



AMERICAN UNIVERSITY OF BEIRUT

WATER AND LIVELIHOODS IN THE COASTAL AND  
INNER PLAIN OF AKKAR, LEBANON

by  
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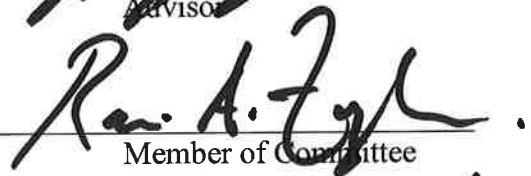
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## AN ABSTRACT OF THE THESIS OF

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Recurrent claims about the demise of water resources in Lebanon have risen for the past eight of years, ever since the onset of the Syrian civil war. Numerous triggers were considered, ranging from the inadequate infrastructure to the lack of governmental support, or the sudden surge in population following the influx of Syrian refugees. Farmers are most affected by changes in water availability as their livelihoods are linked directly to agriculture – the prime utilizer of water resources. Relying on farmers' perception and knowledge, the current thesis aims to assess the state of water resources in part of the agricultural plain of Akkar, Lebanon. A rapid rural appraisal method was used to collect data in the field over a period of seven days to identify current water resources management practices and their implication of water availability around the catchment of Arka and Ostuene. The Sustainable Livelihood Approach has allowed us to better analyze the livelihoods of farmers and its link to water management. Results have shown that surface water is not made available to farmers nor is it adequately used and managed, which means that farmers end-up resorting to groundwater pumping to irrigate their crops. The lack of proper monitoring, governmental services, and continuous market competition have proven to be some of the primary concerns highlighted by farmers in Akkar. Recommendations have thus been shaped based on community knowledge and designed in a way to fit various livelihood strategies.

Keywords: Agriculture, Livelihoods, Water Resources, Rapid Rural Appraisal, Sustainable Livelihood Approach, Syrian Conflict.

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## GLOSSARY

ITS: Informal Tented Settlements.....	29
LRA: Litany River Authority .....	1
MCM: Million Cubic Meters.....	27
MoEW: Ministry of Energy and Water .....	25
NLWE: North Lebanon Water Establishment.....	1
NWSS: National Water Sector Strategy .....	25
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# CHAPTER I

## INTRODUCTION

As the Syrian conflict enters its eighth year, neighboring Lebanon has hosted more than one million Syrian refugees (VASYR, 2017) which constitute 17% of the total displaced Syrian population (UNHCR, 2018b). Economically, Lebanon has suffered as the country's growth rate dropped a staggering 7.4% during the three years following the crisis (YenÝlmez, 2017). With an already weak infrastructure, rising economic distress and a 40% population growth between 2011 and 2017 (World-Bank, 2018b), unmet demands are bound to get higher. As the crisis protracts, competition over resources intensifies. In recent years, an increasing trend of fresh water pumping has been observed in most parts of Lebanon to meet the demands of the inhabitants. The Lebanon Environmental Assessment of the Syrian Conflict & Priority Interventions concluded in 2014 that "the increase in water demand caused by the refugees is exacerbating the existing stresses on water resources in general and to groundwater resources in particular" (United Nations Development, European, & Ministry of Environment, 2014).

Current research studies on water availability place emphasis on the spillover effects of the Syrian civil war on Lebanon with their interventions shaped accordingly. As water resources are a top concern nowadays, any changes are linked automatically to the outbreak of the Syrian conflict. However, is that the case? Beyond the current discourse placing Syrian refugees as the main catalysts of change in water availability,

what are the main factors affecting this resource? Moreover, how severe is the present situation? To better understand the state of water resources in Akkar, Lebanon, it was only logical to place farmers at the center of this analysis. They are in fact, the primary users of water resources in Akkar and the ones most affected by changes in water availability. This research study applied the Rapid Rural Appraisal methodology, which encompassed interviews with farmers and stakeholders, direct observations and the use of secondary data (climatic variables and groundwater measurements). In parallel, the Sustainable Livelihood Approach (SLA) was later on applied to analyze the livelihood choices farmers make concerning the use of available water resources. Consequently, the status of water availability and governance in Akkar, Lebanon was identified. Supported by the community's knowledge, water management recommendations were generated to fit the various types of farming households better.

## CHAPTER II

### LITERATURE REVIEW

#### **A. Overview of water resources in the MENA region**

Water scarcity in the Middle East and North Africa (MENA) region has been further amplified as a major concern in the arid area, especially regarding surface water. It has been estimated that more than 60% of the MENA's population resides in water-stressed areas, a percentage that is far greater than the global average set at 35% (WorldBank, 2017). Water availability is further affected by the region's exposure to negative climatic changes (Waha et al., 2017) and the alarming increase in population that is projected to reach around 500 million individuals by 2050 in MENA countries excluding the GCC (World-Bank, 2017). The region's high dependence on groundwater resources is quite clear, whereby 76% of freshwater sources used in the MENA result from direct extraction of groundwater systems, subsequently composed of approximately 66% non-renewable fossil aquifers (Lezzaik & Milewski, 2018). Apart from Lebanon, the withdrawal to availability ratio amongst MENA countries surpasses the critical 40% limit, meaning that groundwater depletion is at an even higher risk in Jordan, Yemen, and Libya for example where the withdrawal to availability ratio surpasses the 100th percentile (FAO, 2013; Waha et al., 2017).

The agricultural sector is typically one of the prime utilizer of water resources in the MENA, taking up about 80 percent of the water budgets (Sowers, Vengosh, & Weinthal, 2011). Even though the sector generates minimal economic revenues from water (WorldBank, 2017) and that employment in the field has decreased over the

years, agriculture is still considered an important source of income to a large number of countries in the MENA (Antonelli, Laio, & Tamea, 2017). Antonelli, Laio, & Tamea (2017) explain that between 2010-2012, it was estimated that out of the total rate of employment in the region, 25-40% were allocated to the agricultural field. As irrigated areas expand in the Arab world, groundwater abstraction increases as the main source of irrigation water (Ambalam, 2014). The agricultural sector in GCC countries, for example, is the largest utilizer of water resources. In fact, 60% of UAE water resources is allocated to agriculture, forestry, and urban landscaping (Shahid, Ahmed, Shahid, & Ahmed, 2014). The excessive rate of groundwater pumping generated from agricultural practices has had major implications on the quality of water in specific and on the GCC's environment as a whole – pushing farmers to downsize production or abandon the whole practice (Shahid et al., 2014). Mining renewable resources in unsettling frequencies is an alarming issue in Arab countries. The increase in the number of private, unlicensed, and unmonitored wells is increasing groundwater withdrawal levels (Antonelli et al., 2017; Waterbury, 2017). This, in turn, surpasses annual re-charge rates (generated from precipitation and snowmelt), severely contributing to a decrease in groundwater levels and escalating concerns over food production in the region (Antonelli et al., 2017; Waterbury, 2017). With limited availability of arable land in the most of the MENA region, countries that fall in this territory end up becoming more and more reliant on agricultural imports (Antonelli et al., 2017). The MENA region is classified as the top wheat importer worldwide with seven MENA countries amongst the thirty primary food importers universally (WorldBank, 2017). Trade of agricultural goods is classified as an important component in the achievement of food security in the MENA region whereas trade is directly linked to the concept of “virtual water” – also



defined as water contained in edible goods (Lee, Mohtar, & Yoo, 2018). Tony Allen believes that agricultural trade and virtual water enables the reduction of water constraints nationally and regionally, and decreases international inequalities in the supply of water (Gilmont, 2015). The concept of virtual water has been largely discussed. Some studies elaborated on the fact that virtual water trade can provide water-deficient countries with additional amounts of this resource, allowing them to preserve it for more important usages, such as domestic and industrial usages (Antonelli & Sartori, 2015). However, Wichelns and Merrett have argued that less economically developed countries, which are unequipped economically and politically to handle unpredictable changes in world market prices, are prone to becoming more negatively dependent in terms of their food security (Antonelli & Sartori, 2015). Although relying on food imports in GCC countries is considered to be less financially and environmentally costly given their limited water resources, Saif et al. (2014) believe that it is still viewed as a risky investment especially that prices may change unexpectedly. On the other hand, investing in local agriculture exerts excessive strain on groundwater and requires as well as energy and financial capital (Saif, Mezher, & Arafat, 2014). Thus, GCC countries are seen investing in alternative, and sometimes controversial, water saving techniques to achieve food security. Some GCC countries have resorted to investing in agricultural land in the East African region, which provides them with steady imports. In parallel, it poses numerous ethical questions since governing laws and regulations are absent (Saif et al., 2014). Similar deliberations have been examined in regards to water management through virtual water trade in the Maghreb region. Some researchers, such as Sebri (2017), believe that virtual water trade can be justified as a potential practice enabling the enhancement of water supply in that part of the

MENA region. He explained that the Maghreb region is known to play a key role in virtual water trade, especially considering it exports immense amounts of embedded water in crops while not importing as much. Thus, he believes that an import strategy that considers multiple components such as the political and socioeconomic status of a country can be advantageously incorporated in water policies (Sebri, 2017). Other water management techniques such as the desalination of water through the use of renewable energy are also encouraged in the Maghreb region, a region rich in renewable energy such as solar radiation (Sebri, 2017).

Referring to concepts such as virtual water and ecological footprint, Arjen Y. Hoekstra emerged in 2002 with the novel notion entitled water footprint (Haie, Miguel Rodrigues, & Joana Castro, 2018). A water footprint can be regarded as an inclusive indicator that takes into account the usage of water both directly and indirectly (Aldaya, Chapagain, Hoekstra, & Mekonnen, 2012). It provides distinct spatiotemporal knowledge related to the appropriation of water directed towards different objectives - overall; it can help deliver more insight on how end users utilize and consume freshwater (Aldaya et al., 2012). The concepts of virtual water trade and water footprint have received increasing interest and have been integrated into various water management studies. For example, researchers adopting the life cycle assessment are seen adopting the water footprint concepts in their research (Hoekstra, 2017).

