current broken utility systems. Conflicts between Israel and the Arab world drew Lebanon into a precarious situation, especially with regard to its larger neighbor Syria which played a significant role in the Israeli-Arab wars. The Syrian state underwent a coup in 1949 marking a new chapter in Lebanese Syrian relations something which has yet to return to the same levels of cooperation (William Harris). The wars against Israel at the time marked the beginning of independence for the Arab states leading to the strengthening of some powers and the destruction of others. Lebanon was able to avoid most of this reshuffling with an armistice signed with Israel in 1949, however, this did not mark the end of Lebanese Israeli hostilities (Harris, 203). The Lebanese state found stability following the 1940s this time with the election of Fouad Chehab, the founding general of the Lebanese army and a somewhat autocratic leader. His government was able to build a functioning Lebanese state increasing education and building modern infrastructure. General prosperity lasted for roughly fifteen years, until the late 1960s with the 1967 Six Day War and increased instability sparking in the early 70s (Harris). The Disruption started to spark in the late sixties with heavy immigration of Palestinian refugees. The Six-Day War marked a turning point for Palestinian hostilities towards Israel and in how the Palestinians would use Lebanon to organize and fight the Israeli state. At the time Lebanon was home to over 100,000 Palestinian refugees and after the defeat of Syria and Egypt in the Six-Day War Lebanon was the best place to stage attacks against Israel while being outside its borders (Foley). This militarization added stress to the Lebanese state and obviously built hostilities between Lebanon and Israel. Many of these hostilities still exist to this day. This military and social pressure along with the struggles of the Chehabist government put Lebanon in a delicate position (Harris). These large groups of refugees put pressure on an already strained political

system and eventually led to the 1975 – 1990 Lebanese civil war. This civil war ravaged Lebanon, killing tens of thousands and crippling the nation's ability to function effectively to this day. Large shifts in power and sectarian control occurred throughout the fifteen-year time frame with Maronite Christians losing some government control and Sunni and Shia Muslims gaining more. This time period also saw a large influence from neighboring and international countries which damaged Lebanese nationalism for decades. After surviving this chaos several governments pushed for new development for the whole nation but political stagnation after the civil war hindered serious progress and created an ad hoc infrastructure system. At the end of this brutal fifteen-year civil war a large infrastructure campaign, funded by the World Bank, began (World Bank). The campaign, the National Emergency Reconstruction Program (NERP), focused on rebuilding public infrastructure “including construction and renovation of urban roads, sidewalks, retaining walls, street lighting, water and sewerage networks, as well as restoration of municipal buildings and information and communications technology (ICT) equipment.” destroyed during the conflict (World Bank, 2009). The program brought Beirut and other cities back to pre-conflict levels of infrastructure “with 440 subprojects benefiting 178 municipalities” statistics which the World Bank considers a success (World Bank, 2009). Many of these projects were short to medium-term solutions which would require further investment in the decades to follow. The national program essentially brought Lebanon's utilities back to normal operation but did not dramatically improve the systems. In 2012 the National Water Sector Strategy was published outlining the strategies and physical projects necessary for the nation to keep up with growing demand and decreasing supply. In the years to follow Lebanon was hit with numerous setbacks and political turmoil leaving the plan unfinished. In 2018 after six years of no major improvements, the Capital Investment Program was published. This report

was essentially an updated version of the NWSS which took into account the Syrian refugee crisis and the economic downturn.

The present situation in Lebanon is one of dire circumstances and major instability. Suffering from the country's worst economic crisis for over four years, over 80% of Lebanon's population has fallen into poverty. The office of the president has been absent since the long-time president Michel Aoun's term came to an end on October 30, 2022. A unified government has not been formed. Public services are essentially non-existent, and the political elite has very little incentive to change the current stalemate. In their yearly report, The Human Rights Watch explains "According to the World Bank, the Lebanese crisis ranks among the 'most severe crises episodes globally since the mid-nineteenth century,' and is the product of three decades of deliberate, reckless fiscal and monetary policy" leading the country towards the simultaneous collapse of nearly all government entities (World Report). A shift in political will and a desire for substantive change must occur for Lebanon's economy and government to stabilize. This could be achieved through new government backed social works such as infrastructure development like dams to exploit Lebanon's vast surface water resources.

*Geographical Water Sources.* Groundwater, specifically from rivers and streams, acts as Lebanon's main water source. These rivers originate from multiple different sources but can mainly be attributed to the unique geographical structures of Lebanon including mountains, forest cover, and a coastline. This geographic diversity allows for a high density of rivers and streams. The Lebanese people are dependent on the consistent flow of these sources without which a stable supply of fresh water would not be available. One of the most important pieces of geographical topography which is responsible for a lot of the groundwater sources is Mount Lebanon. This key mountain is the source of ten different rivers fed by both snow melt and

rainfall, flowing into the Mediterranean without much obstruction (Harris). This unique geographical feature grants Lebanon a unique water independence that nearly all its neighbors do not have (Harris). The unfortunate truth of this independence is these rivers are not harnessed for water collection in any significant way. Until the government utilizes the Mount Lebanon watershed true water independence cannot be possible.

*Failed Rebuilding Plans.* Unfortunately, many of the larger improvements to infrastructure were destroyed in the 2006 Israeli invasion of Lebanon. As the central government stumbled after the assassination of the incredibly important former prime minister Rafic Hariri in 2005, the possible involvement of Hezbollah and Syrian forces created a tense environment (In The Eye). Sparked by provocations from the terrorist group Hezbollah, the Israeli Defense Forces invaded southern Lebanon on the 12 of July 2006. This conflict ended on August 34, 2006, with “1,191 deaths and 4,409 injured” (Reuters). In this short period of time, Israel targeted substantial portions of civilian infrastructure, particularly electricity stations, water utilities, bridges, and roads (Human Rights Council). The damage incurred over such a short period of time amounted to 2,464 billion dollars and has almost certainly never been fully addressed (In The Eye). The destruction of water pump stations along with piping, the corruption of the government, and sectarian divides made it incredibly difficult to rebuild the necessary infrastructure. Even in an efficiently run government unburdened by corruption, a lack of funding, and bureaucracy, it would still take years for normal functioning infrastructure to return and even more, time until it is improved. These targeted attacks severely damaged the relatively new infrastructure built in the years following the civil war and forced the government to take additional international loans for recovery.

