WATER POLICIES AND POLITICS IN LEBANON: WHERE IS GROUNDWATER ?

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Roland Riachi

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LIST OF ACRONYMS

AFD	Agence Française de Développement, French Development Agency
BGR	Bundesanstalt für Geowissenschaften und Rohstoffe, Federal Institute for Geosciences and Natural Resources
BMLWE	Beirut Mount Lebanon Water Establishment
CAS	Central Administration of Statistics
CDR	Council for Development and Reconstruction
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GDE	General Directorate of Exploitation
GDHER	General Directorate of Hydraulic and Electrical Resources
GDP	Gross Domestic Product
IRFED	International Institute for Research and Training for Harmonized Development
LRA	Litani River Authority
MECTAT	Middle East Centre for the Transfer of Appropriate Technology
MoA	Ministry of Agriculture
MoE	Ministry of Environment
MoEW	Ministry of Energy and Water
MoIMA	Ministry of the Interior and Municipal Affairs
MoPWT	Ministry of Public Works and Transport
MoSA	Ministry of Social Affairs
NGO	Non-Governmental Organization
NWSS	National Water Sector Strategy
OECD	Organisation for Economic Co-operation and Development
TVA	Tennessee Valley Authority
UNDP	United Nations Development Programme
UN-ESCWA	United Nations Economic and Social Commission for Western Asia
UNHCR	United Nations High Commissioner for Refugee
Unicef	United Nations Children's Fund
USAID	United States Agency for International Development

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1 Introduction

The objective of this report is to analyse the contemporary challenges facing groundwater resources in Lebanon. From the evolution of land tenure regimes to modern politics, we outline the use and mismanagement of groundwater in the country. The intensive use of groundwater resources is of relatively recent origin, dating back no more than half-century in most countries. Lebanon illustrates this global trend with a tripling in irrigated area, rising from 40,000 ha in 1960s to 120,000 ha in recent years (MoA and FAO 1963, 2010). This was accompanied by a hike in pumping equipment usage, whether for urban, industrial or agricultural use. In the 1970s, official reports identified around 3,000 wells in the country (CDR 2005a). In the 2000s, documents refer to about 50,000 private boreholes (World Bank 2003, MoEW 2010). The most recent information available on the number of wells identifies around 80,000 wells, which represents a high average of 8 wells/km^2, among them more than 59,000 unlicensed wells and 21,000 operating with a license (MoEW and UNDP 2014). Whether legal or illegal, these figures are huge when compared to the 842 public wells supplying the public water networks.[1] This exponential increase in the number of private wells is primarily the consequence of citizens seeking autonomy due the absence of, or deficiencies in public networks. This informal and illegal practice accelerated during the war and later during the reconstruction period. One must consider that the drilling of wells by militias, political parties and their factions has long been a mean of creating new allegiances, or consolidating old ones (Ghiotti and Riachi 2014). From drilling wells and supplying cisterns to constructing large dams, war and post-war actors have used and are still using water as a socio-communitarian service to reinforce their political and social legitimacy (Riachi 2013).

Since the Lebanese civil-war ended in 1990 with the Taef agreement, the Lebanese government has launched a number of policies addressing water usage, ranging from the early emergency reconstruction plans in 1992, to targeting large-scale projects to rehabilitate infrastructure and meet increasing demand. Along those infrastructure-based policies, none of the post-war governments did tackle coherently groundwater usage and management issues. The emphasis has been on reaching water security through the mobilization of engineered solutions, such as the construction of around twenty dams on Lebanon's 17 perennial rivers. Despite the ultimate role it plays in Lebanon's water supply landscape, groundwater has only been granted limited attention within this vision. This driving discourse behind those policies advocates that it is only through the storage potential of dams that the current pressure on groundwater can be relieved, while aquifers should be kept as strategic reservoirs.

This dominant supply-side vision focused on dam construction has obstructed any formulation of a clear and comprehensive public policy regarding the use and conservation of groundwater in the country. Looking at water policies solely from this surface supply-side perspective does not address the legal pluralism that governs springs and groundwater uses, especially private rights on water sources (*houqouq muktasaba*) and access to groundwater under different pre-existing practices, rules and norms (Riachi 2013). This juxtaposition of norms, codified at the end of the 19th century by the Ottoman Medjelle and in the 1920s under the French Mandate, assembles customs, Islamic Hanafi jurisprudence, old French laws, added to some new laws prepared or enacted under donors pressures (see Section 4). As we discuss in this report, it is the power relations of the country, economically ruled by a *laissez-faire* regime and politically governed by confessionalism, that are behind maintaining this legal pluralism in groundwater management. It is clear that with a legal system devoted to private property usufruct rights and in light of

[1] According to UNDP (2014), out of the 842 public water supply wells, only 20 wells are equipped with continuous groundwater monitoring devices.

neoliberal policies, groundwater in Lebanon is being depleted, with various degrees of water appropriation, commodification, privatization, and property rights.

In order to understand and address groundwater challenges, this report first covers the production of groundwater from natural endowments and climate change, uses and pollution (Sections 1-3). Secondly, the report looks into the place of groundwater in water policies (Sections 4-5). The report is structured as follows: Section 1 gives an overview of Lebanon's hydro-geography. Section 2 addresses domestic water and urbanization groundwater related issues. Section 3 analyses aquifers use in irrigation, emphasizing on the export market-led production of water-intensive crops. Under a prism of political and power relations to water, Sections 4 and 5, respectively, deal with the legal and institutional frameworks governing the use of groundwater in the country.

2 Hydro-geography, climate change and groundwater conditions

In order to understand groundwater issues, it is important to give a quick overview of the hydro-physical endowments of Lebanon. The country stretches along 210 km on the eastern side of the Mediterranean with an average width of 55 kilometres. The country is divided into three main geographical areas; The Mount Lebanon range with an altitude that rises from the coast to 3,083 m, the interior Beqaa valley, with an elevation varying between 800 to 1,200 m and the Anti-Lebanon, with its highest point situated at Mount Hermon at 2,814 m in its southern part. Due to its mountainous ranges, the orographic effect induces multiple climates, with rainfall estimated to range between 2,000 mm (snow cover equivalent) and 200 mm in the arid region of Hermel in the northern part of the Beqaa.

When climate change is not inducing extreme conditions, the country has generally a Mediterranean weather and a winter lasting from October to April, with 80% of the rainfall occurring in four months, between November and February. However, this precipitation trend is showing rapid variations in patterns, as will be discussed later. When compared to the rest of the Near-East region, Lebanon is in a relatively fortunate position regarding its overall water resources because of its mountainous landscape that makes all the water available originates from within the country. This removes the country from any water dependency position, of course, without excluding hydro-political tensions with Zionist Israel over Jordan tributaries, Hasbani and Wazzani, as well as the limited allowed access to the Assi, shared with Syria and Turkey.

Geological karst formations are dominant in more than two-thirds of Lebanon. Geologic studies show that there are 15 major aquifers in Lebanon, out of which 14 are in karstified carbonate strata (Edgell 1997). If Greek historian Herodotus described Egypt as being the "*gift of the Nile*" in the 5th century B.C., there is no doubt that Lebanon is a gift of karst. This rocky carbonated and calcareous limestone formation favors infiltration and gives birth to 250 perennial springs and 17 rivers (ibid.). Surface runoff in Lebanon is mostly dependent on groundwater flows from karst aquifers. Except the Litani and Assi in the Beqaa valley, other rivers have no significant alluvial aquifers that could help support their flow and form torrential rivers flowing over short distances on the western flank of karstic Mount-Lebanon (see Figure 1).

Rapid changes have occurred over the last decades in Lebanon's aquifers. The main limestone Cenomanian aquifers' discharges have shown an average decrease of 9 litres/second (33%) between 1984 and 2005, while Jurassic aquifers showed a decrease of 6.5 litres/second between 1987 and 2005 (21%) (Shaban 2009). This has led to a drop of the water table between 20 to 25 meters in the Cenomanian aquifers and 5 to 10 meters in Jurassic aquifers. Under the effects of climate change, estimates indicate that two-third of the Lebanese territories are prone to severe desertification by 2025 (MoA 2003). According to hydrology experts previous estimates, the effect

of climate change would reduce the water balance by 15% and will induce a 6% increase in the demand for water for irrigation between 2000 and 2020 (Bou Zeid and El Fadel 2002).

Overall snow cover and precipitation rates decreased by 12–16% over the four decades, between the 1960s and 2000s, while spring flows showed a 23–29% drop and river flows reached half of their average volumes (Shaban 2009). According to scenarios made by the Second Communication Report on Climate Change for Lebanon to the (MoE 2011), Lebanon is likely to witness an increase of 1°C in average yearly temperature before 2040, reducing water availability by 6-8% and by 12-16% with an increase of 2°C. A 4°C scenario by 2090 will decrease rainfall between 25% and 50%. A decrease in precipitation, admittedly due to culminating climate change effects, coupled with uncontrolled pumping of aquifers in the country, have caused this sharp decrease in spring flows and aquifer levels, and the situation is worsening.

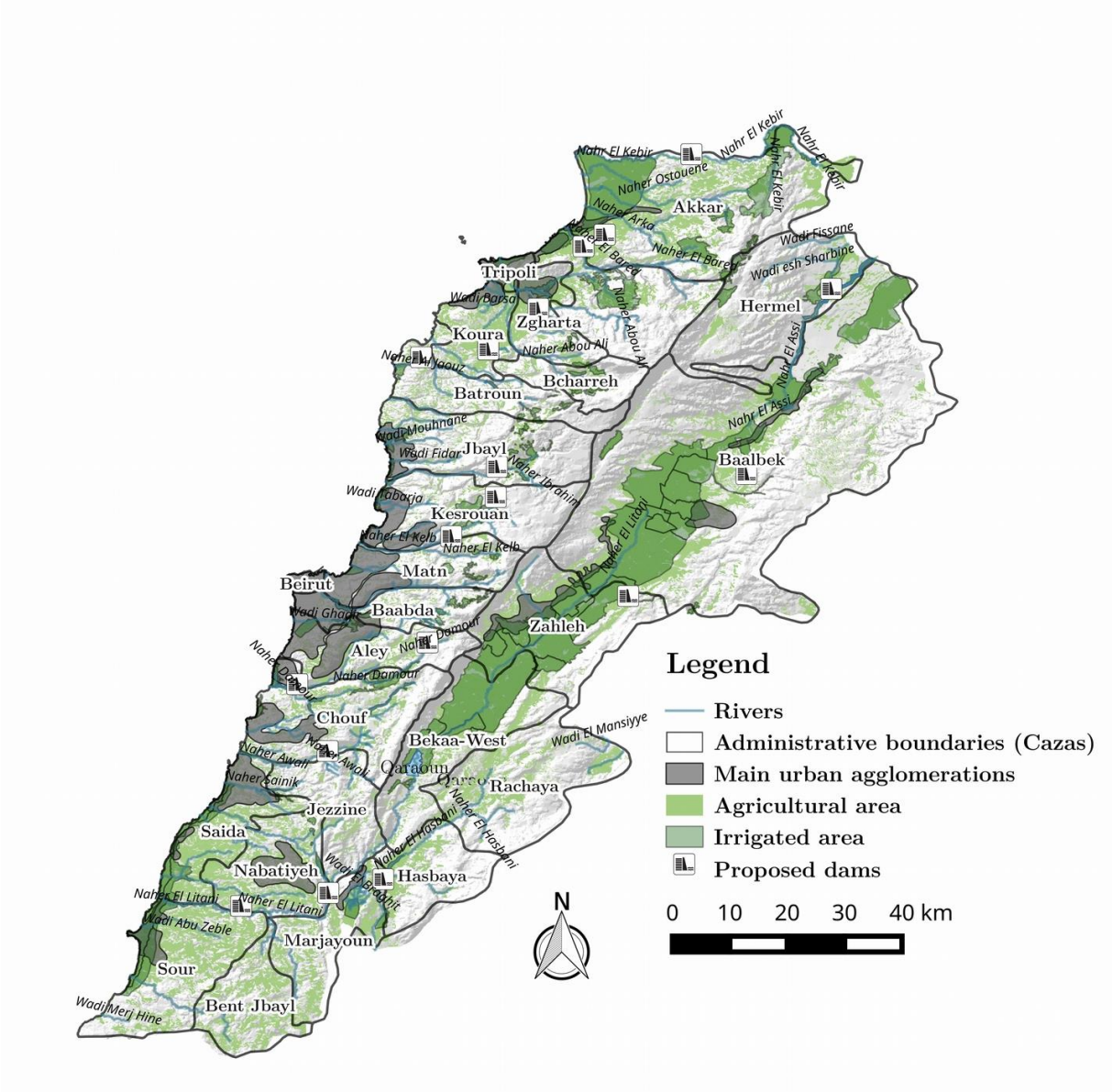
A recent assessment made by the Litani River Authority estimated that groundwater storage decreases annually by 70 million m^3 (Mm^3) in the Beqaa valley, and will continue to decrease in the future (Amacha 2014). In 2009, Bassam Jaber, former director of the General of Directorate of Exploitation at the Ministry of Energy and Water emphasized the environmental changes taking place, stating that "*[twenty] years ago we used to count on 80-90 rainy days a year in Lebanon. Today we forecast 70 rainy days*".[2] It is clear that climate change is rapidly modifying water availability, and when two extremely dry winters were recently recorded (in 2014 and 2016), no drought crisis measures were enacted to cope with the situation. In 2014, only late in July, parliamentarian committee for public works made a call for a state of water emergency; no substantial measures were taken but some surprising official statements appeared, proposing to import water from Turkey "*by using enormous plastic balloons (…) shipped through the [Mediterranean]*."[3]

In the absence of a sound public water supply, the pace of groundwater overexploitation is accelerating. It is important to note that since the 1970s until now, no serious improvement has been made in quantifying groundwater resources on a regular basis. Before the war, Lebanon used to have a decent hydrological service, especially in the agricultural areas such as Akkar in the north and the Beqaa valley inland. The United Nations Development Program (UNDP) made the first groundwater map and aquifer assessment in 1970. Today's water balance data is based on old measurements and estimations and does not take into consideration the impact of land use changes, such as the effect of deforestation, pollution or urbanization, on aquifer recharge or on surface runoff. The lack of good data hinders any clear accounting that would shed light on the reduction of springs and river baseflows, or wells yields from aquifers.