In contrast, scholars like Wichelns et. Al (2011) do not believe that virtual water trade and water footprint are useful tools that enable the research community to grasp problems pertaining to water, nor help develop adequate policies that enhance the quality of people's lives. Adding, they believe that "tempting to describe inherently

complex production and trading activities with notions based on a single resource can be misleading and potentially harmful”(Wichelns, 2011).

Similarly, the Integrated Water Resource Management (IWRM) approach was developed to govern valuable water resources. The Global Water Partnership (2011) defines IWRM as a systemized process that regulates water and other relevant resources to generate socio-economic revenues sustainably without causing environmental harm. IWRM approach relies on the incorporation of multiple sectors and places water resources at the forefront of all natural resources, the ecosystem, and socio-economic commodities (GWP, 2011). Though its implementation has been argued as difficult due to the outdated supply-oriented mentalities that govern the sector, Rached & Brooks (2010) consider IWRM useful in terms of triggering more meaningful water policy discourses in the MENA region. Morocco, for example, was able to restructure and enhance its water institutions, signifying that IWRM integration and reform could be applied to other countries in the MENA region (Rached & Brooks, 2010).

Water management theories have evolved over the years and have ultimately led to the emergence of the Water-food-nexus discourse, an approach that integrates water security, energy security, and food security (FAO, 2018b). As demands over resources are expected to sprawl with the projected population increase, the water-energy–food (WEF) nexus is presented as a means to ensure the sustainable provision of fundamental necessities to human beings, example water, and energy (Stephan et al., 2018). The article explains that overall, the nexus considers cohesive governance and management as cross-cutting with various areas and levels. Though some countries like Lebanon have a ministry for both water and energy, implementing the WEF approach in Arab

countries is still problematic as institutional integration is still not reflected in policies (Chnais, Farajalla, & Hajj, 2016).

Some of the main water management practices in the MENA region have been reflected above. Various discourses have been introduced, critiqued, and studied to ensure that water delivery persists in the MENA region despite multiple obstacles.

## **B. The History of water management in Lebanon**

### ***1. The Ottoman Empire (1516-1918)***

Per Riachi (2016), the governing laws that were inflicted on regions under the Ottoman ruling, including Lebanon, were crafted based on religious beliefs where the *Sharia* and the prevailing *Fatwas* were responsible for the organization of the water sector in Lebanon. Riachi further explains that eleven articles, based on the fatwas of the Ulema and Hanafi jurist Khaireddine Ramli, were created to manage the allocation of water resource in the Levant during that time frame (Riachi, 2016). The development of these Islamic laws was mainly attributed to a shortage of water resources that prevailed in the MENA region and the significance early societies had placed on governing this resource (Jagannathan, Mohamed, & Kremer, 2009). As a matter of fact, concepts such as the right to drink water (*haqq el-chifa*, *haqq el-chirb*) or the right to irrigate land (*haqq el-rayy*) were all derivative from the sharia (Ghiotti & Riachi, 2013). As per Ghiotti & Riachi (2013), water early on was considered a strategic resource that influences the value of land greatly, alters economic production, and can generate income. Based on the Hanafi doctrine, two types of water rights exist: the “*Mubah*” signifying public water sources, and “*Mulk*” referring to private water sources that provide its owner the right to benefit from the water they own - “*Haqq Al-Intifaa* known

not to interfere with the water rights of other riverine landowners (Riachi, 2016).

Generally, the right to access water could be inherited from generation to generation or transmitted to a new owner if the land is sold (Riachi, 2016)

Communal “*Mushaa*” lands were prominent in the Beqaa, South, and the Akkar valley in the North of Lebanon – areas historically known for their agricultural purposes in the Levant (Riachi, 2016). The term refers to a jointly owned property, whereas a larger plot area is collectively kept by a group of people or a community (Irby, 1971).

Communal land was believed to be governed by the Timar tenure regime that was enforced during that time. The regime referred to the plots of land or profits the ottoman ruler awarded to people in exchange of their assistance, in other terms “the iqta of the Islamic empire of the Caliphate” (Encyclopædia-Britannica, 2015). Riachi (2016) explains that high-ranked leaders were seen as having power over communal farms as they were entrusted with land concessions and tax collection. Irrigation practices during that time were restricted to either parcels adjacent to springs or Roman constructed canals - the case of Tyre, El-Qaa, Baalbek and Anjar. The practices mentioned above paved the way to the “*Iqtaa*” system that assigned feudal families the powerful role of tax collector in their communities. Thus, to preserve their rights to use agricultural lands, farmers had to pledge their loyalty to *Muqtaajis* and pay taxes to the Sublime Porte (Riachi, 2016).

According to the book, *A History of Modern Lebanon*, Fawwaz Traboulsi (Traboulsi, 2007) presented some of the most important historical events that occurred in Lebanon. The author explains that during the era of the Mutasarifiya (1861-1915) under the Ottoman ruling, the economic sector seemed to boom and was predominated by monoculture and mono-production of silk that stretched from Mount Lebanon to

Akkar which fed into the silk industry of Lyon, France. He then clarifies that the thriving industry of silk production came at the expense of other sectors which resulted in commercial shortages, and attributed towards the dominance of cash crops at the expense of subsistence agriculture (example: cereal) – increasing external imports. Traboulsi (2007) also talked about the increase in migration trends that consequently resulted in the increase Waqf lands during that period. This further restricted the underdeveloped agricultural sector and made it harder for those who wanted to return to reclaim their properties back, triggering an agrarian movement that called for the just distribution of land (Traboulsi, 2007)

During the nineteenth century, the Ottoman Tanzimat reformers imposed several rectifications to the governing legislations in countries under the Ottoman ruling - Syria, Lebanon, Iraq, and Palestine (Hanson, 1987). Established on the grounds of the French civil code (Napoleon Code) and functioning besides the sharia, the Majella was introduced in 1875 to govern all sectors activities (Ghiotti & Riachi, 2013). Introducing land ownership throughout that era increased organizational inequalities regarding water accessibility and made power relations more prominent amid different areas and social classes (Ghiotti & Riachi, 2013). According to Hirsch (1959), the Majella Code was a compilation of preceding beliefs. The code affirms that everyone can use public water resources; however, riparian property owners are entitled to benefit from their owned waterways (Hirsch, 1959). It is important to note that the Majella was surpassed by French legislation in Syria and Lebanon (Hirsch, 1959).

Before the fall of the Ottoman Empire, Riachi (2016) explains that the “Code of irrigation” was established in 1913 to manage the water used for agriculture. He elaborates that this code covers multiple areas such as the regulation of irrigation use

when shared irrigation schemes are applied, and the type of authority and responsibility different parties have in the maintenance of irrigation networks. In rural areas, local communities still apply these governing regulations in their current irrigation management systems (Riachi, 2016).

## ***2. French Mandate (1920-1943)***

Per Traboulsi (2007), the prevailing authorities during the French mandate wished to nurture the rise of middle-class farmers who can operate as a social base for the mandate. However, as he explained, the patronization of traditionally landed notables aided the French in gaining the allegiance of the inhabitants in times of political instability. Traboulsi (2007) also mentioned that landowners in areas of Akkar, the Bekaa, and the South, the principal recipients of governmental assistance and agricultural development projects, were greatly supported by the French authorities. After the collapse of silk production in the 1930s, however, another emigration movement occurred that pushed further people from their lands (Traboulsi, 2007). In parallel, the water sector witnessed some important changes. In fact, in 1925, the state announced that water resources were public and circulated a decree that specified the category of reimbursements that current users have a right to receive (Closas & Molle, 2016). Also, no permits were required to abstract water if water levels remained below 100 meters per day (Closas & Molle, 2016). In 1926, Ordinance 320 was recognized by the French authorities as a means to better control groundwater (Closas & Molle, 2016).

## **C. The History of Water Governance of Lebanon**

### ***1. Post-Independence (1943 - 1974)***

According to Traboulsi (2007), the expansion of the water sector was hindered during this period as the developmental funds that Lebanon received were limited. The number of funded projects was not enough to cover the whole country, and in 1956, approximately 70% of the villages did not have access to tap water and complemented this unreliable supply of this source with groundwater (Traboulsi, 2007). Irrigation practices were not that prominent during the 1950's with a staggering 6% of arable lands being irrigated (Traboulsi, 2007). This percentage increased to 20% during the 1960s and was accompanied by groundwater abstraction of about 5% of the farms (Traboulsi, 2007). A new law was issued to control the pumping of groundwater and the construction of wells in the 1970's – similar in content to the laws issued during the French mandate. (Traboulsi, 2007)

Due to scarce references about agrarian movements occurring in Akkar, a summary of part of the book “A history of modern Lebanon” by (Traboulsi, 2007) was used below to describe what occurred in Akkar during the end of the 1960s. As per the author, landowners in 1969 resorted to more mechanized systems of production at the expense of sharecropping. Sharecroppers were thus forced to pay rental and production fees for the lands they once tended to. Consequently, pushing them to give up the practice of sharecropping completely, emigrate in search better future or become waged laborers, as they did not have the means to continue agricultural production. These events were interpreted by Traboulsi (2007) as push factors that rid the landlords from local farmers and, allow them to better profit from capitalist manufacturers who pay more. (Traboulsi, 2007). According to Petran (1987), the early 1970s of Akkar were marked by the rise of



a worker-peasant coalition led by a Ba'athist lawyer with the purpose of revolting against the existing system of exploitation. The peasants of Akkar fought against unjust socio-economic conditions, and in opposition to any attempt Beys take to sell their holding to capitalist entrepreneurs, rendering them displaced and unemployed (Gilsenan, 1990). As per Petran (1987), these rebellious acts reached their peak in 1972 where a war over irrigation rights erupted. The clan of Baarini, who supported the peasant's movement, and Suleiman clan were also at war during the same time over irrigation rights and land ownership - this amplified the conflicts in the region, and consequently required military intervention in 1974 (Petran, 1987).