In the years following the 2006 invasion, Lebanon has been continually marred by conflict and sectarian divisions which have made it nearly impossible to build a strong central government capable of upgrading water utilities. These issues became exacerbated by the Syrian refugee crisis which began in 2011 and continues into the present day. The government estimates 1.5 million Syrian refugees are currently in Lebanon living in serious poverty and placing strain on water utilities which hardly function at normal capacity (Lebanon). This crisis began several years before the 2019 economic collapse of Lebanon, the COVID-19 pandemic, and the 2020 Beirut port explosions, all of which have essentially debilitated the country. Allowing all infrastructure but especially water utilities to go unkept has worsened the already dire humanitarian crisis involving these Syrian refugees. Additionally, the remaining 4 million individuals reliant on this broken system are stuck with either insufficient amounts of water or private water prices which have become unaffordable, "Families are affected both by insufficient supplies of water and prices many can't afford." (UNICEF). The government has not been able to adequately build distribution piping for these refugees because they are firstly not recognized, do not live in regulated housing, and because the funding and political will does not exist. Most of these issues have been recognized by the global community yet hesitancy to invest due to corruption and malpractice has hindered any solution.

The historical background of the current water crisis in Lebanon reveals the political instability of the country and the long-term impacts conflicts have on nations. Over thirty years after the end of the civil war, Lebanese citizens are still impacted by the political turmoil and physical destruction which it brought. A 2009 World Bank examination of Lebanon's water supply concluded "transforming resources into quality drinking water for the entire population has proved difficult despite Government investments in infrastructure." a point which underlies

the struggle to rebuild following the civil war (World Bank, 2009. Pg. 14). Although a reconstruction plan was attempted, infighting and bureaucracy essentially halted any hope of full recovery. This report acts as a canary in the coal mine, only two years later hundreds of thousands of Syrian refugees would flood across the border bringing the already fragile system to the edge of complete failure. This would be followed by further crises making it essentially impossible for the government to ever truly respond to the failed water systems they have faced for over thirty years.

*Corruption.* There has not been a lack of attempts at solving the innumerable issues facing Lebanon's water crisis, unfortunately, the reality is that most became lost in a sea of corruption and bureaucracy. These decades of inoperative utilities have led to little to no wastewater treatment, the prevalence of waste runoff, and the threat of negative health effects on refugees and Lebanese citizens. The over 1.5 million estimated Syrian refugees in Lebanon face little to no legal status and are forced to live in cities, villages, or tent settlements. This is because of government policy which never created formal refugee camps. This may have been a clear political move but with a broader view of the past decade, it points to the poor state of the Lebanese government. Since 2019 Lebanon has lost 3 points and fallen to 149<sup>th</sup> in Transparency International's yearly corruption ranking, a telling metric of the nations struggling government (Transparency International). Only after protests in 2019 and the Beirut Port explosion have any measures been taken to address corruption. The passing of several laws aimed at mitigating corruption is a positive step but until they are tested in court, they hold little merit. In an article written for Transparency International Mohammad Almoghabat states "There is a critical need for structural reforms to tackle corruption on the systemic level. Political integrity and political will must be encouraged to enforce the laws already adopted and to adopt new legislation



necessary in the fight against corruption.” a succinct summation of Lebanon’s current corruption problem. Some academics argue that the widespread presence of corruption has roots in the Ottoman occupation of the land that is now Lebanon (Salam). The oppressive nature of Ottoman rule developed disloyalty among the Lebanese people and vindicated corruption on the local level. Mohammad F. Matter wrote about this in *Options For Lebanon* and posits “Corruption rests on a simple equation related to one basic tenet: the supremacy of accountability; without it, corruption is given free rein and, when it exists, corruption recedes and fades away.” going on to examine the relationship of corruption in Lebanon (Salam, 175). This quote and others point to the nearly ever-present reality of corruption in the country. At the time of publication, Matter claimed “The Lebanese concur that corruption is rampant, that it has encroached on state and administrative institutions and become embedded in minds and souls.” A bold statement that has yet to be proved otherwise (Salam, 175). This issue of corruption has spread to nearly every level of the economy from banking to agriculture. Making the present issues with electricity and water utilities a clear problem of poor management and historical inadequacy. Furthermore, when it comes to climate change, corruption has made it nearly impossible to adequately respond and has created an environment ripe for conflict.

*Conflict.* Water-based conflict in Lebanon has not been historically common and large-scale modern-day examples are rare. Even so, the circumstances in which Lebanon finds itself have created an environment prime for conflict especially with Hezbollah acting as an inter-government group providing water for their own group. This complex balance of interests could lead to conflict between Hezbollah and other ethnic groups in the government or public sphere. The massive levels of corruption at this tier of government have already sparked protests in 2019 which led to the stepping down of the prime minister and the retirement of several officials. It

would require very little instigation to cause further upheaval from the general population markedly over something as critical as water.

*Future Projections.* Ultimately the complete failure of Lebanon's water utility system will create a humanitarian disaster for both the 1 million plus Syrian refugees along with nearly all Lebanese citizens, the majority of whom now live near the international poverty line (Lebanon: Almost Three). Unless the international powers at play in Lebanese politics can stabilize its fractured government, focus on these bipartisan issues, and remove decades of red tape, the country risks becoming a failed state. Simply, providing the investment and physical know-how to build new water infrastructure has the potential to positively impact millions of individuals. Monetary investment alone cannot continue as the only means of support, alternative forms of more direct investment must be utilized. In the conclusions of the 2009 World Bank report, they state "Invest in improving water quality to generate positive health and financial returns for households. A focus on improving quality and reducing losses, if accompanied by a public awareness campaign, would have a direct effect on welfare." a decade-old assessment that still holds true to this day (World Bank, 2009. Pg. 44). The biggest issue holding back such an investment is lack of political will rooted in decades of corruption and hostile international influence. In a region full of aggression and conflict, the international community must recognize the need for stability and push Lebanon's government whether publicly or through diplomatic channels to act. Under proper leadership and support, Lebanon can provide an anchor of stability in an erratic region.

### **Chapter 3: Perpetual Political Inaction**

*Political Structure of Lebanon.* The following chapter will focus on politics and the relationship between politics and water access to the greater public. There will be a close

examination of the Lebanese political system and how their shifting powers have troubled the nation's infrastructure overall. It will generally cover the failed policies and influential groups in Lebanese politics. First, though, a quick explanation of the political role in water scarcity and conservation is necessary. In the global north, water utilities are heavily regulated entities usually run by regional governments with heavy oversight by the federal government. This level of control has been deemed necessary to protect the public and guarantee a fresh water supply to as many citizens as possible. In the global south, this framework for water utilities has not been possible. There are a multitude of reasons behind this, with each country experiencing their own set of unique circumstances. The political situation in Lebanon plays a significant role in the broken water utilities and electrical systems in the country. A complex political system based around the eighteen religions present in the country has led to major corruption and political alliances that hinder the creation of any united government. When the three major state positions of president, prime minister, and speaker must be constitutionally held by a Maronite Christian, Sunni Muslim, and Shia Muslim tendencies to help their own group hinder the development of a well-run state. Although this division by religious sect may seem politically promising its implementation is incredibly defective “[resulting] in a government largely made up of competing bureaucratic fiefdoms rather than a single unit attempting to govern the Lebanese state.” Making it nearly impossible to quickly build infrastructure (Khatib, L & Wallace, J). In addition, the electoral system in Lebanon has been categorized as majoritarian, in the case of Lebanon the candidate with the most votes wins the election. This can lead to issues where the majority of the population did not vote for the candidate in office. As the population of Lebanon has grown and political parties multiplied it created an environment where “the higher the number of candidates in a district and the fiercer the competition the lower the percentage of

votes required to elect a candidate” making proper representation incredibly difficult (Salam, 3). Sectarian power struggles and a strong sense of religious unity over nationalism means very few groups have the desire to change this broken system. Many other countries have suffered from majoritarian voting and the discrepancies it creates and many of those countries have moved towards a proportional form of representation. Until a more representative government is placed in power the inefficiencies of Lebanon’s state will never be truly solved. Although several attempts, as recently as 2019, have attempted to change Lebanon’s government none have succeeded. The revolts in 2019 succeeded in deposing the standing government but after its dismantling, no government has been able to replace it. Leaving Lebanon with a fractured barely functioning state that provides nearly nothing to its citizens.