Surface and groundwater quality data can be found in different studies but most of those sampling activities have been conducted since the 1990s in fragmented unofficial efforts as part of academic studies, ministry official environmental assessments, environmental research institutes, or international organizations reports. There is a clear need for data to account for spatio-temporal variations in river and groundwater quality, something Lebanon has not been consistently monitoring. Some institutions, like the Litani River Authority in 2007, started collecting water quality data for standard bacteriological and physical-chemical parameters. Other projects such as the Litani River Basin Management Support (USAID funded project based at the Litani River Authority) started to collect data in 2012 for a quantitative and qualitative groundwater resources assessment but the lack of data on historical trends remains a hurdle. With the end of the project, data collection was discontinued due to technical and financial shortcomings.

[2] IRIN News, 13 August 2009, Lebanon: Reduced rain window threatens water crunch. According to results from the Implementation of Technical Tools for Water Management (MOTGE) project, Safege 2009.
[3] The Daily Star, 9 July 2014, Qabbani calls for state of water emergency.

Figure 1. Lebanon's administrative boundaries, agricultural areas and proposed dams



Source: Author's compilation

It is only recently, 45 years after the first report, that a second UNDP repot has been published which identifies existent aquifers and makes a decent effort to assess groundwater basins report (MoEW and UNDP 2014). With this technical report, a better understanding of the hydro-geologic composition of the country can be considered in future groundwater studies and policies. According to the report, the hydrostratigraphic units of the country are classified into three main groups: aquifers, semi-aquifers and aquicludes. The two main aquifers are the Kesrouane Jurassic (J4) and the Sannine-Maameltain (C4-C5), which are mainly composed of karstic carbonate rocks and covering about 5590 km2 of the Lebanese territory. In the UNDP 1970 study, 32 groundwater-basins were identified and divided into two main hydrogeological provinces: the Mediterranean Province and the Interior Province. Based on the re-evaluation of groundwater basins undertaken during this study, a total of 51 groundwater basins were identified; of which 28 productive basins and 3 unproductive basins are located in the Mediterranean Province and 17 productive basins and 3 unproductive basins are in the Interior Province.

It is widely recognized by different water balance studies that Lebanon receives on average 800 mm of rainfall per year, which is equivalent to 8.6 billion m^3 (Bm^3) per year (MoE 2010). Evapotranspiration reduces this amount by 56%, giving around 4 Bm^3. As a result of trans-boundary and aquifers runoff available water resources are estimated to represent 2.7 Bm^3, with 2.2 Bm^3 of surface water and 0.5 Bm^3 for groundwater recharge. According to the compilation of those different estimates (ibid.), net exploitable surface and groundwater is estimated at 2 Bm^3. In contrast, national consumption is estimated to be around 1.5 Bm^3, which represents a very high rate of consumption versus availability of the exploitable resource (almost 75%). When broken down according to sector, agriculture diverts around 65% of water, domestic use 25%, and the industrial sector 10% (NWSS 2010).

According to the National Water Sector Strategy report (MoEW 2010), Lebanon's yearly water balance includes 0.5 Bm^3 of natural groundwater recharge, while it is estimated that almost half of the water used is abstracted by wells, which amounts to around 0.70 Bm^3. According to this data, under normal climatic conditions there is a yearly 200 Mm^3 deficit in groundwater. The recent UNDP (2014, p. 72) report, however, notes a much more alarming drop in many groundwater aquifers in urbanized and irrigated area (see also Figure 1) stating that: "*Many of the coastal groundwater-basins, which are heavily urbanized, show significant deficiencies in the water balance. Deficiencies reaching more than 150* Mm^3 *per year in the dry year were observed, such as in the North Lebanon Cretaceous Basin which showed a deficiency of 157* Mm^3 *(equivalent to 427 mm); the Hadath-Hazmieh Cretaceous Basin with a deficiency of 7.2* Mm^3 *(equivalent to 544 mm); and the Beirut Neogene-Quaternary Basin with a deficiency of 38.4* Mm^3 *(equivalent to 648 mm). The South Beqaa Neogene Quaternary Basin and North Beqaa Neogene-Quaternary Basins show deficiencies in their budgets of up to 45.7* Mm^3 *and 34.2* Mm^3 *respectively (equivalent to 84 mm and 50 mm), mostly due to intense exploitation for irrigation purpose."* This report provides much higher values for groundwater recharge (mentioned above at 500 Mm^3), also defined in the report as inflow to groundwater, in a dry year (2010-2011) as 3,570 Mm^3 and in a wet year (2011-2012) to 6,105 Mm^3. The difference in accounting for groundwater recharge between this recent report and the estimation of water balance in any existing report estimating the water balance is striking. Groundwater recharges are 7 to 12 folds higher in this Groundwater budget compilation compared to any other Water table estimations. Underestimating the importance of groundwater in accounting for water balance in official reports, and not using a groundwater water budget instead has led to an overestimation of surface water. Inflated surface runoff estimations has subsequently been used in the rhetoric advocating for building dams to capture this "wasted" water going to the sea.

Many studies proposing water supply and demand scenarios have been used to advocate for large-scale projects. A World Bank report (2009a: 13) estimates that water demand will almost double and reach 2.8 Bm^3/year in 2030, with an assumption that "*domestic and industrial water demands are anticipated to grow at about 5 percent per annum*". In contrast the National Water Sector Strategy (MoEW 2010) argues that the demand increase will be reaching 1.7 Bm^3 in 2030 under a moderate consumption growth rate of 1%. Whether with moderate or high predictions, all official and international policy prescriptions focus less on groundwater management and emphasize increased surface water storage through the construction of twenty dams and twenty hill lakes all over the country (see Section 5.3). The mainstream approach governing those policies advocates that climate change and population growth are the main causes of water scarcity.

However, what is striking is that none of the supply trends took into consideration the expected drop in rainfall that was discussed previously. In addition, the estimates of consumption did not consider the foreseen stabilization in population in Lebanon in the 2040s. As mentioned in an UN-ESCWA report (2010: 2): "*The population size of Lebanon increased from 2.6 million in 1980 to 4.3*

million in 2010. It is expected that the population will keep on increasing to reach 5.323 million in 2045 after which it will decrease slightly." Despite this, policies are driven by a Malthusian logic that lead to mobilizing large-scale projects to face demographic pressure.[4] Those advocating for dams are also utilizing any climate change induced water-crisis to advocate for surface storage. Something that is counter intuitive, as less precipitation means logically less springs runoffs, hence, less surface storage, which of course lead to higher unexpected opportunity costs. Any physical solutions to water shortage in Lebanon have to start by assessing the level of flow, storage, use and depletion of aquifers. Next section emphasizes the relation between groundwater conditions and urbanization in Lebanon.

3 Urbanization, public network and the wells option

As a result of rural-urban migration and the many other migratory and refugee population movements that Lebanon witnessed during the 20th century, it is estimated that 53.1% of residents in Lebanon live in slums, according to UN-Habitat (2005).[5] The recent influx of more than a million of Syrian refugees since 2011 has increased this figure, due to their inadequate housing conditions; 40% of Syrian refugees live in inadequate substandard shelters; among them, 15% live in tents (UNHCR and UN-Habitat 2014). The political discourse emphasizes that this situation has added a huge demographic burden on the country's already scarce water resources and poor networks. This, however, is a gross exaggeration of the real impact of the refugee population on the country. In 2013 a World Bank report assessing the need for international community assistance to Lebanon reported that additional estimated water demand was a mere 26.1 Mm3/year, equivalent to 7% of the pre-crisis domestic water demand, barely a 1.5% of total water freshwater consumption (World Bank 2013). With the sharp drop of tourists during the same period, the effect could even be nullified at the national scale.

Of course, refugees do not have the same consumption patterns as locals to compare properly. According to a UNICEF survey (2012), 60% of Syrian households in Lebanon have reported not to have access to adequate water supply, and 40% reported the prevalence of diarrhea among children in the two weeks prior to the interview. A UNHCR report noted that in informal settlements "*water is most commonly accessed through wells located within the rented property or nearby. This water is frequently not suitable for drinking. Residents instead rely on water distributed by NGOs (and sometimes purchased) which they store in tanks provided by international organizations*" (UNHCR 2014). Although they largely do not rely on the public network, Lebanese government uses water consumption by refugees as financial costs to seek funds from international donors. Exaggeration in the statements made about the use of water by Syrian refugee exacerbates the population-driven water crisis discourse and often turn into xenophobic narratives, rather than serving genuine humanitarian need. This also holds for news about the impact on water quality of the sewage generated by refugees. It should be noted that most towns were polluting water due to lack of treatment facilities and with hazardous industrial spillage well prior to the crisis in Syria.

It is at the end of the civil war in 1990 that the concentration of population in urban areas created a profound change in water use, shifting priorities from agricultural to urban use. While only 2.5% of the surface of Lebanon was built on in the 1960s, urban areas currently account for 8%, with

[4] In his book Essay on the Principle of Population (first published in 1798), Robert Malthus presents his theory demonstrating that population growth always increases beyond its limits of subsistence, long criticized as being overlooking social, political and economic factors behind the uneven allocation of wealth.

[5] UN-Habitat 2005, Global Urban Observatory database

densities reaching 1,300 inhabitants per km2. More than one third of the population is concentrated in coastal cities, with 1.3 million people living in Beirut and its suburbs. In 2004 it was estimated that among 4 million Lebanese, 50.4% of them lived in the Beirut and Mount-Lebanon area, 20.5% in the north, 12.5% in the Beqaa and 16.6% in the south (MoSA et al. 2006).

Due to a deficient water supply network, new practices have emerged in the supply of domestic water, bottled water and jugs, cisterns and the multiplication of domestic wells. This mismanaged expansion of urbanization has put direct pressure on water resources, especially on groundwater. For instance, high water salinity in coastal aquifers due to groundwater overexploitation driving seawater intrusion is having a severe corrosive effect on pipes (El Fadel et al. 2000; Korfali and Jurdi 2009). Another indirect effect of urbanization on groundwater is the expansion of quarrying to supply construction materials. Around 700 extraction sites are reported in Lebanon, covering 5,267 ha and causing the destruction of arable and forestry lands. Excavating on high-infiltrating karstic limestone formations, those quarries have sedimentation and pollution effects on aquifers that in turn can have disastrous impacts on the whole water cycle. Most of this industry is operating illegally, with close ties with politicians who often also own the quarries in question (Leenders 2004).

In terms of domestic water infrastructure coverage, many reports before the civil war stated that Lebanon was close to achieving universal service, with a network covering 95% of households. Different censuses and household surveys have recently estimated that the percentage of households and buildings connected to the public network is close to 80% (CAS 2005; MoSA et al. 2006). Even though this ratio is high compared to other countries with the same level of development as Lebanon, large disparities remain within Lebanon. More than 90% of households in Beirut are connected to public networks, but this is only the case for 45% of households in Akkar in the north (MoSA et al. 2006).

Most of the surveys and censuses studies that addressed water and sewage networks have published regionally aggregated data. The only exhaustive study was the first Buildings and dwellings census made by the Central Administration of Statistics between 1996 and 1997. The census took the "*Circonscription foncière*" (CF), which is the smallest administrative unit in the country (there are around 1,500 CF) and collected building and household data. The results of the census at the national level showed that 77% of buildings were connected to the water network, 17% relied on wells and 35.6% were connected to a sewage network.

It is possible to identify three regions where public network connections are low and dependency on wells is proportionally high. First, rural and mountainous regions where the network has always been limited. Second, in peri-urban areas where the network was not able to cope with the rapid increase of new constructions. Third, the southern occupied regions, liberated in 2000 (e.g. Naqura, Bint Jbeil, Khiam and Marjaayoun). This situation is true for both water and sewage networks, and when those are missing, reliance on wells increases. There is also a high correlation between the lack of water and sewage networks, reliance on wells, and water-borne diseases (Riachi 2013). Water-borne diseases hit mainly rural areas like Rashaya, Hasbaya, West Beqaa, Baalbeq, but also cities like Zahle and Tripoli.