Per Chatila (2013), institutional reforms to the water sector had commenced during 1972 to enhance the effectiveness of the sector. The reforms were mainly targeted towards combining the existing autonomous water authorities into five main entities. However, the civil war that started in 1975 had suspended any attempt of implementation. (Chatila, 2003)

The historical events that occurred in Akkar demonstrate how the capitalist movement altered the agrarian sector affecting; as a result the livelihoods of many. Resources, be it land or water, are without a doubt precious material that triggers conflicts and wars. What was previously described is but a segment of important historical events that Akkar has witnessed and might witness once again.

## ***2. Civil War (1975-1990)***

Closas & Molle (2016) explained that during the civil war of 1975, public services broke down and water delivery got hindered. Thus, obstructing any development, the water

sector was aiming for and increasing the trend of groundwater pumping by private agencies (Closas & Molle, 2016).

### **3. *Post-civil War (1996 – 2010)***

Though in 1994 multiple water authorities were created in different areas such as Koura, Doniyeh, Akkar, several decrees were passed in 1996 that officially recognized the creation of public institutions known as water establishments in the North, South, Beirut & Mount Lebanon and the Northern and Southern parts of the Bekaa (Closas & Molle, 2016).

Farajalla, Kekrzian, Farhat, Hajj, & Matta (2015) explained that to centralize the organization of the sector, law 221 of the year 2000 assigned the responsibility of policymaking, national planning and water resource management to the Ministry of Water and Energy (MoWE). At the same time, Water Establishments (The four independent Water Establishments: North, Beirut Mount Lebanon, South, and Bekaa) and, the Litany Water Authority (LRA) were responsible for service provision, replacing the 21 water authorities that were once responsible for the upkeep of water resources. The authors also highlighted that this legislation had received criticisms related to the ambiguity of its implementation. They see no clear statements regarding the MoEW/public institutions role in policy creation. Moreover, Farajalla et al. (2015) think that a lot of the roles assigned to stakeholders in the water sector overlap, pushing some institutions to transfer their allocated duties onto others. Furthermore, the authors believe that law 221 restricts municipalities/local communities' role in executing small irrigation plans, collecting wastewater and managing water networks. However, the authors did not want to generalize this notion as some local water

committees/municipalities still fulfill their original duties to compensate for the WE inability to carry out its role fully (Farajalla et al., 2015). Closas & Molle (2016) mentioned that some of these water committees, specifically in Akkar, have opposed this water law since its last modification in the year 2000. As water supply is still lacking in some part of Akkar, we see more consumers resorting to more privatized water forms such as pumping water from private wells and purchasing it from tankers who also extract water from wells (Closas & Molle, 2016). Others voiced their concerns about the fragmented relationships between water resource management agencies and the absence of stakeholders in any aspect of a project's implementation and design (WorldBank, 2003). Not to forget, the outdated laws governing the sector dating back to the Ottoman ruling and French mandate (WorldBank, 2003). In short, the generated outcomes of law 221 involved RWE's inability to be self-reliant, amounts that are enormously overdue and understaffing.

Another approach to regulating the water sector was introduced in 2005, it was known as Water Code or "Code de l'Eau." With aid from the French government, a draft was produced with an Integrated Water Resource Management (IWRM) approach in the front line to fill in institutional gaps of law 221 (Amine, 2016). Concepts such as 'user pay,' 'polluter pays,' and decentralization emerged to help manage the sector. However, drafting of the code was never completed (Amine, 2016).

The 2006 Israeli war that hit Lebanon, though not directly damaging to Akkar, led to significant economic losses, infrastructural impairments and much harm to public administrations. The war has impacted all sectors (including agriculture) and has generated implications on local livelihoods whereas, 545 farming lands were no longer used because of damages (Darwish, Farajalla, & Masri, 2009). Per Mouchref (2008), the

marketing of agricultural goods also suffered during that time, where transportation was hindered, and export was undoubtedly blocked – affecting farmers in Akkar. Thus, several farmers took-up loans and amplified production but unluckily the Nahr-Al Bared war broke, leaving them with enormous debts (Mouchref, 2008). 64.6% of the households involved in agriculture witnessed a decrease in productivity because of the two subsequent wars (Mouchref, 2008). Selling their agricultural goods was also problematic as importers from the Gulf terminated their contracts with producers from the North due to the political instability in the region (Mouchref, 2008).

To compensate for the shortfalls of law 221, the MoEW came up with a strategy that aimed to: ensure that the reforms of law 221 are met; come-up with plans to generate financial resources for Regional Water Establishments; come-up with policy frameworks to help fill in gaps, be it legal, institutional and organizational; and, establish a set of investment needs to meet water supply targets in the water sector (Amine, 2016). Hence, under resolution No. 2 dated in 09/03/2012, The National Water Sector Strategy (NWSS) was passed by the Ministry of Energy and Water in collaboration with national stakeholders and international donors (Bassil, 2010). NWSS's mission highlighted the need to continuously and sustainably safeguard the supply of water, irrigation services, and health-related amenities. The NWSS included a section on the importance of finalizing the “Water Code draft” and ensuring that it gets implemented (Bassil, 2010). The participation of the Private sector has been highlighted under “Financial and Commercial Initiatives” section and has been considered an “enabler to incorporate know-how and fresh capital” (Bassil, 2010) – all goals were short lived.

In 2010, Decision 118 was released to standardize and control groundwater permits in Lebanon (Closas & Molle, 2016). In the document “Groundwater governance in the Middle East and North Africa region” (Closas & Molle, 2016) valuable information about legally digging-up wells in Lebanon was provided:

Before drilling any well (less than 150 meters), users were requested to get a notification certificate. If one is planning to dig a well deeper than 150 meters or pump an amount that is higher than 100 m<sup>3</sup>, the ministry requests further approval. To begin with, an application needs to be sent directly by mail to the Ministry as decentralized offices do not exist. MoEW receives it and transfers it to the Hydrogeology service which in turn assigns an authorized private company to conduct an assessment on the technical characteristics of the request. The Hydrogeology service revises the study and forwards it to the Water Rights and Expropriation Service who are responsible in parallel to study the sound characteristics of the request. Accordingly, the Water Rights and Expropriation Service grants approval to the well request which eventually gets signed by the president. This permit should be renewed by the ministry the year after to allow the well owner to make use of the well he dug (Closas & Molle, 2016).

By the end of 2010, one can sense the forceful theme of centralized governance accompanied by an encouragement to seek private funds to manage the water sector in Lebanon.

#### ***4. Syrian War (2011- present)***

The Syrian conflict that ignited in March 2011 is now entering its seventh year with more than 5,598,685 people displaced around the MENA region (UNHCR, 2017). Because of the war, neighboring Lebanon has singlehandedly hosted around 1.5 million

displaced Syrians, 34,000 Palestinian refugees from Syria (PRL) and an additional 35,000 Lebanese citizens who have returned from Syria since 2010 (the Government of Lebanon and the United Nations, 2018). A significant number of these refugees have settled in the North and the Bekaa governorate – locations adjacent to the borders and typical destination for Syrian migrant workers involved in the agricultural sector (World-Bank, 2013). Based on the UNHCR’s most recent data, it has been estimated that the Bekaa currently hosts 357,315 Syrian refugees while the North hosts 253,147 (UNHCR, 2018).

At the beginning of the conflict, the Government of Lebanon and the international community focused primarily on the delivery of humanitarian aid to meet the direct needs of the refugees – no proper assessments nor any plan of action took place the first two years after the onset of the war. Based on UNDP et al. (2014) the following has occurred: 1) a committee was established based on the Prime Minister’s Decision no.146/2013 (amended respectively by Decisions no. 72/2014 and no. 75/2014) and, commissioned to ensure that an evaluation is carried out to assess the needs of both refugees and the Lebanese host community; 2) a financing mechanism was created and turned into a multi-donor trust fund that oversees the provision of aid to refugees; 3) the Central Security Unit (Central Unit) was established (based on ministerial decisions no. 1 dated 13/1/2013) in 2013, and regional security cells were formed at the District Commissioner level to keep track of the state of Syrian refugees.

Based on a governmental request initiated by the Prime Minister of the country, the World Bank in collaboration with other parties (ex. UN, EU, IMF) conducted a needs assessment in 2013. The generated study was entitled “Economic and Social Impact Assessment” (ESIA). The study identified that post-conflict, the demand on water has intensified and reached 26.1 million m<sup>3</sup> /year (MCM/year) – making-up around 7% of

the pre-crisis demand of 335 MCM/year (World-Bank, 2013). This means that the gross water demand for the refugee population (including the 25% losses in distribution leaks) is 106 liters/person/day (World-Bank, 2013). Second, it highlighted that the stability risks that might arise from “the displacement of private water providers brought about by the progressive formalization of un-regulated private water service providers” (World-Bank, 2013). Another environmental assessment was commissioned and overseen by the Lebanese Ministry of Environment in collaboration with international organizations. This study was conducted in 2014 and mainly investigated the level of environmental damage in the country (United Nations Development et al., 2014). The report highlighted various concerns, one of which is the depletion of water resources as an underlying environmental outcome (United Nations Development et al., 2014). It was concluded that the increase in water demand that Lebanon is witnessing due to the influx of refugees had placed an additional immense strain on its water resources, especially groundwater (United Nations Development et al., 2014). To further clarify, public water network, wells, and public reservoirs/standpipes were noted as the primary sources of water utilized by refugees – a source made-up mostly of groundwater. (United Nations Development et al., 2014). MOEW/ UNDP (2014) confirmed that the water level in numerous wells located around Lebanon has decreased by a range of 1 and 20 meters. Taping into natural springs and the decrease in precipitation was also mentioned as other factors affecting water availability.