*Water Governance.* In the case of the Middle East and Lebanon in general, the past fifty years of instability have led to a weak central government and thus poor investment in infrastructure inevitably leading to issues with water management. In Christopher Ward and Sandra Ruckstuhl’s book *Water Scarcity, Climate Change and Conflict In The Middle East* many astute observations are made, yet one summarizes the region as a whole: “Asymmetrical power has led to asymmetrical access to water” a reality especially present in Lebanon (Ward & Ruckstuhl, 2017, Pg. 79). Certain groups, usually the wealthy elite, have consistent access to water while those in the middle class or below either have no access or are forced to purchase water from a private retailer. The inconsistent availability of water for the majority of the nation can be partially blamed on the decades-old piping and distribution network, the failing electrical system, and the consistent damage from armed conflict. This history of neglect along with little to no government enforcement or regulation has created a piecemeal system of outdated piping and poor water capture systems. This leads to major water loss through leaks or simply lack of

capture. Ideally, a country's government would have systems in place to capture ground and surface water, sanitize the water, and distribute the water to most citizens all in regulated and updated piping/fittings. Lebanon fails to capture the majority of its surface water, recycles essentially zero wastewater, does not have enough distribution stations, has large water loss, and has serious issues with aged machinery. The reality of this failure means over fifty percent of Lebanese are not connected to the water system (USAID). The branch of government responsible for the Lebanese water system is the Ministry of Energy And Water which oversees four regional departments covering the whole nation (MOEW). This asymmetrical access to water is in itself a divisive issue coupled with the economic downturn and massive poverty it holds the possibility of sparking conflict. The issues faced by Lebanese politics, due to a multitude of foreign actors, conflicts, and global crises, have all accumulated against public utilities, drawing thin the already broken system.

*Possibility For Conflicts.* Recognizing water as a human right, it makes logical sense that governments take the utmost care to ensure the protection of their nation's supplies and the safety of that resource. In the Middle East, the scarcity of water has led some nations into conflict over the protection of water. These regional conflicts have been categorized by Ward and Ruckstuhl "The classification identifies three levels of conflict: at transboundary level, at national or sectoral level and at the local level." An arrangement that could soon be used internationally (Ward & Ruckstuhl, 2017, Pg. 52). Regardless, at present the Middle East is a prime example of how water insecurity can lead to internal or external conflict but especially instability. These concerns especially affect minority groups such as the Palestinians. There are a multitude of examples where state enforcement has forced Palestinians to continue using poor water sources rather than be allowed to access Israel's central water supply (Ward & Ruckstuhl,

2017). Another example of conflict caused by water insecurity would be “In Morocco, farmers on the public...surface irrigation schemes have benefitted from massive subsidies over several decades, whilst rainfed or traditional irrigated farmers in the remote Atlas Mountains have received virtually no support” an example which highlights internal disputes between similar minority groups (Ward & Ruckstuhl, 2017, Pg. 65). In this case internal disputes likely led to favoritism and the exclusion of one group from aid by the central government. This type of historically motivated policymaking cannot be avoided anywhere in the world, but water security should not be involved in this political jockeying. These examples are becoming increasingly common as parts of the global south struggle with water scarcity, yet the point stands that government involvement in water management is absolutely necessary but must be followed by equity and transparency. In the Middle East, this may be asking a lot from some governments, but water management may be one issue where such bipartisan cooperation is possible. Lebanon with its tattered and broken water system has an opportunity to rebuild in a more equitable and sustainable fashion serving as a testing ground for much larger nations in the region.

*Non-State Actors.* In Lebanon, there are innumerable actors both government-related and private which influence public utilities and how government funding is spent. On the topic of water, as stated before, the most significant entity is the Ministry Of Energy And Water (Walnycki, 2017). This government ministry oversees the four regional water establishments and writes the policies which the four regions observe (Walnycki, 2017). The MoEW is heavily supported by aid organizations, especially the United Nations and UNICEF. Without this aid it is unlikely any public water utilities would be active. Other non-state actors such as Hezbollah provide basic water services to impoverished households (Walnycki, 2017). Hezbollah does not represent a substantial physical presence in regards to the distribution of water, rather their

political party garners serious influence on the national stage. The influence of Hezbollah within Lebanon and the region has been studied in depth in other academic journals. Considering this, for the purposes of this paper, the complexities of Hezbollah's influence will not be discussed. A basic and necessary understanding includes that Hezbollah "has grown in status to be able to influence and control the state in Lebanon from within state institutions as well as outside them." And because of this, their group de facto controls all water utilities (Khatib, Lina. Pg. 4). This has led some to describe the group as a government within a government, acting on its own accord without any oversight from other authorities (Khatib, Lina). Even more so, Hezbollah is considered a closely associated arm of the Iranian government and directly contradicts the goals of Western nations such as the United States. This heavy influence from what the United States considers a terrorist organization makes navigating simple infrastructural work exceptionally difficult. Excluded from this description of actors within Lebanon, for the sake of brevity, are the innumerable business interests throughout the country and the still present influence of Syria and Israel as previous power holders. The Syrian occupation of nearly half of Lebanon from 1976 to 2005 played a massive role in the discontinuity of infrastructure especially considering the post-civil war growth period (Pan, Esther). Although the role of Syria and Syrian troops is complicated the influence they held and still hold is not. Large parts of Lebanon are still influenced by Syrian power from these decades of control. The porous border with Syria has also allowed the country to build even more influence through economic dependence and the undercutting of Lebanese goods. Yet most deplorably the Lebanese people are excluded from this menagerie of geopolitics within their own country. The vast number of competing interests in such a small geographic area has left the Lebanese people on the sideline of their own country. In 2019 massive protests attempted to voice this discontent but ultimately the enormous protests

did little in achieving large-scale change. Considering the conflicting interests of the Lebanese state, Hezbollah, Iran, Syria, the United Nations, and the Lebanese people, finding a middle ground for joint cooperation may seem impossible. Nevertheless, water may provide the best and only area for all these groups to work to benefit the whole. A neutral topic, water, which is also necessary for the survival of each party and all people within Lebanon may be enough to force cooperation.