Sewage system coverage is mainly concentrated in coastal cities and in some capital cities of districts (*Cazas*, or *Qada*). Recent surveys found that two-third of Lebanese households are connected to a sewage network (MoSA et al. 2006). This is almost double of what was found for buildings in the 1997 and 2004 buildings censuses, in which only one-third of buildings were connected to a sewage system (CAS 2005). According to the 2010 National Water Sector Strategy, only 4% of water used in Lebanon is treated (MoEW 2010). Hazardous spills are affecting springs and aquifers, with 70% of groundwater polluted by fecal coliform (Plan Bleu 2000). In some areas,

direct spills to the sea led to bacteriological pollution of coasts reaching 200 times WHO standards, as in Halba, Selaata, Tabarja, Nahr el Kalb, Antelias, Ramlet el Baida, Ouzai, Saida and Baissarieh (MECTAT 2005, 2013).

A lack of wastewater facilities in the Litani river basin in the Beqaa has caused disastrous rates of chemical and biological contamination due to direct sewage and industrial effluents to surface and groundwater. A recent EU-funded research found that the cost assessment of water resource degradation in the Upper Litani Basin is estimated alone at 0.5% of the National GDP in 2012 (EU 2014). In 2014 the Lebanese government unveiled a USD 730 million project to tackle the whole Litani basin pollution, but no achievement is yet noticeable. The current situation has severe direct human, economic and social costs. WHO data on water-borne diseases shows that in 2004, 2,500-3,000 people died in Lebanon because of severe diarrhea, with children under 14 representing 80% of cases. The same report estimates disability-adjusted life year (DALY) to reach 257 for 100,000 inhabitants, economically equivalent to 75 million USD or 0.3% of GDP per year.[6]

A study carried out by the World Bank in 2004 estimated at 2.8-4% of GDP the environmental and social costs in Lebanon, with 1 to 1.2% due to poor water quality. By considering the hidden costs of water management, such as unaccounted water, opportunity costs, and environmental costs, a World Bank report (2009b) estimated that the total cost of inaction in water management in Lebanon is 2.8% of GDP per year. The largest share is the private opportunity costs or domestic expenditure on off-network water supply, amounts to 1.3 percent of GDP (USD 308 million) representing 75 percent of the total budget (ibid.). The most prominent sources of private water supply, in terms of expenditure share, are delivered returnable containers (35%), followed by delivery trucks (21%), water bottles (16%), artesian wells (2%) and private supply networks (1%). The deficit between demand and supply for potable water has resulted in a rationing of the service. The situation is particularly acute in Beirut and Mount Lebanon, where water supply drops from 13 hours during the wet season to only 3 hours during the dry season. In other regions with lower population density, summer rationing reaches on average 9 hours (World Bank 2009a). With no metering at all, water is charged through a flat fee collected by the Regional Water Authorities (*Etablissements des Eaux*).

In spite of the absence of metering and a correct evaluation of leakage, it is estimated that the actual fee is potentially able to cover all operation and maintenance costs of the water network in the country. If Water Authorities are not able to reach their cost recovery targets, it is mainly due to low bill collection. A World Bank report (2009a) found out that the Beirut Mount Lebanon Water Establishment (BMLWE) covers 223% of its operation and maintenance costs through collected bills. This cash flow is being channeled to large-scale projects, notably Janna dam on Nahr Ibrahim and the Greater Beirut Water Supply Project, that includes the Bisri dam on Nahr el Awali, co-financed by the World Bank and the Islamic Fund for Development. Both projects are supposed to augment water supply to Beirut and its suburbs, for a total amount of more USD 2.5 billion coming from international loans and BMLWE cash flows (See Section 5).

Despite these mediocre network conditions, according to the Millennium Development Goals database Lebanon has 100 % of its population with adequate water provision and 95% with access to improved sanitation, in contradiction with what was discussed above.[7] Due to service rationing

[6] World Health Organization data on Global Burden of Disease, www.who.int/healthinfo/global_burden_disease. The disability-adjusted life year (DALY) is a metric used in public health using a time-based measure combining years of life lost due to premature mortality (YLLs) and years of life lost due to time lived in states of less than full health, or years of healthy life lost due to disability. Calculating economic losses is valued at one year of the per capita Gross Domestic Product (GDP), Riachi (2013).

[7] Data on www.mdgs.un.org and available on different national communications.

and uneven distribution between regions and neighborhoods, water provision is at the core of geographical inequities and territorial fragmentation. The rationing of the service has been the only answer to the institutional constraints generated by the structural adjustment policies undertaken during the reconstruction period (Section 5). Between the lack of a convenient public network and a scattered urban development, almost one-fifth of Lebanese households rely on private wells. This situation is mainly found in peri-urban and rural areas. Coupled with a lack of sanitation network, most of the Lebanese aquifers are polluted by seawater intrusion or sewage effluents. The next section will address the use of groundwater in the agricultural sector.

4 Groundwater and the agricultural economy of Lebanon

Irrigation in Lebanon uses 60-70% of the total annual freshwater diversions in the country (MoEW 2010, MoE 2010). There is unfortunately no precise data about the share of groundwater. Roughly, it is estimated that about one-half of irrigation is supplied from rivers and spring water and the other half from groundwater (World Bank 2003, NWSS 2010). The share of GDP that the agricultural sector holds has quickly declined over time with the service oriented economic policies of the country. In 1950, it was estimated that agricultural production contributed to 20% of GDP, a rate that dropped to less than 5% in recent years.[8] One third of the Lebanese territory is estimated to be arable (3,300 km2) and a quarter of the country is cultivated (2,310 km2).[9]

About 28.5% of the Lebanese population live below the upper poverty line of USD 4 a day, out of which 8% are under the lower poverty line of USD 2 a day (UNDP 2008). Poverty is prevalent in the predominantly rural *mohafazats* (provinces) of Akkar, North and South Lebanon and Baalbek-Hermel. In 2006, the incidence of rural poverty was highest in North Lebanon (52.5%), followed by South Lebanon (42%), Beqaa (29%), Mount Lebanon (19.5%) and Nabatiyeh (19%). Rural areas in the Beirut suburbs and in the Hermel and Akkar regions also have a high incidence of poverty (4.5%). The expenditure level of poor households in the mohafazats of the North is far below the poverty line; their per capita poverty deficit is 2.4 times that of the overall one. The North has 21% of Lebanon's population, but 46% of the extremely poor population and 38% of the entire poor population.[10] It is estimated that 7.2% of heads of households work and derive their main income from agriculture (MoSA et al. 2006). Agricultural activity has the highest poverty rate among the economic activities of the country, with an average monthly income of 288 USD and a median income of 300 USD (half of the national average). Under these conditions, 67.5% of households earning their primary living from agriculture are poor, lack medical coverage, and have no access to education or to public infrastructure, electricity, drinking water and sanitation (UNDP 2008).

Lebanese agriculture has a high cost structure for several reasons, among others: i) the mountainous nature of much agricultural land; ii) a limited domestic market and small, fragmented holdings that prevent economies of scale; iii) a high proportion of hired labour; iv) inefficient irrigation practices; v) and intensive use of fertilizers and pesticides, due to the lack in extension services, and encouraged by input suppliers. Rural communities have little access to credit, banking, or the financial services they need to engage in income-generating activities. Farmers can also live in isolated communities not served by irrigation schemes, and suffer from the lack of basic infrastructure.

According to the most recent general agriculture census for Lebanon made in 2010, half of the country's cultivated land is irrigated (112,900 ha), showing an increase of 8% in irrigated lands

[8] World Development Indicators, World Bank.
[9] FAOSTAT 2012.
[10] Ibid.

between 1998 and 2010 (MoA 2012). Permanent crops represent 54% of cultivated lands (fruit trees and olive trees), followed by seasonal crops with 44% (20% cereals) and greenhouses 2%. Irrigation by gravity is practiced on half of irrigated lands, down from two-thirds in 1998. These figures have however to be regionally contextualized. In the Beqaa valley, for example, agriculture shows an increasing trend in the modernization of irrigation techniques, with 75% of sprinkler (55%) and drip irrigation (20%), against 57% in Baalbek and Hermel irrigated area. The 2010 agricultural census also shows that the Beqaa has the largest agricultural lands representing 43% of national agricultural area and 55% of national irrigated area followed by the north (25% of total agricultural lands and 22% of total irrigated area), the south (22% of total and 15% of the total irrigated area), Mount-Lebanon (9% of total and 8% of total irrigated).

In the first general agricultural census carried out in 1961, cereals were the predominant crop (39% of total cultivated lands), progressively decreasing to 25% in 2007 and 20% in 2010 (MoA 1999, 2008, FAO and MoA 2012). In 1998, 53,000 ha previously cultivated with wheat were reported as abandoned in addition to around 100,000 ha of terraced lands. This transformation is mainly due to a shift towards high-value and water-intensive crops that has shaped the agronomic landscape of the country during the last decades (MoA 1999). The same sources estimate that the area with fruit trees has progressively expanded, and now amounts to one third of the total cultivated land. This specialization in high added-value crops has led to high profits per agricultural land when compared to neighboring countries. For the year 2009, Lebanon's value of production per surface ration is estimated at 280,000 USD/km2, six times as high as in the Syrian Arab Republic and 11 times that of Jordan.[11] Endowed with microclimates because of its geo-physical features, Lebanon has a varied agricultural production and forty agricultural areas each with different geographic features and specific productions. As a brief overview, in the Beqaa and Akkar valleys, the main agricultural regions, seasonal and rainfed crops are dominant. The heights of Mount Lebanon and Anti-Lebanon, the *jurd,* have for a long time been used for grazing. At an altitude of 1,000 to 1,600 meters, Mount Lebanon climate is suitable for tree crops (mainly apples, pears and stone fruits). At lower altitudes, on both flanks of Mount Lebanon, and from the mountainous north to the interior south, olive trees are cultivated among other trees, such as almonds and vines. Vegetable crops are also found in open fields or in greenhouses. Tobacco growing is notably present in the south of the country, and less in the Beqaa and the North. Closer to the coast, the agricultural landscape includes a large share of citrus and banana trees, especially on the South coast.

Comparing the two latest General Agricultural Censuses from 1998 and 2010 by the Ministry of Agriculture and the Food and Agriculture Organization of the United Nations (FAO), one can notice structural changes in the agricultural production of Lebanon. Important changes are noticeable with the return of southern farmers to their lands after the Israeli military troops withdrew from the southern part of the country in 2000. In terms of individual holdings, the 2010 Census accounted 169,512 agricultural units in Lebanon, showing a 2% increase since 1998. Both censuses identified fragmentation features in the agricultural landscape. In 2010, 68% of farms were reported to be smaller than 1 ha, representing 18% only of the total agricultural lands. The same census established that 91% of farms are less than 4 hectares in area and represent half of the total agricultural land. Those over 10 ha represent 2% only of holders, but 33% of the total agricultural area.

The fragmentation of farms concentrates means of production and investment capabilities in the hands of few, particularly, the development of in land irrigation and access to groundwater. This is clearly more favorable to large farms which are able to access capital and invest in irrigation

[11] World Bank, World Development Indicators, www.data.worldbank.org.

infrastructure. The lack of public infrastructure and small farms cooperatives worsen this situation. The use of pumps to capture surface water or aquifers strongly depends on the size of farms. According to data from the 2010 census, 10 % only of the farms of less than 5 hectares were equipped with pumps against 60 % for farms of over 20 hectares. As shown in the following graph There are 67 irrigation schemes in Lebanon, mostly managed by private large farms and some local committees, representing 65,600 ha (World Bank, 2003). They represent 58% of total irrigated area in Lebanon. It is clear that the main growth in irrigation investment since the civil war is due to private initiative, namely through wells, while public and communal irrigated schemes have remained without any noticeable expansion. The beneficiaries of public irrigation schemes under the responsibility of the Litani River Authority pay a fixed seasonal fee based on the area of the plot and the type of crop. A few pilot water projects use volumetric charges. Water users outside these systems are members in 209 different local water committees (World Bank, 2003), which share irrigation schemes. Many were created prior or during the civil war to fill the gap left by the absence of public institutions.

Figure 2, very small farms (less than 2 dunums, equivalent to 0.2 hectares) are more likely to be irrigated than small and medium farms as they mostly rely on shared surface water, while large farms constitute most of the irrigated land, thanks to their access to groundwater.

The "Agricultural Atlas of Lebanon" published in 1998 by the Ministry of Agriculture (MoA 1998) is the only official document to date that attempts to quantify groundwater use according to irrigation techniques. Groundwater-irrigated lands reach a maximum level of 71% in the South, followed by the Beqaa with 68%, while it does not exceed 25% in North Lebanon. It is in the Tyre, Rashaya, Western Beqaa and Zahle cazas that the rate is the highest respectively with 85%, 84%, 75% and 72% of total irrigated area in each caza. The Atlas estimates that 42% of land is irrigated from groundwater using gravity method as the only irrigation technique, with 45% using sprinklers.