A severe drop in available water resources has been presumed, especially that the percentage of individuals having access to water in Akkar was lower than the Lebanese average preceding the onset of the war (Baylouny & Klingseis, 2018). Akkar, one of the biggest agricultural regions, contains the second largest number of Informal Tented

Settlements (ITS) after the Bekaa with 300 ITS's in total during 2014 (United Nations Development et al., 2014).

The number of active Informal Settlements in Akkar increased and reached a total of 426 by the end of July 2016 – 77% of which receive water from boreholes in comparison to 21% that benefit from water trucking (Lebanon-Inter-Agency-Coordination, 2016). In 2018, it was estimated that around 46% of refugees, comprised of 79% of those who live in ITS's and the 41% who reside in substandard structures, get water from wells (Baylouny & Klingseis, 2018). The number of informal settlements occupying vacant plots of land in Akkar does not necessarily affect agricultural production. According to the United Nations et al. (2014), the concern on the long term arises from the lack of delineation plans protecting agricultural land from being used for construction. With the increasing population pressure that the country is witnessing, there is no guarantee that these plots will be left intact or solely kept for agricultural production. Signs suggest that some construction work (mainly related to shelter units) is taking place in agricultural areas resembling semi-permanent housing. (United Nations Development et al., 2014).

The first Lebanon Crisis Response Plan (LCRP), a collaboration between the government of Lebanon and national/international partners, was first put in place in 2015. The LCRP is a humanitarian response to the Syrian crisis that aims to respond to refugees' (Syrians and other vulnerable groups) most urgent needs and to target the host community as a means to alleviate the pressure that the conflict has exerted on Lebanon (LCRP, 2015). The Plan's main objectives are “1) to ensure humanitarian assistance and protection for the most vulnerable among the displaced from Syria and poorest Lebanese, 2) to strengthen the capacity of national and local service delivery systems to expand



access to and quality of basic public services; 3) and to reinforce Lebanon's economic, social, environmental and institutional stability" (LCRP, 2015). The first LCRP that was published gradually shifted to a more durable strategic framework entitled first Lebanon Crisis Response Plan (LCRP) 2017-2020. The operational response plan targeting the water sectors ensures that by 2020, access to safe drinking water is adequate and delivered sustainably to the vulnerable inhabitants in Lebanon. Hazardous wastewater management will be considerably reduced to ensure that the health and economic costs of environmental degradation is cut-down (LCRP, 2017). This will be achieved through three important measures that include, "finding a national solution for cost-effective servicing of informal settlements, enhancing Lebanon's capacities to deliver reliable water quality as well as quantity, nationwide and in areas of greatest vulnerability, and a heavy investment in wastewater management, to mitigate health and environmental risks" (LCRP, 2017).

In general, Lebanon has been unable to adequately respond to the essential requirements of refugees nor its residents, as governmental capacities are somewhat absent. Regarding water, the focus has been directed mainly towards increasing supplies rather than managing demands. Thus, dependence on external parties has ultimately amplified in an attempt to meet growing demands. (Baylouny & Klingseis, 2018)

## **D. Sustainable Livelihood Approach**

### ***1. SLA in Relation with Agriculture, water and rural livelihoods***

Water can be utilized in a number of different ways encompassing both productive and consumptive activities that undeniably influence rural/urban livelihoods in a variety of manners. The absence of water can be in itself a sign of poverty. Thus,

one can sense how complex the role of water is in maintaining human wellbeing (Cook, Gichuki, & Fisher, 2006). Factors such as crop production and processing can affect or be affected by the amount or the quality of water available (Cook et al., 2006). Farming households, for example, depend highly on this resource for crop production and raising livestock. This natural capital is considered crucial to the agricultural sector in Lebanon, where 61% of the total amount of water is allocated solely for irrigation purposes (R. FAO, 2014). Most communities in developing countries depend on farming-based activities as a principal source of livelihood. Lebanon is no stranger to that, especially since approximately 20 to 25% of Lebanon's active population is involved in the agricultural sector (R. FAO, 2014). The contribution of the agricultural sector to local GDP has reached approximately 80% in many villages located in the South, Baalbek, and Hermel (part of the most deprived areas in the country) (Cook et al., 2006). This sector has also been known to supply many job opportunities and a source of income for those who are in need. One can sense in broad that water availability and how this resource is utilized in agriculture, constitute two significant constraints to the wellbeing of an individual (Cook et al., 2006).

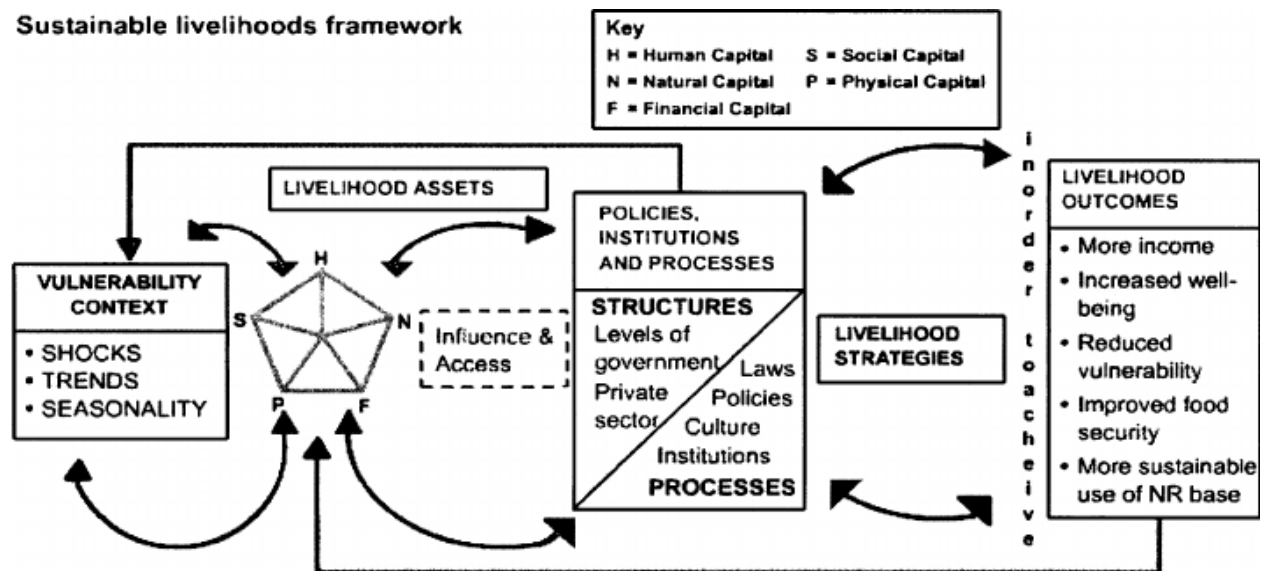
The concept of livelihood is defined as “the sum of ways in which households obtain the things necessary for life, both in good years and in bad. These necessities include food, water, shelter, clothing, and health care” (Faurès & Santini, 2008). Chambers and Conway noted in parallel that for a livelihood to be sustainable, it needs to be resilient to external pressure and should be able to preserve or boost its competencies without inflicting any damage on the natural resource base (Scoones, 2009) – something that is currently not taken into consideration. As mentioned in earlier sections, water exploitation is greatly felt nowadays with grave consequences on

production and rural livelihoods. The Sustainable Livelihood Approach (SLA) is a highly talked about concept in rural development. It places great emphasis on individuals and their needs. According to Haidar (2009), poverty reduction is at the heart of SLA. Hence, formulated interventions need to empower the poor so that they can create their own opportunities, ensure they have enhanced access to assets and enable the development of better policy and institutional environment. Analyzing the factors that impact the livelihoods of individuals is crucial to SLA as it enables investigators to identify better entry points to support livelihoods (Haidar, 2009).

Based on Nicol's (2000) claims, the sustainable livelihoods framework can enhance the results of water-related initiatives. He explained that the Sustainable Livelihood framework increases the level of intricacy in the analysis of water usage at the household level in addition to detecting any variations in the decision-making process at the household level. According to Nicol (2000), this can be achieved through the following: "Unpacking the components of demand at the household level, identifying the range and depth of barriers to access; embedding these household factors in the community- and national-level processes, making the micro-level linkages to macro-level policy and institutional environments." Overall, this framework can ignite links between water sector operations and an array of socio-economic and policy related concerns, ranging from decentralization and political responsibilities to the management of alarming changes to the surrounding natural environment (Nicol, 2000). In parallel, the SLA can help better target community-level water supply concerns and the division between water supply and water resources management (Nicol, 2000). This is significantly important to the different forms of water scarcity and the communities' perceptions of it (Nicol, 2000).