Along with these political non-governmental organizations, there are many traditional humanitarian non-profits working to lessen the burden of the water crisis for all those living within Lebanon. One such organization focused on matching people with technical skills and those in need goes by the name The Environment Academy. Founded in 2019 the goal of this organization is to match researchers with wide-ranging specialties with communities seeking help to complete a project (Plackett). These projects range from irrigation services to mitigating wildfires (Plackett). An additional non-profit focused specifically on water services is OBBA or Operation Big Blue Association a group focused “on the conservation of coastal and aquatic biodiversity as well as the integrated and sustainable development of the Lebanese waters.” (Operation Big Blue). This organization highlights the desire of the Lebanese people to better their environment regardless of government support. There are many of these small non-profit organizations which are working to make as big of a difference as possible. Larger-scale nonprofits such as the United Nations Children Fund are also working diligently to produce lasting change not only in their direct field but also tangentially for instance children’s families. In fact, UNICEF Lebanon has taken on a large role in supporting the roughly 1.5 million Syrian refugees now in Lebanon (What We Do). They cover a wide breadth of initiatives and work closely with the Lebanese government (What We Do). These international nonprofits like



UNICEF and the Lebanese Red Cross along with small grassroots organizations make real substantive changes in people's daily lives. As long as the government is unable to function at an even partial level these nonprofits will provide the most direct help for those in need. The major limitation of these nonprofits is that they cannot truly solve the problem, they can only provide a direct solution to niche issues, not the systemic problems facing Lebanon.

*Water Strategies.* The detrimental effects of Hezbollah and the other actors discussed have not completely stopped the country from creating development plans around water and climate change. In 2010, the Ministry of Energy And Water released a report titled National Water Sector Strategy (NWSS, 2010). This report details the current state of water use and systems throughout the nation, the necessary amounts of investment, environmental concerns, and a strategic roadmap for the future. The NWSS includes short-, medium-, and long-term goals reaching from 2011 to 2030. In practice, this would have allowed any lawmakers in the present or future to stay in line with a predetermined guide. The final chapter of the NWSS, Strategic Roadmap, outlines everything from "Artificial recharge of ground aquifers" to "Enforcing planning and spending responsibilities" (NWSS, 2010. Pg. 86). The level of detail outlined can be seen in Figure #1 showing a timeline of goals. Interestingly, several of the main points recognized as necessary for change include leadership and mindset changes throughout ministerial positions. This just provides evidence that those in power recognize the need for major political change but lack the means to enact any of the necessary amendments. Unfortunately, because of this political stagnation and the multitude of crises that have occurred over the past decade, the NWSS has not been fully adopted or ever truly implemented. Now over ten years after the publication of this document, the Ministry Of Energy And Water remains

focused on electricity production through oil and gas exploration rather than environmental preparedness.

Eight years later a new initiative was developed recognizing the efforts of the National Water Sector Strategy and the Syrian crisis. This was called the Capital Investment Program and was a national initiative which covered many different sectors and focused on the United Nations' sustainable development goals. It aimed to address water and irrigation as well as wastewater issues. The CIP report justly recognizes "Water supply is still being rationed due to shortages of water resources, power failures, and excessive power bills for the operation of the pump stations; adequate additional water resources have not been mobilized to date, and surface and groundwater resources are heavily polluted due to current wastewater discharge practices." Continuing to argue for the increased construction of reservoirs to focus on the exploitation of surface water, rather than groundwater, as the rapidly depleting groundwater table should be saved as a reserve (Capital Investment Program). The report goes on to list how the government plans to renovate and maintain existing systems along with the different sections breaking up the "Development Vision". There are three sections breaking up the Development Vision in the water and irrigation chapter. These consist of Category A, B, and the Lebanese Crisis Response Plan. Category A focuses on the "projects for extending the Supply through expansion and improvement of the existing systems" or simply increased efficiency (Ibid). Category B consists of projects related to increasing supply through the exploitation of surface water with dams (Ibid). Finally, the Lebanese Crisis Response Plan relates to the Syrian refugee crisis. It includes earmarked budgeting for the expansion of networks and the temporary extraction of groundwater. Unfortunately, it is explained in the report that the LCRP has essentially been left by the wayside with its initiatives being adopted by the CRP. In summary, the three key pillars of

the CRP consist of the maintenance and improvement of existing resources, the construction of four dams to increase groundwater collection, and the expansion of networks to supply rising demands (Capital Investment Program). The exploitation of Lebanon's vast surface water can be achieved through the building of dams and reservoirs, a plan originally developed in the NWSS that was never fully realized.

The following chapter examines wastewater in the Lebanese water system. The unfortunate reality of the wastewater system is that in 2010 roughly 8% of all wastewater was collected and processed. The new Capital Investment Plan estimates based on new information and data that 29% of wastewater is now processed. This statistic comes at a high cost after "More than a billion USD have been invested up to 2012 in the wastewater sector" with obviously very little direct impact (Capital Investment Program). Now with the 2018 wastewater plan programs are in place to protect inland water supplies and increase wastewater treatment. The development vision of this chapter includes the completion of ongoing wastewater projects, protection of planned dams, protection of major surface and groundwater resources, upgrade of the coastal treatment plants for secondary treatment, expansion of existing wastewater treatment plants to meet future demand, upgrade of the collection networks in Beirut and its neighborhoods, the completion of small-scale works (Capital Investment Program). What follows is a detailed explanation and list of each project along with its level of completion. Although the majority of the projects have yet to be completed large amounts of funding have been earmarked, now administrative incompetence is the largest hurdle stopping the success of this program. As a final note, this chapter explains that the private sector is involved in the development of wastewater activities, but further studies are necessary to fully utilize the private sector. Current policies do little to incentivize the growth of private investment, but this policy hopes to explore positive

future paths. Regardless of future plans these decades of untreated wastewater have undoubtedly increased pollution in local waterways, in the Mediterranean, and caused unknown health effects to innumerable citizens.

The failure of the National Water Sector Strategy highlights the severity of Lebanon's current position. The already present influence of climate change will force all political actors in Lebanon to either cooperate on pragmatic legislation or witness their nation fail. Even the national Ministry Of Environment explains "Being a vulnerable country with scarce water resources and high population density in the coastal areas, Lebanon is already facing and will continue to face several challenges such as sea-level rise and decrease in precipitation as a result of climate change." Making progress towards mitigation is something of utmost importance (NDC). The stresses of economic collapse, millions of refugees, political stagnation, and climatic shifts will inevitably lead to either conflict or collapse. The following chapter will attempt to lay out a framework of what must be done and who must do it for Lebanon to not only rebuild its water infrastructure but also prevent the collapse of its nation. The chapter will draw heavily from the previously discussed National Water Sector Strategy, Ward & Ruckstuhl's *Water Scarcity, Climate Change and Conflict in the Middle East: Securing Livelihoods, Building Peace*, and the interview with Fady Debbane of the Debbane and Sahkil Group.