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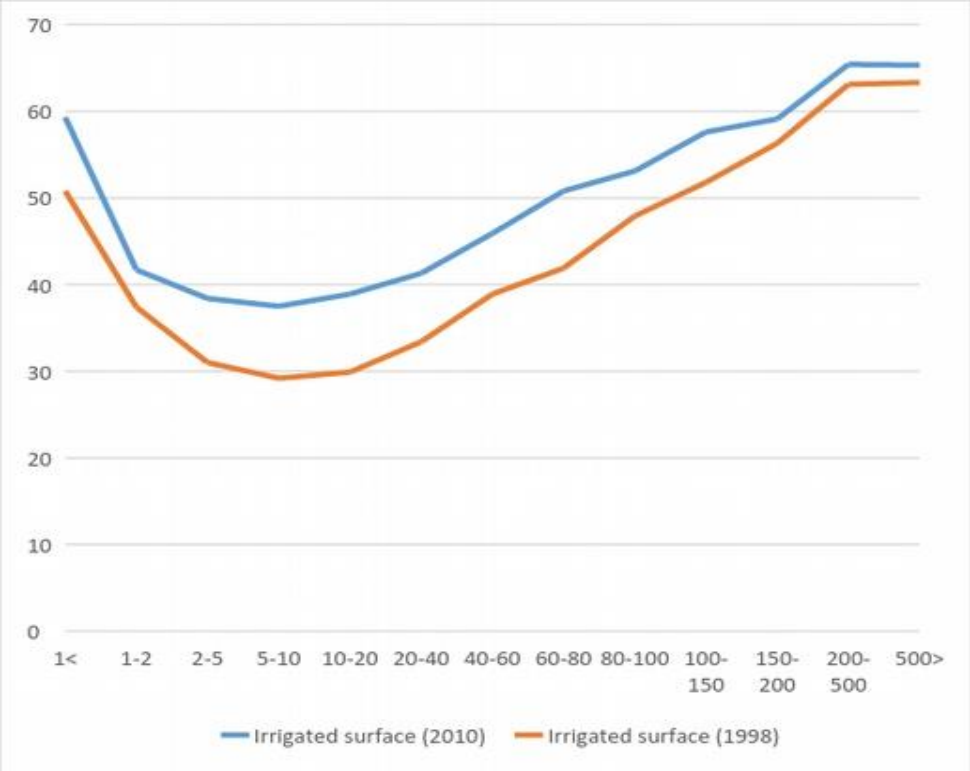
Figure 2. Irrigation in Lebanon and size of farms (%, in dunums)



Source: Data from the 1998 and 2010 General Agricultural Censuses data (MoA and FAO 1998, 2010).

Legally, those irrigation schemes are often formed by water rights holders recognized by Decree 320/1926 (see Section 4.2). Landowners organize irrigation rotation and delegate the operation of schemes to an elected Shawish, or *natour al Huqul*, meaning land guardian, according to Decision 2618/1924. Institutionally, those committees should be under the tutelage of water authorities and municipalities, but they operate independently, sharing maintenance costs and management use among beneficiaries. According to reform law 221/2000, committees and water rights are to be dissolved and fully integrated into the Regional Water Authorities (see Section 5). To date this has not occurred. Only international organizations, such as the World Bank and development agencies (e.g. USAID, Italian Cooperation, UNDP or AFD), implement projects advocating for the establishment of formal Water Users Associations based on those committees.

Many irrigation schemes use both surface water and (recent) pumping from aquifers. For instance, agricultural lands in the south, planted with citrus and banana trees and primarily irrigated by Litani's Canal 200 in the Qasmieh Ras El-Ain irrigation scheme, in the southern coastal area (Saida-Tyre coastal strip),[12] are also complemented by groundwater sources. This situation is found in other areas where local water committees initially rely on spring water, such as in Chamsine-Anjar, Terbol, Bouday, Alleq, Bar Elias, West Beqaa and Rashaya. In those areas, there is a clear tendency for communal irrigation canals, some of which have been functioning for centuries, to be supplemented by wells. This practice includes pumping directly in the Beqaa valley lowlands, leading to a drop in the water table, and more recently wells drilled in highland aquifers, situated

[12] The Qasmieh Ras El-Ain project, also known as the Canal 200, uses the Qaraoun dam waters to irrigate about 4,000 hectares, the project consists of 1,200 farms with plots varying from 1 dunum (0.1 hectares) to 35 hectares. It is the largest public irrigation scheme managed by the National Office of Litani.

on neighboring flanks, leading to a drop in springs flows. The intensification of groundwater reliance for irrigation has mainly been driven by private initiative. As discussed above, the adoption of wells in agriculture has rapidly increased in the last few decades. The main result of this modernist water-supply approach (discussed in Section 5) was the drop in rainfed agriculture and the trend towards water intensive crops, mainly irrigated by private or communal initiatives. There are important links to the actual national food system to be made, highlighting the agro-food market and water plans.

By analyzing agro-food commercial exchanges, we find that Lebanon produces twice the quantity it needs in most fruits and vegetables (Riachi, 2012 and 2013). In recent years, the country has been importing 80% of its wheat while it has over 200% self-sufficiency ratios for oranges, bananas, apples and lettuce for example. This production supplies a lucrative market in the Gulf countries and is subsidized by the government (in the 1960s Chehab's Office des Fruits, and more recently in the Export Plus and Agri Plus programs), and benefits only a couple dozen regional landowners and wholesalers. Neglected by water policies this outflow of (virtual) water accounts for almost one third of the country's water use.

In 2011, the Arab Fund for Economic and Social Development started funding what is to be Lebanon's largest irrigation scheme, the Canal 800, intended to irrigate most of the internal southern area (15,000 ha). In such an export dependent agricultural sector, this can be described as a water grabbing exercise, as the countries that are the most benefiting from the potential production of the project are the one funding it. This intensive production trend suggests that there is a crucial trade-off to make between a lucrative export market and domestic water needs, a trade-off which is not recognized in the political and public discourses. The reality currently appears to be by far in favor of the market. In parallel to Canal 800, and again using the Litani's water, the Greater Beirut Water Supply Project was launched in 2011 based on a World Bank loan. Three other irrigation projects are still considered by decision-makers: Canal 200, which expands the Qasmieh Ras El-Ain area, Canal 600 irrigating the Zahrani-Nabatieh area and the large Canal 900 (28,000 ha), expected to supply the whole southern Beqaa area. Having those projects implemented together places a great strain on a river system that is already facing severe depletion in terms of quantity and quality. Meanwhile, (over)exploitation of aquifers continues mainly by private initiatives, transforming the agro-landscape in Lebanon from rainfed to intensive irrigation. The next sections discuss the legal and institutional frameworks governing groundwater in Lebanon, evolving in close ties to land use and property regimes.

5 Accessing groundwater: from Levantine customs to modern legal framework

This section presents a synthesis of the historical evolution of norms and laws governing surface and groundwater in Lebanon. It will first present the hanafite jurisprudence of the Sharia that governed ottoman tribunals over more than five centuries (1516-1920). The first legal codes dealing with water, the Medjelle (1877), in the late 19th century, and the French Mandate's decrees on resource ownership (1920s), and their further light amendments since independence. The section also tries to emphasize from a property perspective the inertia and path-dependency in the adoption of groundwater use, control and protection laws. Laws governing water use in Lebanon are based on practices and rules that evolved according to historical land regimes, directly related to political power in specific historical moments. Despite the desire of the ruling powers to regulate and sometimes modernize these practices, for tax purposes during the Ottoman Mandate for instance or land parceling during the French Mandate, those practices were able to continue to develop and endure despite the reforms attempted. The legal foundations of

water use in Lebanon follow the long construction and shift from customs to codified land and water laws in the country.

5.1 The Ottoman Empire: practices, customs and reforms over groundwater

Under the Ottoman Empire and a century prior to the land reforms that occurred in the mid-19th century, Archbishop Abdallah Qaraali wrote the "Abstract of law in Lebanon at the time of Emirs Chehab" in 1733 for the Maronite Order of which he was a founding father. The book is essentially a collection of fatwas of the Ulema and Hanafi jurist Khaireddine Ramli who preached during the 17th century. Chapter 20 Section B is named *"Water and lowlands"*, and collects the eleven clauses governing water resource sharing in the Levant at that time. The majority of these clauses deal with rotational water distribution and maintenance requirements of water channels, giving lowlands servitude rights and enforcing the collective maintenance and necessary work upstream. As for groundwater, the seventh clause of the text includes cases of appropriation of water outside the ownership of the land by stating the following: "*Whoever has a well in another man's land must have a passage to get there*."[13] In addition to the division of property types, the Hanafi doctrine that ruled the Ottoman courts allowed the appropriation of water in several cases: proximity to riverbeds, irrigation canals taking water from springs, or by granting exclusive right to a person who dug a well on his land or on an unoccupied land.

Referring to the Sharia, the Sunni Hanafi School recognizes that God owns water but as a state of affairs, it allowed two types of water entitlements: i) '*mubah*' or sovereign waters that belongs to the Sultan domain, also referring to public ownership of the seas and large rivers and lakes, which are free to access for all and; ii) the '*mulk*' or private (canals and wells), and other different types of easement on water sources, known as '*haqq al-intifaa'*. According to the Hanafi doctrine, the right of irrigation depends on the amount of water and the needs of use. Any riverine landowner has the right to enjoy rivers as long as it does not infringe on others rights. Those usufruct easements are transmitted by inheritance or land sale. Cases of separate transactions of the irrigation right and land could happen.

The purchase of water springs was common among the notable Emirs of Mount Lebanon, as is the case of the Nab' el Safa spring bought by the Emir Bashir Jumblatt at the beginning of the 19th century, where the right to the spring is still in possession of the politically prominent Jumblatt family in the Chouf area. It is also important to note that Mount-Lebanon was among the first regions in the Empire that witnessed an early development of private land property, of course under the auspices of the Ottoman Empire. It is there that we find mountain settlements around notables' fiefs (Emirs or Sheikh) and monasteries (*waqf* lands). The inhabitants of these mountain Ottoman provinces have terraced slopes to plant every bit of land with agricultural potential, providing gravity irrigation from the multiple karst springs.

The Beqaa, the south and the Akkar valley in the north, were mainly comprised of collective *mushaa* lands. These have historically composed the main agricultural lands in the western Levant provinces with the Hauran valley in Syria, supplying most of the country's food needs. Attached to the province of Damascus, the control over land was mainly organized under the *timar* system. This land tenure regime mainly consisted of land concessions and tax collection controls granted to high-ranking militaries and local *zuamas* (leaders) over collective farms. Irrigation was limited to parcels near springs (e.g. the slopes of Zahle) or through canals mainly constructed during the Roman period as in Tyre, El-Qaa and Baalbeq, or the first dynasties of Islam, such as in Anjar.

[13] The text of this manuscript. were collected and published by Boulos Massad in 1959, provided by Hyam Mallat (2003).

It is in this context that the roots of power relations took shape under the *iqtaa* system in the different Ottoman provinces of the future Lebanon. *Iqtaa* is a system of administrative organization of fiefs, assigning territory control to feudal families to collect taxes from an area or community. Farmers are allowed to use land in exchange for loyalty to the *muqtaajis* and for paying taxes to the Sublime Porte. As part of its modernization process under European pressure, the Ottoman administration enforced the application of two reforms that affected water use: the *Defter Khane* land registration in 1858 and the *Medjelle* in 1877, the legal framework supposed to regulate and supervise all sectors. Practices and customs on the use of water dramatically changed during this period that saw the opening of the region to international markets and global trade. Public lands were sold to a new mercantile *zuama*, to pay accumulated public debt and European creditors (Riachi 2013). This land reform was based on the French Napoleonic cadastre system. It caused an increase in the value of land and related resources, in particular water. It is within this historical context that the Medjelle was adopted, also inspired from the Napoleonic civil code, integrating water usufruct to land ownership, juxtaposing customs and Shari'a. In terms of legal framework of water, the Medjelle was the first legal codified text applied in the Levant.

Title IV of Book 10 of the Medjelle includes clauses related to water use and management. The first articles (1234-1238) define public waters, *mubah* corresponding to lakes, seas, groundwater and large rivers. Article 1235 states the forbidden ownership of groundwater. However, with reference to the *haqq el chirb* and *haqq el shifa* in the Sharia respectively (1264-1266), the use of public waters for irrigation or drinking is allowed to all as long as water is not exhausted. Further, the Medjelle considers that a well or a river (article 1239), on one or several possessed lands, belong to the landowners, giving them the right to use and restrict access. The Medjelle permits anyone to dig one well or more on his property (1268). Possessing a well carries with it the ownership of the surrounding land (1281-1286). Other articles (1281-1291) determine protection zone of private wells, or *Harim* (17 meters), pollution issues (1212-1224) and the procedures governing the clearing of waterways and maintenance of facilities by the official authorities and landowners (1321-1328).

The Tanzimat (ottoman reforms 1839-1876), especially on land property, sharpened social inequalities between those who benefited from land reforms and poorer commoners (*aamma*), instituting uneven access to private property and fueling farmers revolts all along this period. Based on customs and the Hanafite jurisprudence but also drawing on the Napoleonic code, the Medjelle established a complementarity between Muslim laws and the Roman law, at least with regard to private property and access to natural resources. The Medjelle legitimized the principle of acquired water rights, appended the different legal systems and existing rights to new landowners, mainly urban merchants, and initiated the first privatization wave of collective *mushaa* lands.