As illustrated in figure 1 below, there are five critical components in the Sustainable Livelihood framework that interlink to external factors (example: policies) and, consequently generate different livelihood outcomes. This set of assets can be divided as follows (Assessing Water-Related Poverty Using the Sustainable Livelihoods Framework, 2009):

- The social capital - depicted by relations and networks targeted at sustaining harmonized strategies aimed at attaining livelihood goals.
- Human capital – depicted by an individual’s abilities, his knowledge, good health, and his physical capabilities.
- Physical capital – depicted by the physical goods available (example: infrastructure and equipment).
- Financial capital – depicted by economic possessions (example: savings and credit)
- Natural capital – depicted by natural resources (example: water and soil)



**Figure 1.** The sustainable livelihood approach (Ellis, 2000)

## CHAPTER III

### METHODOLOGY

#### **A. Rapid Rural Appraisal**

The field of rural development has gone through many changes, more so in its delivery than in its practice. According to Chambers (1981), these changes promoted the adoption of a bottom-up approach, a shift towards inherent variability and a move towards learning processes. It has been observed that this field of study has detached itself from the traditional extractive questionnaires and promoted methods of assessments that are more participatory in nature, involving primarily local communities (Chambers, 1981). Incorporating local experiences was a vital component in this research study. Thus, the Rapid Rural Appraisal (RRA) method was deemed most suitable for this investigation. Initially developed between 1970 and 1980, RRA comprises various techniques to gather and interpret information associated with particular conditions or individuals ("Encyclopedia of Evaluation," 2005). Per the Encyclopedia of Evaluation (2005), triangulation is used consequently to validate data, be it through interviews with stakeholders, direct observations or supportive illustrations or sets of secondary data. Moreover, having multidisciplinary teams on-board and relying on semi-structured interviews are vital components for this participatory research technique (FAO, 2018a).

In 2011, Sean Richard Martin attempted to study the adaptive capacity of water resources in the Sikhu Khola catchment of the eastern Nepalese Himalaya. The main aim behind his research was to detect alterations in water resources and understand the inhabitants' capacity to adapt to these changes over the years. To assess people's

resilience in the catchment, Martin (2011) gathered data using the RRA approach. The researcher performed natural observations and conducted a total of 14 interviews with locals and key informants in the region. The researcher was assisted by five Nepalese men who resided in the studied villages over the course of 12 days of data collection. The field information that Martin has gathered was incorporated with secondary sources of information (example: reports, books, and journals) to ensure proper analysis.

(Martin, 2011)

Like the study above, the current investigation has resorted to using the RRA research method to understand the linkages that exist between farmers, water usage and agricultural choices in Akkar, Lebanon. Though many similarities exist in terms of the objective of both studies, the research design of the current investigation was adapted to fit the study area and the lack of essential secondary data about Akkar, Lebanon. The current research study relies on semi-structured interviews that incorporate closed ended-questions that evaluates, for example, the amounts of water used by farmers, as that data is not widely available.

## **B. Study Area**

The governorate of Akkar<sup>1</sup> is located north of Lebanon and includes a total of 203 villages and cities (Al-Nashif, 2012) – 18 of which are part of the study area. In general, the total surface area of Akkar is around 79,800 Hectares (Mouchref, 2008) which is composed of six main areas: Al-Sahel, Middle and Higher Dreib, Joume, Shaffat, and

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<sup>1</sup> Originally a Caza in Tripoli. In 2014, an administrative decision was made to split the seven districts that make-up the Northern governorate. Hence, Tripoli and its five surrounding districts remained kept the North governorate nomenclature while Akkar became its own governorate (OCHA, 2014).

Qaita. Agricultural land primarily dominates with a sum of 40,000 ha of which 14,000 ha are cultivated, and only 11,650 ha are irrigated (MOA & FAO, 1998). Apart from agricultural fields, several other land use in Akkar can be depicted as shown in table 1 (FAO, 2010).



**Figure 2.** A general overview of the Akkar plain and its hydrology

Types of Land use	Area in ha
woodland/scrubland	25,000
grassland	6,040
nonproductive natural land	3,261

**Table 1.** Land Use for Akkar Caza (FAO, 2010)

Within the 95 ha allocated for rivers (FAO, 2010), four main rivers cross Akkar: El-Kabir, Ostuene, Arka and El Bared (ELARD, 2016). 7,879 landowners, 5,800 heads of animals raised as livestock (MOA & FAO, 1998), and, around 430 poultry farms (for both chicken and egg production) can be found in the in the governorate of Akkar (Mouchref, 2008)

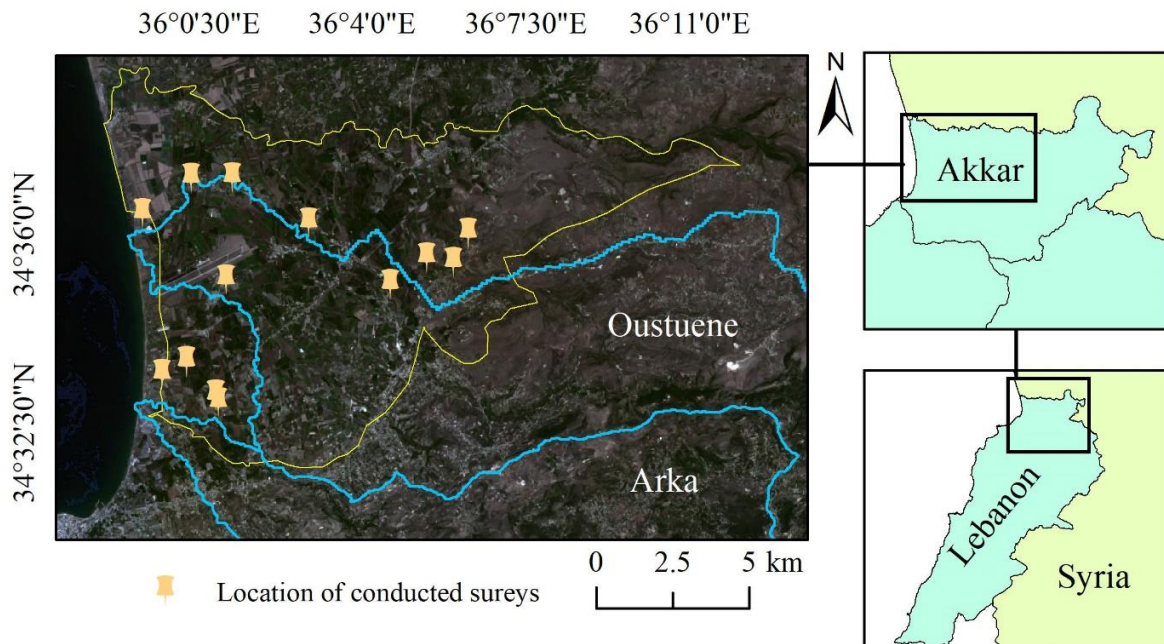
Akkar currently shares a 100 km border, 27 villages and three official crossing points (El Aarida, El Aaboudieh, and Boqaiaa) with Syrian territories (OCHA, 2014). These factors made Akkar easily accessible to refugees fleeing the Syrian civil war that started in 2011. Currently, 105,880 Syrian refugees (UNHCR, 2018a) are hosted by 75% of the governorates villages, with the majority staying in Wadi Khaled, Hnaider, Majdel, Kherbet Daoud, Bire, Kouachra, Kneisseh, and Dahr Lysine. In the Akkar plane alone, 13,533 Syrian refugees are accommodated in addition to the existing 23,000 to 30,000 Lebanese inhabitants (Al-Masri & Altabbaa, 2016) – refugees either stay in rented apartments or in informal tented settlements located on vacant plots of lands<sup>2</sup>.

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<sup>2</sup> Around 30% of hosting villages in Akkar accommodate Informal Tented Settlements (ELARD, 2016).



As the conflict continues in Syria, demands and disputes over resources and services in Lebanon are bound to rise. This study aims to assess to the state of water availability in Akkar over a period of 16 years taking into account some factors, mainly relating to farming choices. Hence, 18 villages in the plain of Akkar were chosen to evaluate the situation of resources based on social and physical measurements. They were located around the inner and coastal plain of Akkar and, cover 10% of the total area of Akkar (Total surface area based on google maps is around 8,000 Ha). In sum, figure 3 displays the study area and showcases the main villages where interviews took place. These villages were chosen since they fall within the Ostuene and Arka watersheds, are composed mainly of agricultural land and are hosting large numbers of refugees. These villages are the following: Kherbeh/ Al khraibe, Tall Abbas Ech Charqi, Massaaoudiyeh, Tall Kerri, Saadine, Haouchab, Darine, Cheikh Zennad, El-Kneissé, Kfar Melki, Tall Kerri, Mqaitaa, Darine, Al-Kleiat, Al-Hissa, Tal Abbas El-gharbié, Al-Sammounié, and Kobbet Bchamra. The villages listed above are illustrated in figure 3 – below.