#### **Chapter 4: Possibility For The Future**

This chapter will examine both the issues hindering change in water legislation and the solutions proposed by a multitude of sources, ultimately developing water management suggestions based on the available material. A substantial series of barriers hamper any kind of new progress on national water management. In short, the fledgling government does not have the resources or power to address such a topic when those in power are not guaranteed stable

positions. The severity of the economic and refugee crisis has created so much instability it forces those in power to focus on quick solutions, not spend money on long-term infrastructure projects deemed unnecessary. Part of any possible solution would be ending this cycle of instability and allowing government actors to move forward with long-term actions.

Additionally, with the help of the international community, forgiving large swaths of debt and restructuring the Lebanese lira would allow direct action to be taken towards electricity shortages quickly shifting to water utilities. In an economically and politically stable environment, regional utilities may begin using the funding to repair and replace infrastructure rather than focus on staying alive. In a position with a relatively stable government and economy, Lebanon can then begin to work towards climate change preparedness with close attention to water and agriculture.

A close neighbor to Lebanon, Egypt, has been able to support a water utilities system with far greater success even with less surface water and while being heavily reliant on the Nile River. One city which has a population roughly twice the size of Beirut at roughly 5 million is able to safe drinking water to nearly all of its citizens, this city is Alexandria, Egypt. Although geographically similar, placed on the Mediterranean coast, historically and economically both cities have varied greatly. The political situation between the two is incredibly different and the level of historical damage to utilities in Lebanon cannot be disregarded. Keeping these differences in mind though one can look at the possibilities of a well-functioning system in Alexandria. The Alexandria Water Company claims to have just under 2 million active subscribers with metered connections, 9 thousand-plus kilometers of piping, and 17 different branches (البوابة الالكترونية لشركة مياه الشرب بالاسكندرية). These metered connections can serve whole families and represent more than a single individual. That is equivalent to giving almost every individual in Beirut a metered connection. In Egypt as a country around 91% of the population

receives water directly in their household (Nikiel, Catherine). In contrast over 50% of Lebanese citizens do not have consistent access to clean water (Lebanon In Danger). This does not mean that Egypt faces no issues of its own, with over 90% of its freshwater coming from the Nile River it has become existentially tied to the health of the Nile (Nikiel, Catherine) In a world increasingly threatened by climate change, dependency on such a vulnerable source will inevitably become a serious issue. This has in fact already begun to manifest as an issue because the origins of the Nile River lie in Ethiopia and Sudan. As previously discussed, having control over the Nile River threatens 90% of Egypt's freshwater supply, and if threatened the possibility of conflict between Egypt and its neighbors will continue to grow. The possibility of conflict will be pushed by Ethiopia's desire for its own water security and the creeping water shortage in Egypt (Goodman, Eliora). This should act as an example in multiple ways first that complex water utilities are possible for Lebanon and second that Lebanon should not become reliant on the simplest source of water. Ideally Alexandria and Egypt in general would be seen as models for reaching a large population with relatively good water coverage. For Beirut and Lebanon to replicate such a system they would rely on renewable surface water from dams with the creation and upgrading of transmission lines being the largest hurdle. Egypt should be seen as an example of what is possible with even a relatively well-functioning state and especially after going through the 2011 Arab Spring. Recognizing the fact that other cities and nations in the region have succeeded in creating effective water utilities should further prompt change from the Lebanese government.

Only after identifying the source of a problem, one can take the first step in implementing a solution. The major problems hindering solutions to Lebanon's water crisis are first political inaction then economic failure followed by a rising demand and lowering supply. All three of

these issues create a positive feedback loop where none are addressed, and each makes the others worse. In order to break through this cycle one problem must be improved by a large amount. As the NWSS was written in 2012 and the Capital Investment Program in 2018 they do not take into account the economic downturn of 2019 and the COVID-19 pandemic, considering this any new focus must solve the country's economic collapse while addressing the most effective way to break the negative feedback loop of corruption. This would require prolonged work with the World Bank, International Monetary Fund, and United Nations. Although Lebanon already deals closely with the World Bank and the UN, a restructuring of its debts through the IMF was met with indignation from Hezbollah and other political groups (Jones). These groups must recognize that a speedy response must occur soon, or the nation runs the risk of being essentially locked out of international financial systems. As stated in an article covering this unique economic crisis "[Lebanon] needs cash and quickly, otherwise the risk is more violence on the streets as the money begins to run out completely." A prospect not wished for by any political faction (Jones). Moving on, after the state begins working with the IMF to restructure debt and open up domestic banking, government ministries can begin to work on fulfilling previous infrastructural or environmental programs. Additionally, these ministries must be audited and held accountable for lost funds or corruption. A national program of this scale would be a test for new laws such as "Law No. 175/2020, Combatting Corruption in the Public Sector and the Establishment of the National Anti-corruption Commission (NACC), first introduced 11 years ago in 2009." Which would strengthen accountability and the rule of law (Almoghabat). The hope would be to build off of the Capital Investment Program, taking into account the past five years, and providing new concrete goals. Ideally, these goals would be legally binding in some way. Finally, with a

political agreement and economic stability, Lebanon can begin to physically repair its broken water utility system.

In a position where the central government and the Ministry Of Water And Energy have stabilized and funding has been provided then each of Lebanon's four regional water utilities must immediately begin working to repair dilapidated systems. The International Institute For Environment And Development published an in-depth examination of the water crisis in Lebanon, paying close attention to the roughly 1.5 million Syrian refugees in the country. It found that many of these refugees are underserved and lack any trust in public services (Walnycki, 2017). This is especially true in southern Lebanon which lost a majority of its infrastructure in the 2006 Israeli war and as previously discussed "Despite post-war reconstruction efforts, in 2010 many people in Lebanon still did not have access to acceptable water services." (Walnycki, 2017). The Southern region of the water utilities was severely damaged and has still struggled to fully recover. This inequality has continued into the present day with many in southern Lebanon continuing to face worse access to water than those in the capital of Beirut. In addition to these geographical inequalities, the water system suffers from extreme supply losses through leaks and essentially no wastewater treatment. In fact, the current systems lose roughly 50% of all piped water and collect only 29% of all wastewater (Capital Investment Program). The remaining wastewater is piped into the Mediterranean. This represents a massive amount of supply of possibly available freshwater which is being directly thrown away. This also represents a major human health risk as firstly wastewater pollutes the Mediterranean Sea and secondly, the unknown amount of wastewater pollution likely exposes a large number of the population to this harmful hazardous waste. This possible exposure to wastewater and its possibility to increase the nation's supply of fresh water are both serious



reasons for the government to prioritize developing wastewater treatment. Reducing the amount lost through leaks and increasing collected wastewater can dramatically increase the supply of fresh water available to Lebanon while also lowering the strain on the natural environment. In addition, this does not consider the number of refugees who because of poor supply are forced to drink from unsanitary sources which may be exposed to untreated wastewater.