In 1913, a few years before the fall of the Ottoman Empire, a new edict, called "Code of irrigation" was enacted to regulate agricultural water use. It regulates irrigation use on shared irrigation schemes, defines sanctions and responsibilities of individuals and the administration of irrigation network maintenance. Its provisions remain relevant and govern the current irrigation management, particularly in rural areas, among irrigation local committees.[14] Water is strongly

[14] The 1913 irrigation code includes, i) definitions of terms and translation of Turkish terms, ii) it also states that irrigation facilities are publicly owned and authorities are obliged to maintain and renovate the network, except what is on private plots, iii) defines the relations between owners and their neighbours and between the administration and individuals, and iv) sets penalties of any offense of the cod, punished by sentences ranging from 1 to 6 months in prison and fines.

linked to the economic, political and social history of the country showing a strong connection to land property. It is in this context that the French Mandate in Lebanon began.

5.2 From shallow to deep wells: French Mandate to modern laws

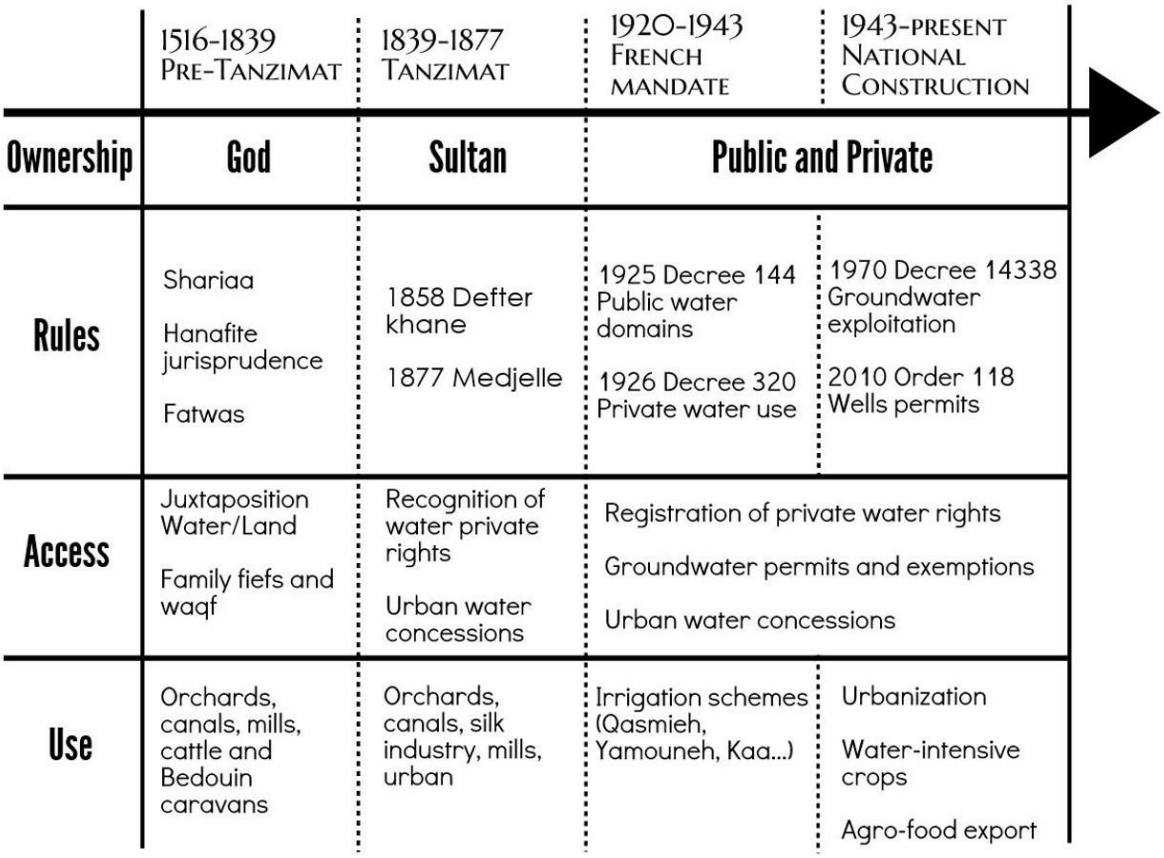
When the authorities of the French Mandate started their intervention in the Levant and created the State of Greater Lebanon in 1920 (actual borders), land privatization and water rights were not a novelty in the legal landscape of the Levant provinces. The rich natural water endowment of Lebanon was praised and legitimized the colonial modernization enterprise. The mandate has used three types of intervention that radically changed water use and management: 1) land registration and the privatization of the collective land under *mushaa*, 2) the establishment of Water laws, and in parallel; 3) the introduction of a hydraulic engineering paradigm (Section 5).

The first action taken by the authorities of the Mandate was to enact specific legislation to organize the water sector, deemed too complex and archaic and thus incompatible with a vision of modernity. The French therefore argued for the establishment of stable and clear ownership structures. First, the decree 3339 of 1920 (December 1s) recognizes the rights of individuals on waters, mentioning the possibility of digging wells under a pre-authorization. Subsequently, two major texts on the state of ownership of waters were enacted: Decree 144 of 10 June 1925 concerning the public domain in general, including water, and Decree 320 of 26 May 1926 on the protection and use of public waters, both referring to the principle of public domain as in French law. The state is the only owner of water resources. However, rules for use and acquisition are to recognize prior-and usufruct rights over water. Those rights are mainly enacted by decree 3339 (12 November 1930) on Land ownership that replaced the *Defter Khane*. It stipulates in article 13: *"Ownership of land include what is on the surface and below it",* which derives from the French property regime, and articles 59, 60, 64 and 77-83 define the servitude rights on water (rainwater, springs, canals and wells).

By enacting these decrees, the authorities made reference to customary ownership rules in the traditional sharing methods of water. Article 3 of the Decree 144 indicates that a landowner enjoying usufruct over property prior to the enforcement of this decree shall not be dispossessed. If this is against the general interest, a just compensation should be paid in advance. Decree 320 identifies rights over water and the conditions for compensation in case of expropriation of those rights. It also specifies the procedures for the establishment of a new water right. Those water rights are subject to land registration and are transferable by sale or succession.

Regarding the use of groundwater, Decree 320/1926 provides the possibility for landowners to prospect groundwater upon the condition to apply for a permit. Article 1-7 stipulates that "drilling wells can be made on private property without permission if the depth of the well does not exceed one hundred and fifty meters" and Article 3 states that "*may be used without permission waters from non-flowing wells drilled on private property and whose flow is less than one hundred cubic meters per day*".

Figure 3. Evolution of water legal framework in Lebanon



Source: Author's compilation, Riachi 2016

Given the increasing proliferation of boreholes coupled with the boom in private irrigation that started in the 1950s and 1960s, a specific legislation on groundwater was issued on May 2, 1970 with the decree 14438 organizing the exploration and use of groundwater. Article 2 of Decree No. 14438/1970 requires obtaining a permit prior to conducting groundwater prospecting or drilling beyond 150 meters. The permit is replaced by a declaration when the drilling depth is less than 150 meters and a notice of receipt is given to the applicant specifying the number, the date of registration of the application and location of prospection (Articles 7 and 8). Like its predecessor 320/1926, Decree 14438/1970 stipulates the exemption of a drilling and use license if the depth of the well is less than 150 meters and if abstraction is less than 100 cubic meters per day. Neither the depth, nor the volume are convincing vis-à-vis the geophysical diversity of the country and the many possible uses of the resource, nor did these limits dissuade farmers and households from drilling wells.[15]

[15] None of the interviewed personnel by IWMI at the Ministry of Energy and Water were able to identify the roots and reasons behind those limits of 150 meters depth and 100 m3/day withdraw (interviews 19/1/2015).

5.3 Recent legislative changes regarding groundwater regulation

Recent updates of decree 14438/1970 were made through Ministerial Order -Decree 118 of 13 September 2010.[16] The new licensing process of those wells involves the new Water Authorities, the Ministry of Energy and Water and the municipalities. The applications for permits through Order 118 are centralized at the ministry level. The decision for this new process was initiated by the new board of consultants of Gibran Bassil, the then Minister of Energy and Water.[17] We can learn from his website,[18] that in one year from the decision "*the number of issued licenses dropped from 1850 in 2009 to 215 in 2010*". However, official data on wells permits were never available.

Order 118 of 2010 organizes the procedure to be followed by well users in order to regularize their well and groundwater abstraction (Interviewee 1, 6th December 2014). Decree 118 brought institutional changes, externalizing some of the roles and tasks previously performed by the Ministry to three private engineering firms. Those companies are the only ones allowed to conduct the necessary technical studies required to obtain well drilling and well use licenses. These companies are also in charge of conducting field visits to control well drilling. Under the new Decree 118, these private companies are responsible for (Interviewee 1, 6th December 2014; Interviewee 2, 6th December 2014):

1. Receiving directly from users the request for well drilling licenses and well use licenses. The request should be accompanied by the following documents specified in the procedure: legalized maps from the cadastral authority, well coordinates, land coordinates issued from the Geography division of the Lebanese Army, a recent ownership certificate, certificate of planning and easement (*ifadat irtiqa' wa takhtit*), certificate of land use issued by the municipality or a notary, and finally, a technical report from one of the companies approved for monitoring and auditing by the ministry.
2. Revising the well's physical characteristics and comparing them to the conditions specified by the law (there should be no impact on other public groundwater or surface water sources, its depth and yield exceed the 150 m depth and 100 m3/day yield).[19] Wells below those constraints are exempted of any fees and must be only declared (*'alm wa khabar*). If the future well location is 2,000 meters away or less from public water catchments (springs or public wells), the report should also include a confirmation from the concerned Water Establishment that proves their inability to provide water to this area before granting an exploration permission. Beyond 2,000 meters, no specific permission is needed.
3. Providing users with a technical report to be presented to the Hydrogeology Service of the Ministry; with other documents required to obtain licenses.
4. Conducting control field visits to verify the authenticity of the information given by well users

[16] Some amendments were made by decrees 547/1990 and 13034/1998, applying new fees of the permits to be coherent with the high inflation that Lebanon has witnessed during the war. Resolution 31/2009 also preceded Order 118/2010 setting a new process to registration applications and declaration for wells exploration, cleaning and exploitation (also found in the former).

[17] Son-in-law of General Michel Aoun and one of the leading politicians of the Free Patriotic Movement.

[18] See website, www.gebranbassil.com .

[19] Interviewee 2 mentioned that this limitation is not a logical one according to the reality on the ground, as most wells are shallower than 150 meters, and therefore do not require licenses. The service of water rights at the Ministry has for a long time requested a change in legislation, without any results. About the rules for wells, Interviewee 3 mentioned that "it doesn't make sense that a well at 149 m depth or a farmer consuming 99 m^3/day don't pay and those having a well at 151 m and consuming 101 m^3 are required to".

5. Putting in place water meters on wells that have obtained a well use licenses.

According to a staff from the Ministry, the use of external private companies to perform these tasks is in contradiction with the concept of public management: "we can't give private companies the authority to deal with the problem and give them the authority on public money" (Interviewee 3, 20th January 2015). The issue of lack of staff and the fact that staff has not been renewed after the retirement of hydro-geologists from the Department is the main reason for contracting private firms (Interviewee 1, 6th December 2014). The government has also not been allowing the employment of new officials. Interviewee 1 stated that there are only 6 officials working in the Groundwater and Hydro-Geology service, while it should include 49 officials (Interviewee 1, 19th January 2015). Additionally, the ministry has had 10 new staff but no geologists, which, according to a member of staff from the Ministry, "is a political decision, […] or also lack of money or maybe both" (ibid.).

The Service does not have a geologist and lacks instruments to measure runoffs, record well data and location. It also lack information on many public wells in Lebanon (drilled by the different Water Authorities for drinking water supply or the Ministry of Agriculture as public irrigation wells). Further to this lack of information, there is also a need for more communication between services to tackle the lack of coordination, as data for international projects is not shared between the different ministerial services (within the Ministry of Energy and Water) and with other Ministries (Agriculture for example) (Interviewee 5, 17th February 2015).

Despite the externalization of well reports to private companies, the Ministry of Water and Energy reviews the applications and has until now found a number of mistakes made by the companies contracted to do the studies for each permit application. For instance, "Sometimes they don't mention a spring nearby" when the assessment of well feasibility is conducted (Interviewee 1, 19th January 2015). After the approval of Decree 118, 3 companies where selected to carry out these tasks but there was no official bidding process for the selection of these companies. The selection was done at the Ministerial level, "they chose specific companies who applied (6 of them)" (ibid.). These companies are under renewable 1 year contract.

A year after having issued a well permit the ministry has to issue another permit for exploitation-use of that well. The same private company will have to do another examination of the well drilled, the yield, etc. in order to issue the report (Interviewee 1, 19th January 2015). The report "gets submitted to the Service of expropriation which issues the final permit. If users do not submit the permit of exploitation, the service will give a warning and the Ministry of interior will close the well" (ibid.).