**Figure 3.** Locations of conducted surveys

### **C. Research Design**

The current research topic is mainly of a qualitative nature focusing on social and governance-related factors that affect water use and possibly promote any type of water mismanagement in an agricultural setting. Farming decisions have a direct impact on water use, thus, understanding the drivers that push farmers to adopt particular approaches concerning water usage is essential. There is an assumption that these approaches are linked to one's assets and living standards. Hence, the rapid rural appraisal method has been applied using various techniques to validate the proposed hypothesis. This research mostly focuses on utilizing semi-structured interviews with farmers and key informants, direct field observations and secondary data as a means to compile essential information for this scientific investigation. Based on the Sustainable Livelihood Approach (SLA), the generated results will be used to deduce livelihood profiles based on a set of criteria - primarily on income and the level of household involvement in agriculture (example: whether all the household relies on agriculture to generate income or whether some members of the family work in agriculture). Farmers who share similar profiles most likely retain similar assets and have gone through comparable circumstances, meaning that their choices are most likely to be the same in relations to water use; this might not be the case for those who have more assets. This will allow for the development of better water conservation solutions that would be adaptable to the various livelihood profiles developed and which in parallel ensure the sustainability of living conditions

To begin with, thirsty semi-structured interviews were carried out and taped to ensure a high level of truthfulness. The research group that steered the interviews consisted of two scholars from the American University of Beirut, a northern resident who is familiar with the area and myself. Interviews were conducted using the

convenience sampling technique. This method involves surveying farmers who were conveniently accessible along the parameter of the study area. This encompassed arbitrary visits to farming households in some villages in the plain of Akkar that occasionally gave us directions to other relevant farmers. It is important to mention that no interview was conducted without prior consent and no names were documented to protect the identities of the interviewees. Moreover, all recorded interviews were transcribed and interpreted. These questionnaires<sup>3</sup> were divided into two sections. The first consisted of close-ended questions targeting the technical aspect of water use in agriculture. Questions such as the types of irrigation techniques used, the amounts of pumped water and the cost of pumping. The other section consisted of open-ended questions that mainly focused on the opinions of farmers in matters related to water governance and management and information about their livelihoods. It is important to note that some photographs and notes were taken from direct field observations. Adding these notes is essential as they provide clarity to some of the accounts shared by farmers. To assess the role of public entities in water governance, two representatives were later on interviewed, one from the North Lebanon Water Establishment and another from the Litany River Authority. The prior is a public entity responsible for the provision of quality water to Tripoli and the whole Northern Government (NLWE, 2018), while the latter has various functions that include proper monitoring for all Lebanese rivers (LRA, 2018). The survey<sup>4</sup> was administered to assess their role in governing resources in Akkar, North Lebanon. The results of this survey in specific will feed into the “Policies, Institutions and processes” section of the SLA approach which ultimately nourishes farming choices.

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<sup>3</sup> The survey can be found in Appendix I and II

<sup>4</sup> The survey can be found in Appendix III and IV

The set of secondary data consisted of literature, various reports and a quantitative assessment that looks at identifying variations in water availability for two rivers, Arqa and Ostuene over the course of 16 years. Two main climatic variables were used: rainfall (mm) and river flow (MCM). The prior meteorological data was extracted from an online governmental platform, Central Administration of Statistics (CAS). The information was originally gathered from General Directorate of Civil Aviation, Climatology Service for the station of Tripoli, North Lebanon. Precipitation records were collected for the period 1999 - 2015.

On the other hand, river water flow data for the period of 1999-2015 for both Arqa and Ostuene stations was gathered from the Litany Water Authority. Graphs incorporating both variables were plotted to assess their evolution over time and to deduce whether there are any specific occurrences outside the norm that might in any way affect water availability in Akkar, Lebanon (example: major decrease in rainfall and surface water). These quantitative observations will provide support to the farmers' shared descriptions of water availability. It is important to note that groundwater levels were obtained from measurements reported in a UNICEF assessment entitled "Hydrogeological characterization of the Akkar Caza" (UNICEF, 2016). These were correspondingly compared to the findings of the current study.

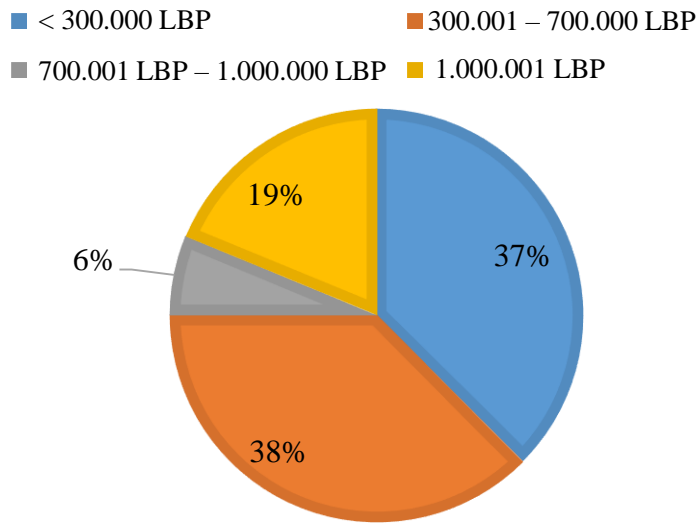
## CHAPTER IV

### RESULTS AND DISCUSSION

#### **A. Demographic and Socio-economic Information**

##### ***1. Demographic and Socioeconomic Characteristics***

To begin with, it is important to mention that the sample is made up of 30 candidates chosen at random from some villages in the area of Akkar. The sample was comprised of males involved currently or formally in the agricultural sector, apart from one local who did not partake in any employment. A household in Akkar comprises a total of nine individuals made-up mostly of immediate family members. On average, three out of the four employed members of the household rely on agricultural practices as a main source of income. The rest usually take-up jobs in public transport or enlist in the Lebanese army. As illustrated in figure 7, no one from the interviewed farmers reported to generate a household income that exceeded 1,000,000 LBP/month = 667 USD/month, and the bulk made no more than 700,000 LBP/month = 467 USD/month – amounts that are usually not enough to compensate for the piling agricultural debts.



**Figure 4.** The distribution of monthly incomes for farming households

Out of the 29 farmers interviewed, 72% own lands that range from 0 to 10 Hectares with 67% explicitly falling between the 0-5 Hectare size ranges. The bulk of the interviewed farmers grow a variety of different seasonal fruits and vegetables; the ones that were highlighted were amongst the most water consuming crops, such as potatoes, tobacco, wheat, tomatoes, citrus. Gathering information about farmers' incomes was challenging as some farmers do not feel comfortable sharing this kind of information. Though this was the case, the available data was compiled and segregated based on income (<300,000 LBP; 300,000 – 700,000 LBP; 700,000 – 1,000,000 LBP and more than 1,000,000 LBP) to generate common socio-economic patterns between farmers. It is important to point out that as farmer's income increases so does their household size which includes immediate and non-immediate family members. Based on the interviews, farmers who generate more than 1,000,000 LBP (667 USD) per month have an average family size of 11 individuals in comparison to farming families who generate less than 1,000,000 LBP and whose household size ranges between 7 to 8 immediate family members. Regardless of income, household members who partake in generating income

work primarily on agriculture. However, those who generate more than 1,000,000 LBP are more likely to invest in larger scale production (own larger plots of land) or rent out their land to other farmers and collect part of the profit.

## **B. Water Usage, Availability and pricing**

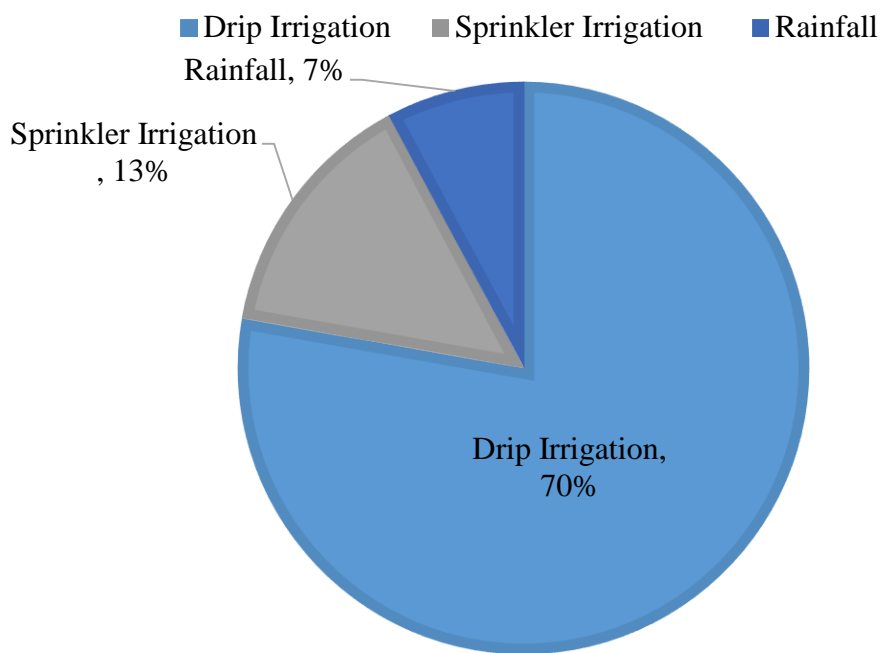
### ***1. Perceptions and practice***

The majority of farmers in the agricultural plain of Akkar have built private wells to pump water and irrigate. 90% of those who were interviewed also claimed that their potable water is extracted from their private wells. The remaining 10% resort to buying water from private companies, purchasing water tanks or benefitting from the water networks implemented by non-governmental agencies such as the UN. The absence of adequate water channels or the outdated infrastructure in some parts of Akkar might be the main contributor to this trend of water pumping. Similarly, 70% of the interviewed farmers stated that they had resorted to digging up wells to irrigate their agricultural lands while only 13% relied on rivers and springs in the area (ex. Al Ghezayli and Khraybeh River) and only 7% depend on rain-fed agriculture. When responses were segregated based on income, it has been observed that farmers who generate more than 1,000,000 LBP (667 USD) per month only use private wells to irrigate their plots of land whereas those who generate less than that amount use groundwater and other sources of fresh water, i.e., rain or rivers to irrigate. 62% of the interviewed farmers did not believe that the amounts of water they are receiving are sufficient. Though responses differed between those who generate less than 1,000,000 LBP (667 USD) per month, farmers who make more than 1,000,000 LBP (667 USD) unanimously agreed that water availability did not change it but had instead remained the same. Because they only use private wells and

have the financial means to irrigate, it is only logical that they do not feel that water availability is affected as their needs can always be covered. Those who feel the change in water availability attributed their dissatisfaction to a number of factors: 1) the lack of containment facilities that protect surface water which usually ends up being wasted to the sea; 2) the drying up of communal and private wells pushing farmers to invest and exploit new ones; 3) salinity issues that arise in some parts of the plain due to over-abstraction of groundwater; 4) the deteriorating quality of fresh water in wells which renders the wells unusable and forces farmers to dig-up new ones in other unexploited locations; 5) altitude and geographical location of farming land. Higher altitude signifies more water abundance while lower altitudes signify a higher risk of flooding in winter and dryer summers; 6) the expansion of agricultural lands consequently necessitating more water.