The Capital Investment Program attempted to address the issues of wastewater treatment, maintenance of existing utilities, and providing supply for increased demand. Although the CIP was written most of the initiatives it proposed were never acted upon because of the 2019 Lebanese protests, the COVID-19 pandemic, and the Beirut port explosion. Making the changes outlined in the CIP along with retrofitting certain objectives in light of recent events would provide a hopeful although somewhat unrealistic national plan. In addition, requiring water metering for as many homes as possible would allow the four regional utilities to increase revenue, decrease supply scarcity, and provide better water to more people. The increased revenue from water metering could then be used to complete the proposed dams of Brissa, Bisiri, Barad, Qarqaf, Younine, and Assi (Capital Investment Program). The increased supply would protect from some climate-induced precipitation changes and provide water access to a greater percentage of the population. Importantly these changes, the building out of water lines in unserved neighborhoods, would also increase access for Syrian refugees who are forced to purchase water from private sellers. Protecting the most vulnerable people from the risk of water-borne diseases and possibly providing economic opportunity. In 2022 a cholera outbreak began spreading through the Syrian refugee population, “Syrian nationals living in an informal settlement in Aarsal town of the Baalbek district.” with the cause being attributed to unsafe drinking water (Cholera -Lebanon). This outbreak has already begun growing with over 6,000

confirmed and suspected cases as of 2023 (United Nations High Commissioner for Refugees). A major concern especially with Lebanon's crippled healthcare system and poor water treatment. The symptoms of a failed water system have already begun to reveal themselves, putting even more direct pressure on the government to make a change. In tandem with new wastewater processing facilities and upgrades to current systems, these changes would provide a stable foundation for future endeavors in shielding Lebanon from the worst effects of climate change but equally as important they would stop the suffering caused by decades of neglect.

*Climate Change.* Working to prepare the country for the future severe temperature and precipitation changes due to climate change would be the final stage of water development for Lebanon. For many countries in the Middle East and North Africa, the majority of their available fresh water has already been harnessed. This is not the case for Lebanon. Inefficient distribution systems along with underdeveloped water capture methods means Lebanon has the rare ability to increase supply while increasing efficiency. The techniques used to achieve this include the "development and adoption of new irrigation technologies such as drip irrigation and fertigation and the harnessing of more water for agriculture through the construction of small and medium-sized dams and water harvesting schemes." (Ward & Ruckstuhl, Pg. 163). This proposition of increased surface water collection is examined in the CIP and the NWSS. The NWSS study used three different future water scenarios: low, medium, or high groundwater availability, this is because as of 2009 51% of the water supply came from groundwater (NWSS). In each scenario, the authors state using surface storage, and dams is required to manage resources in case of shortages (NWSS). Almost a decade later the CIP echoes the necessity of increasing surface water collection and the end of groundwater extraction. This would be done by upgrading the three elements of a water system water sources, water treatment, and water distribution &

storage. Moving away from groundwater extraction would require the completion of several dams and surface water collection projects. One example of increasing the surface water collection through dams is the now-canceled, Bisri Dam project which would have contributed an estimated 125 million cubic meters of freshwater to the Beirut-Mount Lebanon Region (Capital Investment Program). When it comes to water treatment, an example would be the construction of the Wardaniye treatment plant which would have been part of a larger water systems upgrade initiative throughout the capital region (Capital Investment Program). In regard to water transmission, another example is the Awalli-Beirut Conveyance project which contained a mix of initiatives aimed at upgrading water systems, transmission lines, and tunnels. This project has yet to be completed and seems to have also reached some bureaucratic hurdles which have stopped progress (Capital Investment Program). Investment in not only water collection but water transmission lines and distribution is absolutely necessary to see anything close to equitable water access. Projects of this scale are necessary to meet the demands of the present and prepare Lebanon for an uncertain climate future. The reasons for their incompleteness may vary from legitimate physical issues to simple corruption. Regardless, if the earlier studies of Lebanon's future access to water are still accurate in their conclusions, Lebanese leadership must implement these new services and focus on increasing surface water collection. Building the proposed projects would provide much-needed jobs, bring more equitable access to water, and help stabilize Lebanon's faltering economy. This may allow the country to meet both current and future water demands.

These new systems would be part of a broader concept called Integrated Water Resources Management. The goals of IWRM include social equity, economic efficiency, and environmental sustainability (Ward & Ruckstuhl, 2017). The first goal, social equity, would be achieved when

the majority of the population has access to clean water. Economic efficiency means bringing the most water to the most people in the most economical way possible. The third goal, environmental sustainability, focuses on sustaining the natural systems which provide quality fresh water to the whole population. Specifically, this goal is to protect the hydrological cycle for future generations. In short, this concept should be implemented because the "IWRM can thus act as a comprehensive, participatory planning and implementation toolkit for managing and developing water resources in a way that balances social and economic needs, and that ensures the protection of ecosystems for future generations." An obviously beneficial outcome for any country (Ward & Ruckstuhl, 2017). Ward and Ruckstuhl go into further detail in Chapter Six of their book yet essentially this approach, the IWRW, should allow Lebanon to work its way towards water security.

In addition to these water-focused responses climate change will affect many other areas of the Lebanese state and society. There will be an increase in temperatures and less rainfall but along with this intensification "Climate change will cause higher rates of infectious disease, rises in illness and deaths due to higher temperatures, increased malnutrition from reduced agricultural output and higher frequency of extreme events." Putting immense stress on an already deteriorating state. Flooding from sea level rise and reduced crop production are all events that Lebanon must prepare for. It is possible that with new initiatives and help from private entrepreneurship Lebanon can prepare for this future. As extreme weather events increase, and disasters become more common, the public at large may begin to force the hand of the government to take the necessary precautions and prepare for a difficult future. A speech by the then UN Resident & Humanitarian Coordinator for Lebanon, Najat Rochdi, discusses these challenges and the possibility of success when facing them. She concludes that collaboration

between every aspect of Lebanese society from the government to villages is required to address the oncoming challenges of climate change. A social push must be made to educate and raise awareness on the topic with the hope that with knowledge will come the desire for change.