5.4 Current process for well permits, enforcement limitations and problems

During the civil war and up until today, many farmers and households exploited the aquifers without a permit. The question remains as to what extent they are illegal in light of legal texts, as they may fall under exemption under those weak constraints. Depending on sources, between 50-80% of operating wells in Lebanon are illegal (NWSS 2010; World Bank 2009a, 2009b). However, according to Interviewee 1 (6th December 2014), only 10 percent of wells in Lebanon are licensed. Before the approval of Decree 118 in 2010, the ministry received more than 2,000 well permit requests in 2009 and more than 3,000 in 2010 (Interviewee 1, 19th January 2015). These numbers would include, however, all drilling permits and permits for exploitation and use, but also deepening, etc. Of those 3,000 received in 2010, 780 corresponded to demands for drilling permits

for new wells. After Decree 118 was enacted however, the Ministry received 295 new demands in 2011 and 250 in 2014.

According to Interviewee 1 (6th December 2014) and Interviewee 2 (6th December 2014), the private engineering firms operating under Decree 118 are directly paid by users a fee of around USD 800-1,000 for the reports required by Decree 118. Some companies might ask for 50 percent of the price upfront. No financial percentage however is paid by the private companies to the Ministry and therefore the Ministry does not receive any fee for this procedure, even though the Ministry still assesses and reviews the applications. The price of this procedure is a potential disincentive for users not to apply for a permit, since in the past users did not have to pay at all. Interviewees at the Ministry have emphasized the high costs of this procedure to users, leading to a reduction in the number of licenses requests presented per year from 2,000 to 500 per year. This system is thus contributing to a larger number of unlicensed wells, with less control from the Ministry.

After obtaining the technical report from one of the private firms, submitted in a sealed envelope to the Ministry, the user presents the complete well drilling request. This includes the report from the private company and other required documents such as maps, the well coordinates, well use, and submitted to the Groundwater and Hydrogeology Service. After studying the request, the Service transfers the file with a technical note to the Expropriation and Water Rights Service, which is in charge of revising the legal conditions linked to the drilling. A note is then produced by this second service and the file is returned to the Groundwater and Hydrogeology Service for a final decision. If approved by both offices, the request is then sent to the bureau of the Presidency of the Lebanese Republic, after which a decree is expected to be published in the official gazette.

If the Ministry of Energy and Water finds an illegal well, a letter is sent to the Mohafez (governor), who sends a letter to the Office of the Cadastre so that the land plot is marked as not being under regulation, and also contacts the police station so that the well is closed (Interviewee 2, 6th December 2014).

Many wells are dug without permits and under the 'protection' of the police and municipalities (Interviewee 1, 19th January 2015). Drought episodes can also affect the number of illegal wells, as users will drill new illegal wells in order to obtain and secure groundwater for agriculture during these episodes, something observed during the last drought in 2014 (ibid.). "In this summer [2014], people needed water to irrigate in the summer so a lot of wells were drilled without permit, it is under the table'" (ibid.).

According to our interviewee, since Decree 118/2010 was issued users have now to apply to higher ranked officers within the police services to cover up the illegal drilling (ibid.). Additionally, the Ministry of Energy and Water gave instructions to the Ministry of Interior to enforce more strongly the control of wells following Decree 118. Still, the services from the Ministry of Energy and Water do not have the right to enter a private property to control wells without a permit from the Ministry of Interior. The procedure is such that the Minister of Energy and Water should send a letter to the Minister of Interior so that they have the right to enter the land, accompanied by police officers). According to Interviewee 1 (19th January 2015), such control visits are only performed when the service has solid information about a drilled unlicensed well, which is in general a complaint filed by a neighbor. In the opinion of the Interviewee, the control of unlicensed wells is the duty of municipalities and local police services. When the municipalities are asked about this point, they point out that they do not have the right to control and that it is

the duty of the Ministry.[20] Within this web of scattered responsibilities and with very few public personnel, groundwater is illegally withdrawn and wells control is completely missing.

5.5 Other complementary recent laws

In terms of water pollution, the Lebanese government enacted in 1974 the Decree 8735 banning wastewater discharges in public water bodies, rivers and the sea. This was driven by the ratification by Lebanon of international protocols against maritime pollution, enforced by the Barcelona Convention in 1976. More recently, the 444/2002 Law on environmental protection sets quality standards for wastewater discharges putting a framework on the polluter pays principle. The first executive Decree 8633 was voted in 2012 defining Environmental Impact Assessment process in cases of large-scale constructions. Despite more than 700 legal texts dealing with environmental issues in Lebanon, the issue of groundwater pollution remains unclear.

On the legal side, a draft law titled "Water Code" was prepared by the Ministry of Energy and Water assisted by French experts, through a grant of the French Development Agency (AFD). Although the text was elaborated in 2004 and has been intermittently discussed since 2005, different versions have been developed and it is still pending in Parliament for approval.[21] The code promotes a comprehensive approach, advocating for an Integrated Water Resources Management, a polluter-pays principle, River Basins plans and "contrats de milieu" inspired by the French model based on basins management and Public-Private-Partnerships. The *Code de l'Eau* talks about groundwater basin contracts without presenting any definition. In all its versions, the code intends to establish a Water Cadastral Registry compiling all water rights and wells data. The text does not clearly address any issue related to well permit exemptions. It mentions the establishment of surface and groundwater protection zones but does not clearly define them. Despite many loopholes in the code, donors are pushing the Lebanese government to adopt it. The AFD director in Lebanon, Samuel Lefevre, stated in a press interview: *"We will not fund any project as long as the Code l'eau is not adopted"* (AFP, Beirut, 2014).[22] Finally, it is worth noting that in the presence of private rights granted to landowners, and legitimized in the name of the usufruct of private land property, it is actually difficult to uphold their right to drill wells within the current legal structure. None of the decision-makers or donors is really addressing this issue. In addition to the lack of monitoring of tens of thousands of private wells, there is a clear inertia against defining protection zones where drilling would be completely forbidden for the sake of groundwater conservation.

Throughout the legal history of groundwater, one can find a few presidential decisions showing the existence of legal possibilities to define comprehensive bans on further groundwater extraction. However, those decisions have mainly been temporary. Law of 14/1/1963 prohibited water prospecting on private property in the region of Beqaa for two years. Law No. 86/67 (28/12/1967) prohibited the prospection and use of water on private property in Greater Beirut along the area between Naher al Mawt and El Ghadir rivers. More recently Order No. 2528/S (28/5/1996) was issued to protect the aquifer of Kneisseh mountain in response to the destructive

[20] Public official, Ministry of Energy and Water

[21] Refinements in different versions of the Water Code mainly deal with amendments on the structure of what is called the National Water Council. The latter intends to be representing a governance tripartite; government, private companies and civil society members. In 2010, minister of MoEW, Jibran Bassil, and his consultants drafted a version where the minister is at the head of the council, while earlier version mentions the nomination of a neutral figure.

[22] Agence France Presse (11/09/2014): "Le Liban patauge dans ses égouts"

effects of quarry industries on many springs. This situation of scattered legal texts illustrates the clear absence of any coherent vision for groundwater management, controlling wells and protecting aquifers.

Finally, as a result of the generous depth and withdrawal limits set in the past to encourage irrigation during the French Mandate, technology for drilling several hundred meters is now within the reach of many users under a legal regime which treats wells as if they were still hand-dug and shallow. We can conclude that this reflects a situation of private property supremacy over any attempts to protect public resource allocation and conservation. Of course, private property closely relates to the political sphere in Lebanon that has the ability to shape policy, discourse and institutional paths. The next section discusses who benefits from this inertia in protecting and coherently managing groundwater. We start by presenting the fragmentation of institutional responsibilities impeding the management of the resource, as well as their underlying politics.

6 Institutional fragmentation and the forgotten aquifers

This section analyses the role of groundwater usage in the institutional construction of water authorities in Lebanon. We examine the decision-making process surrounding laws and regulations and focus on the adoption of recent reforms. Those reforms were mainly set under structural adjustment programs set up by the International Monetary Fund and the World Bank, during the reconstruction period initiated in the early 1990s. The Taef agreement paved the way for confessional political-sharing, this time under a neoliberal order. This section analyses the politics that shaped formal policies and reforms in the water sector during the last quarter of decade, and examines their historical foundations.

The following subsection begins with the decision-making and water management institutions formed after the civil war. A corrupt power-sharing process reflected both consolidation and continuity in the new consensus framework established by the Taef Agreement in 1989 that put an end to the war. This political system has fostered the formation of political networks encroaching on the bureaucratic organization of public services, creating a suitable environment for the proliferation of corruption. We begin this subsection with a presentation of the institutional organization of water authorities in the country, namely, the adoption of Law 221/2000. Afterwards, we examine the main supply-sided vision pillars of the ten-year plan drafted in 1999, reiterated in the Council for Development and Reconstruction's (CDR) National Physical Master Plan of the Lebanese Territory, approved in 2009 (CDR 2005b), and refined by the recent National Water Sector Strategy (MoEW 2010), endorsed by the government in 2012.

6.1 Institutionalized political arrangements in Lebanon's water authorities

In 2000, a new wave of reforms began with the reorganization of public water institutions (Law 221) and the setting up of a physical strategic national vision known as the ten year-plan. However, both reforms reflect more a continuation of previous policy than any meaningful change regarding water resources planning, notably the continuing systematic mobilization of private and technical solutions. Again, the discourse and planning policies continued to promote large-scale archetypal projects as being the only national redemption in water development. In the following paragraphs, we will discuss the main institutional reforms and central actors in the water sector of Lebanon, elaborating the missing connections to groundwater management.

On May the 29th, 2000, the Lebanese Parliament enacted Law 221, an administrative and institutional reform that restructured the country's water management public authorities. The

reform merged the former 22 local water offices, created between the 1950s and 1990s, into four regional Water Authorities (*Établissements de l'Eau*), but did not alter the structure of central authorities on resource policy. The four regional Water Authorities created by the reform 221/2000 are: 1) Beirut Mount Lebanon (EEBML); 2) North (EENL); 3) South (EESL) and; 4) Beqaa (EEB); to which is added the Litani River Authority (LRA). The LRA maintains its responsibility for irrigation infrastructures in the Litani river basin and is also in charge of hydrological monitoring of other rivers in the country. This new division, although proposed since the seventies, was issued by the Council of Ministers in 1996 (decree no. 9626-0930) and later adopted in 2000, and followed by corrections (241/2000) and amendments (377/2001). Fifteen years after its adoption, many questions should be raised as to whether Law 221/2000 was institutionally effective or socially fair, or not (see Section 6.2).

At the head of management decisions and water investment in Lebanon, the Council of Ministers holds executive power, while the Parliament is responsible for legislation. The Ministry of Energy and Water (MoEW) is the main central authority responsible for national water resources. The MoEW was created by Act 247 of 7 July 2000, replacing the former Ministry of Hydraulic and Electrical Resources. The MoEW is responsible for water policies, proposing major development projects (e.g. dams and inter-basins transfers), setting prices, granting drilling licenses, defining quality standards, and supervising the regional institutions in charge of the resource. Within the MoEW, authority over water is shared between two directorates: The General Directorate of Hydraulic and Electrical Resources (GDHER) and the General Directorate of Exploitation (GDE). The former is responsible for planning and implementing the national strategy, studies and projects, as well as the enforcement of regulations, protection, and maintenance of domestic water networks, irrigation and wastewater. The Directorate of Exploitation is entrusted with the administrative, managerial and financial control of water facilities. It oversees the tendering process and the preparation of concessions as requested by the Council of Ministers, usually through the Council for Development and Reconstruction (CDR).

The CDR was created in 1977 (Decree-Law n.5), to replace the Ministry of Planning and to boost reconstruction efforts, that were expected to begin only two years after the war ended.[23] Since the end of the war, the CDR channels most of the international funds from donors. The nomination of the CDR's president is made by the Prime Minister in office. The CDR is responsible for the allocation of funding for major water projects, but its responsibility also extends to the preparation of master plans. It is actually the main governmental body responsible for tendering and managing large-scale investment projects. The water sector (water networks works, dams, wastewater treatment plants and rehabilitation of irrigation schemes) represented around 20% of the funds channeled through CDR between 1992 and 2012, with a total of approximately US$15 billion. Other public institutions with responsibilities in the management of water resources in Lebanon are: the Ministry of Public Works and Transport (MoPWT), responsible for rainwater and drainage infrastructure works and flood prevention works. Under its authority, the office of Civil Aviation and Meteorological Services is responsible for the collection of meteorological data. In addition, the General Directorate of Urban Planning is responsible for land use planning and is consulted on issues of land expropriation for public works. During the reconstruction phase, the MoPWT focused on highway construction and rehabilitation of the airport, accounting for more than 60% of the budget managed by the CDR.