As demonstrated in figure 8, a high proportion of farmers are using drip irrigation averaging at 11.3 m<sup>3</sup>/h/ha flow rate while 13% is resorting to sprinkler irrigation with an average of 5.1 m<sup>3</sup>/h/ha flow-rate.





**Figure 5.** Irrigation type adopted by farmers

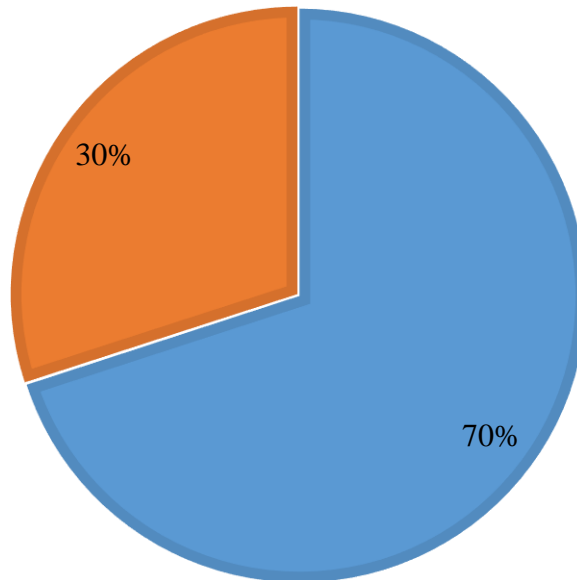
Though the bulk is switching to more water-saving irrigation techniques, it is not the case for everyone, as around 28% of the sample still relied on surface water irrigation with an average flow of 19 m<sup>3</sup>/h/ha. Therefore, we see that those generating an income higher than 1,000,000 LBP (667 USD) per month utilize water-saving irrigation techniques solely such as sprinkler or drip irrigation, while farmers who generate less invest partially in water saving techniques and rely on surface irrigation techniques. This might be attributed to the fact that utilizing these techniques requires financial capacity which a good number of farmers are lacking – specifically when it comes to purchasing different energy sources like diesel, needed for the irrigation system to work. This situation is problematic as energy prices seem to have changed after the eruption of the Syrian war in 2011– 93% of the farmers interviewed confirmed this notion. In 2014, global crude oil prices decreased dramatically and generated substantial fluctuations on the local fuel oil

industry – affecting market dynamics (Mikhael & Saadeh, 2016). In parallel, the demand for fuel oil in Lebanon remains a necessity and has increased following the influx of Syrian refugees to Lebanon (Mikhael & Saadeh, 2016)

76% of the interviewees believed that water is not available all year round, with summer months (mainly July and August) being the driest. When water is scarce, the inhabitants of the villages have to rely more on the extraction of water from wells to compensate for the water they are missing for irrigation. As one of the interviewees explained (Farmer-11, 2017): “during summer or in periods where water is scarce, the inhabitants of the village have to divide the amounts of water amongst themselves and rely mostly on water wells.” This has not been noted as a problem for farmers who generate more than 1,000,000 LBP (667 USD) per month and who rely solely on groundwater pumping for irrigation. This can be justified by the fact that they have the financial means to invest in the costly process of groundwater pumping, hence, when water runs out, they can buy or dig up more wells to irrigate – this is not the case with everyone. The majority of farmers noted that water availability in the region and the levels of groundwater have changed throughout the last 5-10 years; as shown in figure 6, 67% of those interviewed have confirmed that they noticed a decrease in groundwater levels. This, however, has not been sensed by farmers who generate more than 1,000,000 LBP (667 USD) per month because they have the financial capacity to compensate with other sources of water when water is lacking in their area – not sensing the changing. Farmer 14 (2017) explained that when they used to pump groundwater, they were able to extract 4 inches of fresh water whereas recently they are barely able to extract 2 inches. He attributes this fluctuation in groundwater levels to the intensified patterns of water extraction resulting from the lack of water services in the area.

Climatic changes have also forced farmers to alter their usual irrigation schemes; the high number of agricultural practitioners from Syrian origins in the village has also forced farmers to extract more water to ensure that they produce agricultural goods that are timely, sufficient and marketable (Farmer-14, 2017). Farmer 5 (2017), mentioned that water within the vicinity of the village “khreibeh” is still available, while villages of higher altitude such as “Tal Abbas” are suffering from water shortages, the farmer believes that water availability in the plain of Akkar is relative to the geographical location of the village. Climate change was also brought up during the interviews and referred to as one of the reasons that contributed to the change in water availability. As one of the farmers testified, farmers nowadays are obliged to irrigate earlier and more often in comparison to previous years. He further explained that rainfall comes later during the season and stops earlier than usually, obliging them to irrigate agricultural areas instead (Farmer-9, 2017).

- Farmers who believe that groundwater level have dropped
- Farmers who do not believe that groundwater level have dropped



**Figure 6.** Farmers perceptions in regard to groundwater availability

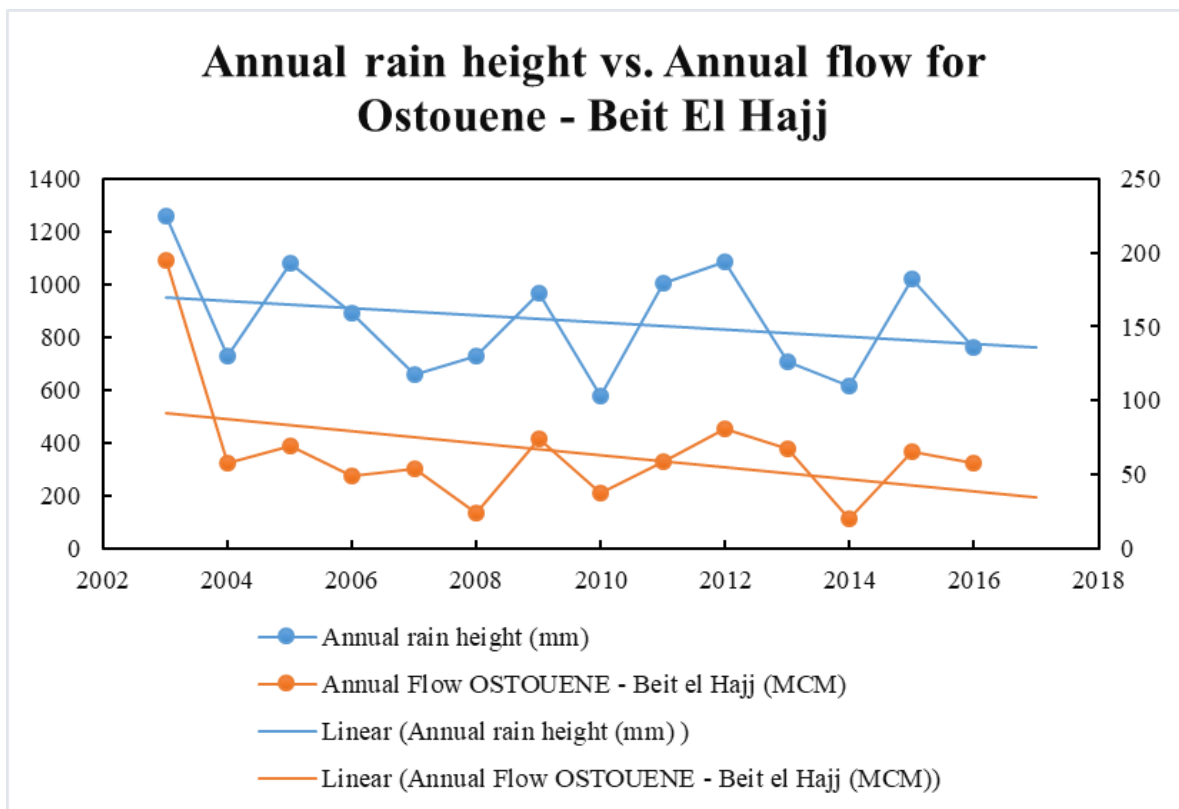
## ***2. Water Availability***

Based on the conducted interviews, groundwater seems to be the primary source of fresh water used by farmers for irrigation. To a lesser extent, farmers also resort to other freshwater sources such as rivers and rainfall to irrigate their crops. In reference to the mixed debate about water availability in the region and relying on various sources of secondary data, this section will focus mainly on assessing the state of water availability in Akkar, Lebanon.