## **Chapter 5: The Best Paths For A Broken System**

Ultimately it must be recognized that Lebanon and the world are entering an age of water scarcity, where the constant exploitation and almost endless supply of water will no longer exist. History has shown time and time again the power water has over society, lifting empires towards new heights and tearing them down just as quickly. Today is no different, every nation, city, state, or region depends on some kind of clean fresh water, and as climate change begins to inflict greater burdens those sources may dry up. In a place as arid as the Middle East countries have already begun falling under their required water levels “Country after country lacks the freshwater to grow enough crops to feed its population or provide the basis for long-term rising living standards” causing tensions and economic downturn (Solomon, 384). Some would argue that water has played a key role in the tumultuous decades of violence that have gripped the region. Regardless of the factuality or degree of that statement, it is indisputable that water has historically held a major role in the Middle East and will likely be a deciding factor in its future success. These nations may choose to fall into violence and bloodshed or, although unlikely “it is possible that with rare statesmanship and sufficient desperation, a Middle Eastern water famine might lead inexorably not to devastating warfare but to cooperative model of water détente that helps forge regional peace.” (Solomon, 412). Although unlikely the interdependence of these states’ water sheds, with cross-border rivers and aquifers, makes some type of common treaty or agreement possible. Perhaps a multi-state initiative to cooperate and work together to solve their joint water crises will not occur but when the prospect is the collapse of the state diplomacy may

come easier than war. Lebanon for this matter has been granted a golden opportunity not only because it could be water independent but because with proper planning and investment, it could export water to its water-scarce neighbors. Ultimately a future will likely hold something in the middle, all that can be hoped for is that leaders see the true gravity of water as a universal human right.

All the previous topics and issues covered attempt to paint an image of a country with massive potential to secure water resources but also one in need of serious institutional and social changes. The goal of the following chapter is to provide empirically backed recommendations working to solve Lebanon's water scarcity challenges while highlighting the potential that the country holds. The most significant element of this includes the construction of dams and reservoirs, repairing physical infrastructure, specifically water piping, water distribution sites, wastewater management, and increasing equitable distribution of water. There has been a long history of reports, initiatives, and strategies to solve this problem dating as far back as 1990 following the Taif Agreement and all the way up to 2018 with the Capital Investment Program. Many of the arguments made throughout these reports continue decade after decade going unanswered until total failure. A quote that shows these decades of neglect is found in the book *Options For Lebanon* by Nawaf Salam, "At a time when the Lebanese are suffering from severe shortages of water, coupled with a deterioration of its quality because of bad management, about half the 2600 million cubic meters of accessible surface and groundwater is wasted every year" this book was published in 2004 (Salam, 258). This quote was written two years before the Israeli war, fifteen before the COVID-19 pandemic and mass protests, and sixteen years before the Beirut port explosion. The problems faced then have only

grown rancid with time. There must be total change within the political system before the country will see real concrete change.

Under the assumption that any type of positive political change occurs, arguably the most important element of a new water system must be the equitable distribution of access. This represents the most morally significant area in the process of rebuilding Lebanon's water system. To achieve this a tangentially related area must also be improved to see the necessary improvements in water, that area is electricity. In similar conditions to the water system, the electricity system has degraded to the point of failure and is in dire need of upgrades. The next area necessary to address is government stagnation and Hezbollah. This must be addressed by both Lebanon and the international community. The third area of concern is the economy. After Lebanon's 2019 economic collapse, very few improvements have been made in reducing inflation or providing aid to those in need. Stabilizing the economy may provide the impetus for government action and ultimately improvements in all forms of infrastructure. Finally, public education about water scarcity and the importance of the environment should be improved. This could be done through public outreach and a hiring campaign to rebuild physical infrastructure. Ideally, all these elements would be done in tandem, but they could also be achieved in series. The main goal revolves around breaking the cycle of inaction. Regardless of order, Lebanon requires major help from the international community both financially and physically/logistically and if the global north hopes to keep Lebanon as a staging ground in a chaotic region they must commit to its relief. Importantly any type of help should not only come in the form of money but also in the form of boots on the ground. Lebanon needs financial resources but also the physical essentials which are required to make progress elsewhere such as water and electricity. When

those essential infrastructure elements are met then serious governmental changes can hopefully be made.

*Infrastructure.* Another key pillar involved in a solution involves repairing widespread water utilities and general infrastructure failure. This involves reducing water waste, distributing the water efficiently, collecting and treating wastewater, and also building dams or reservoirs that reduce their environmental impact. Restoring water services without improving the electrical grid is incomprehensible, without improving the electricity grid the difficulty in upgrading water utilities would increase many times over. An assumption can be made that both would be improved in parallel during such a national shift. With this assumption, the first course of action the government must take would be to fully renovate outdated water treatment facilities with the goal of reducing lost resources. This would be followed by the identification of major leaks in the system and their full repair. Simply achieving this goal alone would greatly aid Lebanon because as stated in Chapter Four, roughly 50% of Lebanon's system-wide water is lost to leaks. Following this step, the Ministry of Water And Energy must begin the arduous task of adding water meters to as many outlets as possible. This was discussed in Chapters Three and Four because it would greatly increase revenue and allow for a better understanding of the water system as a whole. In fact, this one change would produce so much increased revenue that it was included in the NWSS strategic objectives for 2011 to 2022 (NSWW. Pg. 21, 2010). The added metering should also be added to agricultural irrigation, "Irrigation is the largest water consumer, with very limited metering, preventing volumetric charges" a large source of income that the MoWE is not exploiting (NWSS, 2010). This added income would allow both the central MoWE and the four regional water utility services to increase the overall distribution of public access to water. Especially in southern Lebanon, increased access is very necessary but also for the over



one million Syrian refugees who now reside in Lebanon. Along with increasing distribution, these funds should be used to build and finish dams to begin moving away from dependence on groundwater. This final infrastructure repair recommendation would involve increasing surface water storage systems. Again, discussed in Chapter Four and included in the NSWW, Lebanon has a rare opportunity to increase its supply of fresh water while preparing for the effects of climate change. The government can achieve this by building small to medium-sized dams which would significantly boost the country's levels of available water storage in the event of a drought. These recommendations may not represent the most realistic future Lebanon will take, rather a path which may hold the potential to greatly benefit Lebanon in both the short and long term.

*Government.* In order to sustain the physical repairs and upgrades necessary in the water utility system, the Lebanese government must work efficiently and with bipartisan support. To achieve this, Hezbollah must be brought into discussions on water infrastructure. The hope for doing this would be increased political unity and less risk of conflict over the distribution of funds or materials. In addition, this would allow the government to fill the positions of president and prime minister, which are both currently held by the same man Najib Mikati. If all parties are included in the discussions, the likelihood of success will be much higher. This holds especially true for Hezbollah because as discussed in Chapter Three they hold the largest political leverage within the country. Once this unified government has been achieved it must begin working with Western allies to acquire the supplies and knowledge necessary to rebuild its infrastructure. This obviously requires the United States to indirectly work with Hezbollah, yet this should be seen as an opportunity to expose Hezbollah's actions, learn about their organization, and ultimately build trust with the remaining political groups. This can be achieved through extreme transparency. Forcing politicians to make decisions that will be publicly known

typically reduces self-serving decisions. Now with all of these components in place, the government can move forward with protecting Lebanon from its already growing water scarcity.