At a central level, the Ministry of the Environment (MEL), created in 1993, is responsible for proposing and implementing laws related to the protection of the environment. With the Ministry

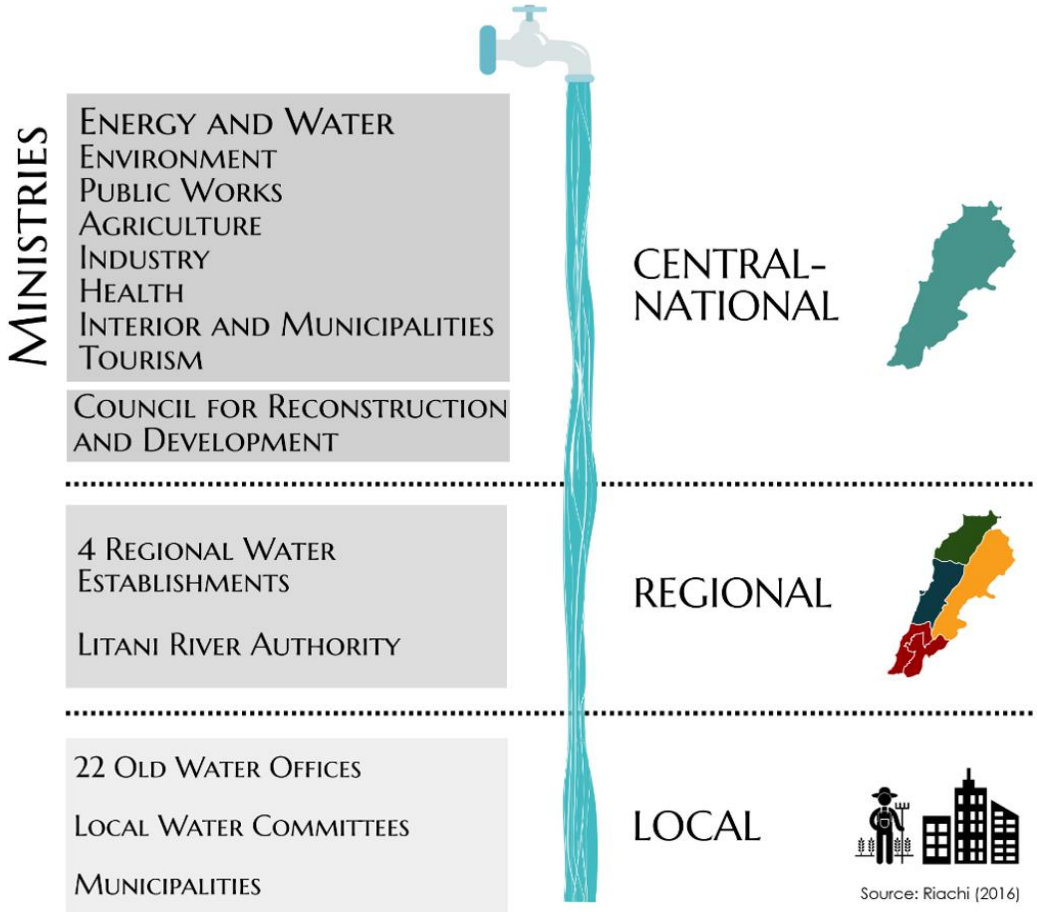
[23] At the time it was expected that reconstruction would start after the Tunis conference for the "Friends of Lebanon" happened in 1978 to mobilize funds for the reconstruction of the country.

of Health, they are responsible for monitoring water quality and compliance with health standards set by LIBNOR (Lebanese Standards Institution founded in 1962), which is under the tutelage of the Ministry of Industry. The Ministry of Health is also responsible for granting licenses to bottled water companies. The Ministry of Agriculture (MoA) leads some modest projects consisting of small irrigation schemes through its Green Plan program. Working in close cooperation with local committees of irrigation, the MoA offers some extension services to farmers through the Lebanese Agricultural Research Institute (LARI), which is also responsible for collecting weather data at eight stations. Finally, the Ministry of Finance collects the fees and the Court of Auditors gives its opinion on drafted projects and decides on the release of investments. At the central level also, and directly under the authority of the Presidency of the Council of Ministers, we find the Council of the South, created in 1977 for the development of infrastructure in areas of the country affected by armed conflict, and the Central Fund of the Displaced founded in 1993 to assist displaced Lebanese war refugees to settle back in their home areas.

The Ministry of the Interior and Municipal Affairs (MoIMA) is responsible for the supervision and coordination of public works at the local level. Under his authority, the security forces are responsible for enforcing arrest warrants and controlling violations related to the environment. Sewage and stormwater management and network fall under the responsibilities of municipalities in Lebanon (according to Municipal Law 1977). However, in many rural areas and in the absence of central intervention, some municipalities were able to address the need of their residents by managing water rights or even supplying them with wells and water tanks. Many of these local infrastructures are often part of political party donations and vested electoral interest.[24] Throughout their existence, municipal authorities have been systematically deprived of financial resources, especially those collected by the central government (Independent Municipal Fund and Telecommunication taxes). This systematic impoverishment of local authorities could be understood as a way to avoid undermining the power of parliamentarians traditionally elected at the caza level. In order to keep control over local authorities, recent municipal elections of 2016 witnessed a coalition of all the traditional governing parties in blocks in order to beat emerging civic independent lists (e.g. *Beirut Madinati, Muwatinun wa Muwatinat fi Dawla, Inma' Zgharta, Amioun bel Ouyoun,* among others). In spite of being new on the political arena, those lists have collected more than 40% of votes, but not yet gained seats because of the majoritarian system. Note that the municipal elections, as for parliamentary election laws, force citizens to vote in the regions where they are registered according to the 1932 census, and not in their place of actual residency, thus, reducing the role of participation in the local community life in many cities. In the 2016 Municipal elections, for instance, participation rate barely reached 20% in Beirut.

[24] Jihad al Binaa, Hezballah's development association accommodates many villages in the Beqaa, south and Beirut's suburbs with water facilities (e.g. Mashrou' miah al Abbass), www.jihadbinaa.org.lb. Other examples could be cited (Amal movement and Ain Zarka pumping station, Lebanese forces and wastewater treatment in Becharre, among others). Some political parties have also bottled water brands, like the Orange Cascade of General Aoun's Free Patriotic Movement.

Figure 4. Water management authorities and public decision-making actors in Lebanon



Source: Author's compilation, Riachi 2016.

At the regional level the Mohafez, the *governor* of the Mohafaza (there are 8 Mohafazas in Lebanon), and Qaimaqam, the *prefect* of a Caza (there are 25 administrative Qada' or Cazas in Lebanon), approve public works plans and the expenditures of municipalities. At the local level, municipalities, under the supervision of the MoIMA, are responsible for public works in their areas and are expected to contribute to the costs of construction and maintenance of the sewerage system. Over the last ten years, many municipalities have chosen to merge into 41 municipal federations to carry joint sanitation and network maintenance.

At the local level, there are more than 200 local committees that manage drinking water and small-scale irrigation schemes. Some of these committees were created during the war but most of them share secular water rights that fall under decree 320/1926 defining private access to water. They are responsible for the maintenance of common infrastructure and rotating irrigation turns among users. Most of them are run under the auspices of municipalities that share municipal *mushaa* lands served by water sources. Some of those water committees that used to rely on spring water and gravity irrigation canals are using the same canals to convey pumped groundwater, leading to more depletion of springs, as discussed in the previous section.

The lack of coordination between public entities, especially between the two main central bodies, CDR and MoEW has to be addressed. They are two of the most symbolic central bodies and are at

the core of the *muhasasa* system in Lebanon,[25] and the appointments are in accordance to confessional power sharing politics. Responsibilities for planning, or implementation and monitoring of public investment often overlap between these two central authorities. During the last two decades of reconstruction, it is mainly the CDR that handled national studies, project implementation and channeled international development loans. An institutional problem arises over the control of CDR, as this body only reports to the Council of Ministers and does not fall under the control by the Court of Auditors and the Central Inspection. As for the Council of the South, it has been under the sole control of the chief of parliament, Nabih Berri, since 1992. Berri appoints its staff and distributes projects within his own political constituencies. This myriad of public actors results in institutional fragmentation, exclusion of other central authorities and a total obstruction of actors at the level of local authorities, unless they are politically related to power networks in the country.

Despite their important role at the central level, many ministries are considered as secondary in power-sharing importance, such as the Ministries of the Environment, Agriculture, Industry, Health or Tourism. Under the political divide, there is a clear consensus between parties on sharing the executive power on the bundle of projects. While the Lebanese parliamentarian elections has been postponed twice since 2014, the country's political factions seem to have found an agreement on running the Council of Ministers and jointly approving projects along political and regional divides.

6.2 The 221/2000 water reform and groundwater stress

In the 1970s, an institutional reform was proposed to redefine the jurisdiction of water authorities in the country. This new division was finally made official by the Law reform 221 in March 29th, 2000. The World Bank and donors pushed for this new institutional design with the intent of applying the principle of cost recovery leading to lower state subsidies and relying on Public-Private-Partnerships (PPP). Regarding financial autonomy, the reform highlighted the need for resource management under market terms. Water reform was listed as a condition for a loan from the World Bank in the mid-1990s (Kunigk, 1999; Riachi, 2013). This loan was mainly meant to allow for both the construction and management of the Bisri dam and its Awali-Beirut conveyor under a PPP with Watson-Montgomery.

Some Lebanese MPs refused to allow any mention of privatization as in the first drafted law in 1996. This led to the cancellation of the proposed loan from the World Bank (Riachi, 2013). Such refusal came mostly from Arab nationalist parliamentarians, who argued against risking national water sovereignty through privatization. The old *zuama* (elite families) that own large properties and prior water rights (to be cancelled by the law) also opposed it, feeling that their privileges, power and patronage was under threat. In its final version, Law 221/2000 did not refer directly to privatization. However, it was followed two days after its adoption by the Law 228/2000 on May 31st, creating the Higher Council for Privatization, the first regulatory structure for private sector participation in the energy, telecommunications and water sectors.

With the 221/2000 reform and law 228/2000, the Lebanese government initially showed a desire to operate the four new Water Authorities under Public-Private Partnerships (PPP). This is still on the agenda of the government, as suggested by the Ministerial Resolution No. 2 of 25 June 2007 prepared by the Higher Council for Privatization to submit a legal framework for joint ventures between the new institutions and the private sector. Following the principles of New Public Management, those reforms were issued under the operational and financial autonomy

[25] *Muhasasa* is a term used to describe 'allotment' of political class allocation of resources, public official appointments, and privileges accrued from the state to their sectarian constituencies to ensure their continued political support.

paradigms to be applied in each region. The responsibilities of the new Water Authorities go to the maintenance and operation of drinking water, sanitation and irrigation; they are expected to set water tariffs in line with their O&M costs. According to the reform, the Water Authorities have the right to choose a direct management or delegate contracts in running water utilities in collaboration with the private sector. Two years after its adoption by the Government, the four presidents of the Water Authorities were appointed in 2002, and the law went into implementation at the end of 2005.

The implementation of the reform saw a series of civil society mobilizations, left-wing and ecological parties refusing privatization, but also strikes from trade unions of the old offices members and local water committees that the reform expected to dissolve.[26] Civil servants were shifted to these new institutions, but their seniority was not taken into account in the new contracts. Until now, the mobilization of water staff through trade unions have called for a review of their new affiliations and a correction in their salaries and pensions. In 2010, the NWSS estimated that 80% of the positions in the MoEW and Regional Water Authorities were filled (MoEW 201). This hiring freeze took place in the end of the 1990s as an austerity measure prompted by structural adjustment programs.

In 2003, the *Société Générale* bank and its Lebanese branch were commissioned by the government to set a study on water management restructuring, and to demonstrate the flaws of the 22 old water offices. The study analyzed the feasibility of water privatization at various technical, financial and administrative levels, offering a framework of regulation and setting the private sector control. In parallel, the Paris II conference in support of Lebanon's reconstruction (held in 2002), unlocked investment funds from the World Bank, the European Investment Bank and the French Development Agency, among others (Riachi 2013).

Prior to the enforcement of the water 221/2000 reform in 2005, the consortium Degremont-Ondeo-Suez was commissioned for the management of water in Tripoli between 2002 and 2007. The question remains as to why was the contract not extended. According to international donors and government officials it was considered a successful experience, since the company was able to reach higher rates of connection and service delivery due to leakage control (AFD 2010). In fact, it was namely the tensions between the Tripoli water authority board and Ondeo that stopped the renovation of the contract (Yousfi 2006, Verdeil et al. 2010, Allès 2011). The former tried to put pressure on hiring issues while the latter failed to properly collect bills and make it a worthy business. However, this contract unlocked many other utility construction projects financed by French loans, through the Agence Française de Développement (AFD), namely Tripoli's wastewater treatment plant. This was finished in 2008 and never operated because of institutional fragmentation and an inability to decide who is responsible for running it.

Following this trend of new management and new development projects during the reform 221, many wastewater treatment plants built in the last decade remain currently non operational (ex: Beirut-Ghadir, Zahle, Batroun, Tripoli, Tyre, Saida). Where the stations are completed, the problems of power supply or lack of minimum flow arise in the absence of sewers (ex: Iaat, Joub Jannine, Jiyeh). In addition, sixty small wastewater treatment plants and thirty rural sewage treatment plants carried out by the CDR and by international development loans are not functioning due to financial burdens and institutional fragmentation. This situation is leading to high rates of groundwater pollution in the absence of wastewater treatment. Another important flaw brought by law 221/2000 is the complete neglect of groundwater management as being part of Water Authorities' responsibilities. It rather focused on technical and financial aspects of

[26] Al-Akhbar (3/12/2010), Racha Abou Zaki, "3074 aggrieved water employees", 3074عامل مياه مغبون.

networks without taking into account the natural resource and ecological issues related to aquifers' use and protection.