*Economy.* Overhauling the tattered economy may be the single most important concept in helping Lebanon prepare for the dramatic effects of climate change. Essentially all other topics involved in repairing Lebanon's water utilities are dependent on a marginally better economy than what the country is currently experiencing. The serious nature of Lebanon's broken economy cannot be solved internally but must involve outside help. This help will come in the form of debt forgiveness or restructuring with the International Monetary Fund, the World Bank, and the United Nations. Although previous Lebanese governments have already worked closely with these entities, any future government must work even closer, inviting serious restructuring but also commitments from all those involved. There must also be heavy oversight to avoid corruption or mismanagement of funds. Previous relationships with these entities have been impassive, lacking the substantive change that should be associated with such international groups (World Bank, 2022). Requiring deep commitments forces investment and most importantly results. Part of the results necessary should include backing the Lebanese banking sector, allowing them to resume normal operations, and especially allowing Lebanese citizens the ability to withdraw necessary funds. Rebuilding trust in the banking system will require monetary losses, although it is necessary for the sector to survive. Furthermore, as discussed by the American Task Force on Lebanon, the government must attempt to work with the IMF specifically to "implement reforms necessary to unlock aid from the International Monetary Fund (IMF)" a simple way to gain further support (Gabriel, 2022). Partnering with the IMF should allow for a reduction in inflation and allow price stabilization between the black market and the formal market. The consequences of not making these economic recommendations are dire, as

stated in August 2022 by President and CEO of the American Task Force on Lebanon, Edward Gabriel, “Failure to act will result in a failed state within months.” (Gabriel, 2022).

*Education.* Public education must be the final component necessary to protect Lebanon’s water infrastructure for the future. This education should focus on water conservation along with environmental sustainability in general. In a more direct recommendation, there should be a public information campaign around adding water meters along with water management. This can be used to build transparency with the government and to develop localized water management groups. Creating a series of bottom-up water management groups would fall in line with the Integrated Water Resource Management concept discussed in Chapter Four. These groups would provide a level of future-proofing in that they have an interest in protecting their local water resources. Ward and Ruckstuhl describe this concept as “essentially the modernized equivalent of the ubiquitous community groups which managed water resources in the region since time immemorial” a community element that would have a welcomed return (Ward & Ruckstuhl Pg. 95, 2017). Along with this public outreach and education program, there should be a national hiring initiative for labor to work on both water and electricity infrastructure. This would be similar to other countries’ past initiatives meant to increase employment, reduce poverty, and better the public in general. The hope would be that a better-informed public with a higher trust in government initiatives and economic development will continue the push to further develop water infrastructure but also all elements of society.

*Sustainability.* Introducing the ideas of sustainable development and environmental design should play a considerable role in the repair of Lebanon’s water system. The CIP and the NWSS recognized a relative drop in available freshwater over a decade ago and now Lebanon finds itself in an even worse position to respond to such a scenario. A frozen government,

utilities holding on by a thread, and rising temperatures have all coalesced within the past decade to put Lebanon in an incredibly precarious position. It is because of this existential problem that sustainability must be included in all future plans. A completely failed state would threaten the lives of millions of people and likely lead to a fully-fledged war over the religiously diverse region. Some of the sustainability initiatives necessary involve reducing water consumption, distributing the water efficiently, collecting and treating wastewater, and also building dams which mitigate their impact on the natural environment. One of the most important features to remember in regards to sustainability is retaining underground aquifers. Aquifers are non-renewable sources of freshwater; they take centuries to replenish, and Lebanon does not have access to aquifers large enough to meet its demand for extended periods of time. A case study of what happens when an Arab nation depletes their aquifers beyond repair can be found in Saudi Arabia. Rapidly exploiting their massive oil supplies Saudi Arabia was able to collect vast sums of wealth. Rather than invest that into efficient and pragmatic infrastructure large investments were made in national agriculture, using water which Saudi Arabia did not have. The nation has essentially no renewable surface water and has become completely reliant on the same underground aquifers which fed their ancient oasis. These investments in agriculture led to the incredibly fast reduction of the aquifers, “by pumping out nearly the equivalent of one Colorado River per year – eight times greater than the volume of renewable recharge – the Saudis had exhausted about 60 percent of the accessible aquifers by 2005” a reality which would force the government to quickly attempt to reduce water usage (Solomon, 414). Unfortunately, it is easier to waste water resources than it is to conserve and protect them. The Saudi government should have invested its massive funds towards efficient infrastructure, building trading routes, and developing tourism or industry which could support the nation without future oil sales. Now

Saudi Arabia must depend on unknown advancements in costly inefficient desalination plants. Lebanon must not make a similar mistake by continuing to extract from underground aquifers. They must focus on surface water collection through dams and reservoirs along with wastewater treatment. These methods can be sustainable and with a healthy economy offer far more benefits than just freshwater.

Furthermore, conservation should also be considered in the discussions about this large infrastructure project. For Lebanon, this is exceptionally important because it is home to some of the only temperate biomes in the region with occasional snowfall and forests. One of these ecosystems, the Shouf Biosphere, is home to hundreds of different species with 25 on the internationally threatened list and 48 being native to only Lebanon and the close by regions (Fitt). These 50,000 hectares of land support innumerable species as well as local villages which have survived in the area for hundreds of years (Fitt). Directly to the East of this reserve is the Qaraoun Reservoir, home to the largest dam in Lebanon. This dam has been a success economically and socially yet environmentally it has been mistreated. Lack of regulation leading to pollution from runoff and wastewater has damaged the lake's ecosystem and led to fish die-offs. If Lebanon is to increase surface water collection by further damming the Litani River or the tributaries in the Shouf Biosphere it must take to utmost care to ensure environmental protection. Threatening the species more than they already are risks forcing them into extinction and damaging Lebanon's delicate ecosystems. This risk is why it is incredibly important that new water infrastructure and infrastructure, in general, do not excessively damage habitats. In fact, these new projects provide an opportunity to protect new swaths of unprotected land. Preserving these areas and the services they provide must undoubtedly be included in any discussion of massive national reconstruction.

As has been shown throughout this thesis, the water scarcity problem in Lebanon has become one of the country's largest issues but to address any meaningful area of this problem massive reforms are necessary. These range in complexity from the repairing of water pipes to the restructuring of the country's economy. The unfortunate reality is that many of these seemingly insurmountable objectives must be achieved if Lebanon hopes to continue as a functioning state. The failure of the water system acts as a symptom of widespread problems involving corruption, political stagnation, and economic collapse. The fixing of the water system would then represent the solving of many of the nation's ailments. This attachment between the infrastructure of the state and the metaphorical health of the Lebanese state is the reason why international bodies and allied countries must use water utilities as a means to impact all forms of the Lebanese government. This can be done through all five of the recommendations laid out in this chapter: infrastructure repair, government reforms, economic modifications, and public education. Achieving any one of these goals would represent a major shift in the positive direction. Hopefully the examination of this issue of water scarcity and the recommendations provided sufficiently support the argument for international aid in the rebuilding of the Lebanese infrastructure.

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