Both reform 221/2000 and the recent National Water Sector Strategy adopted in 2012 seem to have added to the confusion regarding the responsibilities in the management of the sector. Groundwater is completely missing in this new re-centralized organization. Fifteen years after this institutional reform, Water Authorities have not established any sound vision or action towards the conservation and the management of aquifers. They have instead concentrated their efforts on administrative restructuring to host PPPs and building dams (Riachi 2013). As we will see in next sub-section, water policies in Lebanon are historically profoundly rooted in a supply-sided vision.

6.3 On the roots of the Lebanese water supply-sided vision

During the reconstruction period (1990-), surface storage sites were first presented in the decennial plan 2000-2009, then in the National Physical Master Plan for the Lebanese Territory, compiled in 2005 and approved by Decree 2366 in 2009. More recently, the Lebanese government has reconfirmed this supply-sided vision by the adoption in 2012 of the National Water Sector Strategy. The post-civil-war period has seen the revival of many on-hold projects that involved large investments, dams and inter-basin transfers, in order to reach what is considered to be the country's full hydraulic potential. This vision was initiated during the French Mandate (1920-1943), was pursued after independence was declared in 1943, and later was continued during the national institutional construction phase (1943-1975). It is the very same policy based on the large-scale water project plans of the pre-civil war periods that the reconstruction phase has reproduced (Riachi 2012). The implementation of those projects has been slow, and in half a century only two dams were constructed. The pace of dam construction has accelerated since 2013, with six dams being under construction or at the final stage of commissioning. All of these have occurred in the face of opposition by citizens and ecological movements.

Even though the history of water policies in Lebanon is marked by a continuity in terms of large supply-sided planning, the political discourse has witnessed a change. One can note a shift in the narrative where large-scale projects were advanced as a modernization process taking advantage of the country´s *water abundance* by the French Mandate and later the United States development mission (Point IV) (1950s), presenting Lebanon as underdeveloped in terms of hydraulic planning. More recently, this discourse shifted towards a *water crisis* driven by population increase and climate change (Riachi 2013; Ghiotti and Riachi 2014).

Holding different positions under the Mandate, the first Lebanese hydraulic civil engineers took high positions in post-independence water authorities and their works are considered until today as pioneering. Many plans made by hydraulic Lebanese figures like Albert Naccache, George Maasry, Ibrahim Abdelal or Rushdi Salhab made their way to implementation through state-led projects during the first independence years (Riachi, 2013). After independence, a hydropolitical challenge arose: Lebanese water experts had to defend the country's natural resource sovereignty threatened by the creation of Israel, with Zionist claims over the Jordan River and its tributaries and even the Litani. Since then, the Lebanese identity was tied to large-scale water projects in order to reach its full development potential and maintain its water sovereignty. Born during the Mandate, the Lebanese civilizing "hydraulic mission" grew after independence, entangled within a process of nationalization and institutional building which presented the country as the "water tower of the Levant" and "the fruit and vegetables basket" of the Middle East.

Beside the sovereignty question of the new republic, a wave of nationalizations of what were private water concessions was adopted (e.g. Beirut Waterworks created in 1877, nationalized in

1951). In spite of the fact that water authorities were nationalized, a new form of organization and private concessions came into being during the Cold war. The United States, through one of the first loans of the World Bank, started its technical assistance intervention in Lebanon through the construction of the Qaraoun dam.[27] The project was inspired by the Tennessee Valley Authority in the United States, or the "Arab TVA", and led to the creation of the Litani River Authority in 1954 (Sneddon 2015). In addition to the reservoir, hundreds of wells were dug in the Beqaa by the U.S. Bureau of Reclamation, an intervention known as the Point IV mission for domestic and irrigation purposes.[28] This period initiated a technical-financial vision of water development which endures until today, however the main irrigation development objectives of the plan were never met. Since the French mandate, a slogan has been deeply ingrained within the Lebanese common discourse that comes from this engineered Lebanese hydraulic mission era: *The country has abundant water but it all goes to the sea, dams are needed to stop this waste*. The origins of this slogan go back to the French Mandate. The "*château d'eau du Levant*" (the Levant's water tower), was considered to be managed in an archaic fashion by the locals and needed to be modernized by a good-willed colonizing power. This is however, still the credo of the most recent governmental plans and strategies. The 1999 ten-year plan of the Ministry of water and energy compiled all existing studies about possible retention sites and brought back to life the same rhetoric. In a speech note in 1998 and prior to his nomination at the Ministry of Energy and Water at the head of the Directorate of Electric and Hydraulic Resources, Fadi Comair noted that: "*The future water Lebanese strategy will be based upon the construction of storage earthfill and concrete dam in order to enlarge the agricultural areas and fulfill the domestic water needs."*[29] Once in office he proposed a decennial plan in 1999, that was later renewed in 2009 (-2018) and recently refined by the National Water Sector Strategy in 2012. This is how the narrative of water development advocating the building of dams has been adapted to contemporary challenges, and dams have to respond now to the circumstances of scarcity driven by climate change and demographic growth. More recently, dams were proposed again in early 2014 in a so-called 'Blue Gold Plan' initiated by the Civic Influence Hub lobby. Building the dams was set as the first objective (among forty) of what they presented as a "holistic" project to get out of the water crisis. A large media campaign accompanied the launching of the project. It was endorsed by prominent politicians, high ranked bureaucrats, industrialists and businessmen calling for water privatization to fund the same combination of large-scale water projects. The Civic Influence Hub proposed refinements on the decennial plan and the national strategy. But beyond technical, financial or institutional small differences, the essence of both plans is the same.

During this pro-dam initiative conflicts of interest and a lack of transparency began to be more apparent. However, many questions about the feasibility of dams and their needs in Lebanon are emerging. For instance, winter 2013-2014 was the driest since the Qaraoun dam was constructed and its reservoir has only filled 40 Mm3 out of the 220 Mm3 potential. More recently, the Chabrouh dam in Keserwan was inaugurated in 2007, representing barely 1% of the 1999 decennial plan. Research suggests that the dam is leaking more than expected because of the highly permeable karsts that characterize the site, an extremely high leaking rate for a dam of this size (Bou Jaoude et al. 2010). Another surface reservoir completed after 12 years of works in Brissa

[27] The USD 27 million IBRD loan was granted in 1952. The construction of the dam, power plant and hydrotunnels was completed in 1959. The reservoir is located in western Beqaa on the Litani, 61 meter high forming a 220 MM3 capacity storage. Note that the Qaraoun dam is the largest feasible dam in Lebanon according to different studies and plans.

[28] New York Times, 20/6/1953, Love, Kennett : U.S. Water Hunters a Hit in Lebanon: Drill Test Wells for Big Dam Project Near Villages That Badly Need their Flow.

[29] Conference note: 'Litani Water Management - Prospect for the Future', Congres International De Kaslik - Liban - 18-20 Juin 1998, Fady G. Comair, President of the Litani River Authority.

in 2013 has never been able to fill up because of karst. Looking at the Janna dam in Nahr Ibrahim, studies have shown the high potential leakage due to karst formation (BGR 2012). This type of calcareous and porous limestone characterizes two thirds of Lebanese geological formations, as presented in the first section. These problems related to storage dams in the context of Lebanon further underline the central importance of groundwater resources for Lebanon.

Many dams are under-construction in the face of local disapproval, municipalities (e.g. Bisri-Al-Midane, Janneh-Nahr Ibrahim, Chatine, Hammana, Mseilha and their neighbouring municipalities)[30] and green NGOs calling for a halt in construction and the implementation of environmental and social impact studies by independent bodies prior to launching the construction. Recent civil mobilizations erupted in August 2015 asking for a response to the inability of the government to find a solution to solid waste management, where hazardous dumps invaded cities and forests. Demonstrators' slogans asked for an end to corruption in CDR concerning solid waste management and the resignation of the government. One of the reasons for opposition to the official plan that depends on incinerators and landfills, while advocating for recycling, is the harm that ashes and waste effluents can do to groundwater in their proposed sites (e.g. Srar in Aakar and Masnaa in West Beqaa).[31]

The National Water Sector Strategy approved in 2012 plans to adopt demand based policies such as metering and volumetric charging, but none of those policies has been implemented. This is especially needed when compared to the pace of costly dam constructions. Concerning groundwater, all the proposed plans and strategies only discussed aquifers from an artificial recharge perspective, falling also under supply augmentation measures and they do not consider deeper legal, institutional, technical and financial reforms concerning water use in order to apply demand management measures. Legally, reforms could consider a review of private access to groundwater as discussed in Section 4 and consider delimiting aquifers protection zone. Institutionally, 15 years after its adoption, reform 221/2000 should be reviewed with regard to hiring personnel, the role of Water Authorities in groundwater management and the regulating framework of historical communal water management. Technically, this should include public network coverage extensions to ensure universal access. Financially, the latter should be accompanied by clear tax exemption and subsidy schemes, encouraging more subscribers, giving away their wells and/or prior water rights, and giving incentive to farmers to adopt precision irrigation techniques.

Coupled with the varying levels of political *muhasasa* within the policy arenas, the choice of such large water projects in the Lebanese context is also influenced by territorial and political power issues maintained by the confessional system. This power-sharing system is based on sectarian lines in parliamentarian representation, embedding a variety of political figures coming from elite families, feudals (*iqta´*), businessmen, heads of militia or retired army commanders. Known as "confessionalism" - a combination of confessional and consociational democracy[32]- is a unique political regime for Lebanon where the government is formed by a grand coalition consensus among different politicians, proportionally allocating political power among the country's community sectarian lines. The political struggle over jurisdictions happens to be more within rather than between communities. Political maneuvering presents dams as a water development

[30] L'Orient Le Jour, Claudia Preti (13/03/2015) Le barrage de Hammana, ou la folie des hommes; L'Orient Le Jour, Raja Noujeim (21/05/2015) Non, messieurs, le barrage « catastrophe » de Janné ne se fera jamais !; Middle East Eye, Marwan El Solh (04/02/206) Lebanon's dam obsession: Who pays the price?

[31] Assafir, Ata Elias (21/9/2015), سرار: حلٌ أم مشكلة؟ , Srar: a solution or a problem?

[32] Consociationalism is a form of government seeking to regulate power sharing in a state comprising diverse ethnic, religious, political, national or linguistic groups, by allocating these groups political representation.

ideal for most political constituencies, where each and every single party has at least one dam project on its agenda. It is important to note that the geographical boundaries of electoral districts (Caza or *Qada'*) are sometimes cities, but they are more generally inter-rivers areas, overlapping with different basins, so approaching any water development project has political consequences (Riachi 2013).

What is important to consider in the formation of the political economy of water in Lebanon is its relationship with land property. The largest share of landholders in Lebanon goes to ecclesiastic properties and many politicians are large landowners (Hariri family, Assem Kanso, Jumblatt family, Skaff, De Freige, Khazen, Edde …), real-estate developers, bankers and engineering companies (Hariri, Mokbel, Murr, Mikati…). It is not in the interest of those large landowners to give up their land usufructs and review national water laws. The economical Laissez-faire regime in Lebanon enabled a political system that ensures the development of a rentier economy led by the businesses and properties of a few individuals.

While aquifers are depleted and polluted, politicians' systematic inaction is summarized as following: i) Being undisturbed by the uneven access to water within the urban fabric; ii) Profiting from water-intensive production and export subsidies on fruits and vegetables irrigated from wells; iii) Benefiting from the easy access to groundwater in all their land-based real-estate businesses; iv) Investing in large-scale water projects through crony contracts, and; iv) Targeting international organizations' development loans to their electoral constituencies.

7 Conclusion

Lebanon's current legal and regulatory framework governing the use of aquifers in Lebanon dates back to the Ottoman Empire and the French Mandate, treating modern wells and boreholes as if they were still dug wells. There are no groundwater protection zones in the country and usufruct rights to groundwater are granted to landowners. In turn, the use of aquifers shaped the historical transformation of urban fragmentation and agriculture in Lebanon. Irrigated areas increased from 40,000 ha in the 1950s to 120,000 ha in 2010. Highly dependent on farm size, dug wells and pumping equipment are primarily found in large farms. Fuelled by the absence of public infrastructure, groundwater use, and its consequences for drying springs and rivers, is an urgent problem that needs to be tackled. Nevertheless, the narrative underlying modern water policies in the country promotes dams as the main solution for addressing water stress and groundwater has been astonishingly absent from policies.

Instead of addressing problems with affordable solutions, by allocating more financial resources to fix networks' physical failures, to construct small water towers and to hire new staff, politicians, high-ranking bureaucrats and international development banks are focusing on expensive large-scale projects. The recent experience with such projects has proven that they are white elephant projects with clear conflicting private interests. The permanence of those engineering solutions favored by politicians obscures the legal and territorial issues related to water. Land property and political divisions are at the root of imposing an uneven allocation of water resources. The reality is that public water management has been systematically impoverished in order to privatize the resource, be it above or under the ground.

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127, Sunil Mawatha, Pelawatte, Battaramulla, Colombo, Sri Lanka
Mailing Address: P.O. Box 2075, Colombo, Sri Lanka
Tel: +94-11 2880000 Fax: +94-11 2786854 E-mail: iwmi@cgiar.org Web: www.iwmi.org

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