### **a. Surface Water**

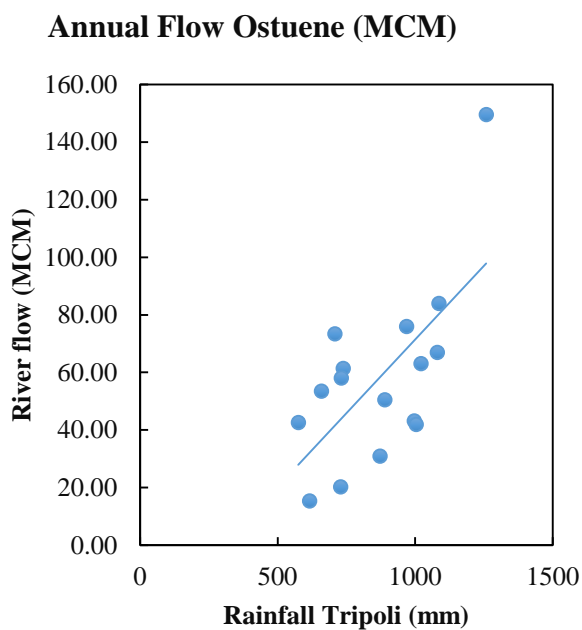
The analysis focused on the status of surface water in the Ostuene and Arka watersheds that cross the study area. Thus, a two-line graph was plotted to showcase the evolution of two variables, annual rain height and annual flow of the Ostouene River – Beit El

Hajj from the year 2003 until mid-2016 – enabling us to deduce any events that have resulted in significant fluctuations. As expected, runoff is highly correlated to rainfall in Akkar. The lowest rain event was noted in 2010 before the start of the Syrian conflict and was accompanied by a mild decrease in annual flow. The lowest flow points were observed in 2008 and 2014. External factors (e.g., increase in irrigation diversions) might have contributed less correlation in some years. Post-Syrian conflict, the lowest flow point, and rain height were observed in 2014 – a year where Lebanon witnessed a major drought. Hence, low annual flow point can be attributed to the lack of rainfall and the consequences it carries with it such as an increase in groundwater abstraction to compensate for rain-fed agriculture.



**Figure 7.** The relationship between annual rain height and annual flow for Ostouene – Beit El Hajj

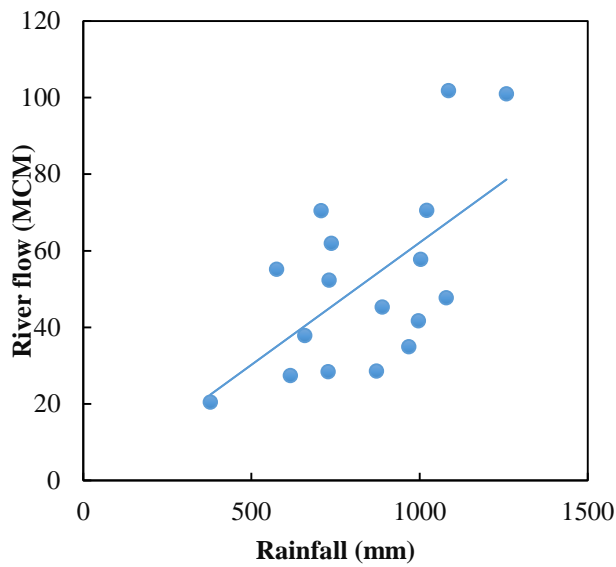
The significance of a correlation, p-value as given by the significance F was generated for the relationship between annual flow and rainfall for the Ostuene river. If P-value is less than 0.05, then the correlation is statistically significant. In figure 8, there is a significant positive relationship between the annual flow of Ostuene river and rainfall in Tripoli where,  $r(14) = 0.65$  and  $p < 0.05$ .



**Figure 8.** Correlation between rainfall in Tripoli and river-flow for Ostuene Akkar, Lebanon

Similarly, in figure 9, there is a significant positive relationship between the annual flow of the Arka river and rainfall in Tripoli where,  $r(14) = 0.53$  and  $p < 0.05$ . To sum up, any changes in rainfall patterns will have direct impacts on the annual water flow for both Ostuene and Arka rivers. Some of the interviewed farmers have claimed that they noticed changes in rainfall patterns, ultimately affecting rainfed agriculture and water availability in streams. However, based on the climatic variables presented under this section, these fluctuations are not yet alarming though farmers sensed the change in

### Annual Flow Arka (MCM)

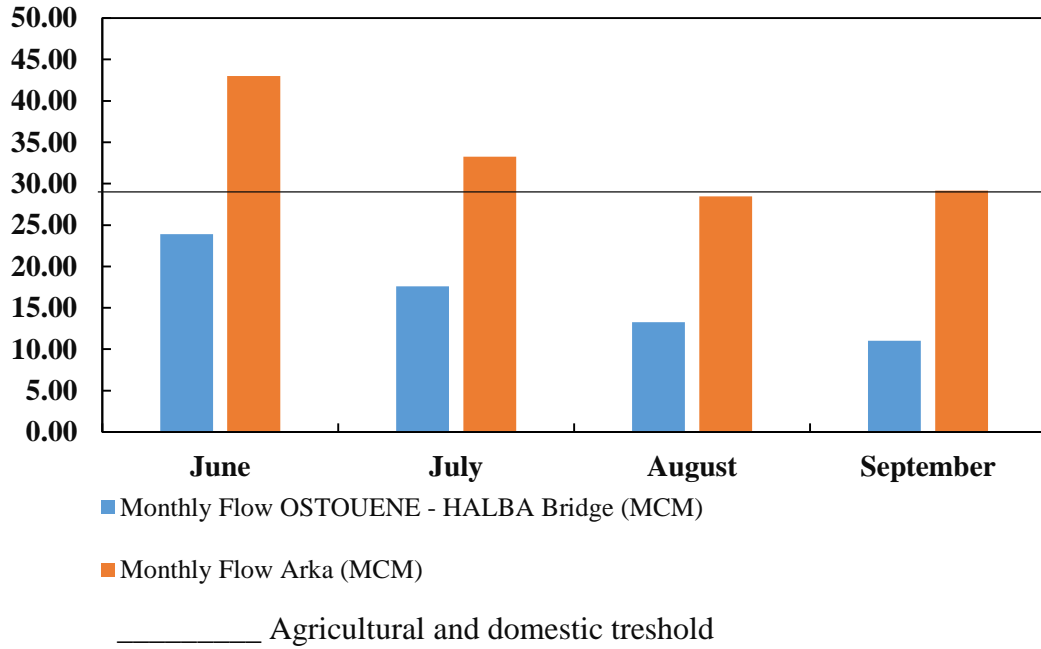


rainfall patterns, as some claimed that rainy seasons start later than usual while it ends earlier than it used to. Thus, it is important to keep track of this sort of information and generate future climatic scenarios to help evaluate our available resources.

**Figure 9.** Correlation between rainfall in Tripoli and river-flow for Arka Akkar, Lebanon

Assuming 600 mm of water per ha per season, 30 MCM/year are needed to satisfy irrigation requirements for spring and summer cultivations. Based on figure 10, it is apparent that the Ostuene river is unable to meet irrigation demands during all summer months – reaching its lowest peak in September. Arka river, on the other hand, can meet water demands almost all summer. Its lowest peak is in August and it is approximately equal to the agricultural and domestic threshold. Overall, August seems to be one of the driest months for irrigation where water availability is low for both Arka and Ostuene rivers.

Average river flow during summer months



**Figure 10.** Average river flow during summer months

i. Surface Water Supplied by Arka and Ostuene

Based on the data provided by the Litany Water Authority, it was estimated that over the period of 15 years, both Arka and the Ostuene river were able to supply on average 117.83 MCM, a minimum of 42.84 and a maximum of 251.42 MCM of fresh water to the plain of Akkar (refer to Table 2).



Year	Annual Flow OSTOUENE - HALBA Bridge (MCM)	Annual Flow Arka (MCM)	Sum of both
Average	58.2	54.0	112.1
Min	15.4	27.5	42.8
Max	149.6	101.8	250.6
Standard Deviation	31.1	23.1	51.4

**Table 2.** The amounts of water supplied by Arka and Ostuene to the Plain of Akkar from 2000-2015

ii. Surface Water Demand in the plain of Akkar, Lebanon

In addition to the host communities demands, the plain of Akkar hosts 13,533 Syrian refugees divided into 30% residing in informal tented settlements versus 70% of refugees living in urban settlements. Hence, the assumption is the following:

- The 30% of refugees who reside in informal settlements will require 90 Liters of water per day.
- The 70% who live in urban settlements and will require 180 liters of water per day.

Table 3 summarizes the water requirements of the 30% and the 70% of the Syrian refugees, as well as the host community and the agricultural sector. The total water demand in the plain of Akkar was concluded to be 52.4 MCM. The average water supply for Arka and Ostuene river (table 2) exceeds the total water demand – water supply is double the size of water demand. Maximum water supply is around 5 times greater than water demand (250.6 supply versus 52.4 MCM demand). However, in the case where the minimum is supplied (equal to 42.8 MCM), not all requirements will be met unless proper water management is achieved. It is important to note that though the

amounts of water supplied in most cases were far greater than the amounts of water demanded, extraction should not exceed the recharge rate of each stream to ensure the conservation of the resource.

Category	Criteria	Total water requirement (MCM)
Syrian Refugees	requiring 90 L/day - Informal Settlement	0.13 MCM
	requiring 180 L/day - Urban Settlement	0.62 MCM
Host community	requiring 180 L/day - Urban Settlement	1.65 MCM
Agriculture	10,000 m <sup>3</sup> /ha of water needed	50 MCM
Total		52.4 MCM

**Table 3.** The amounts of water required for consumption in the plain of Akkar, Lebanon

While comparing the farmers' responses to the findings of this section, contradictions seem to arise. While most farmers believe that water is not available all year round (especially after the onset of Syrian civil war), the surface water data shows that water remains available and is enough to cover demand in most cases. This might be attributed to the fact that surface water is not properly conserved nor properly distributed amongst farmers and probably wasted to the sea, as farmers believe.

b. Ground-Water

Farmers access to surface water is limited. Thus, it is only logical that the majority felt that water is not sufficient to meet their demands. The result is many

farmers resorting to groundwater pumping to meet their personal and agricultural demands.

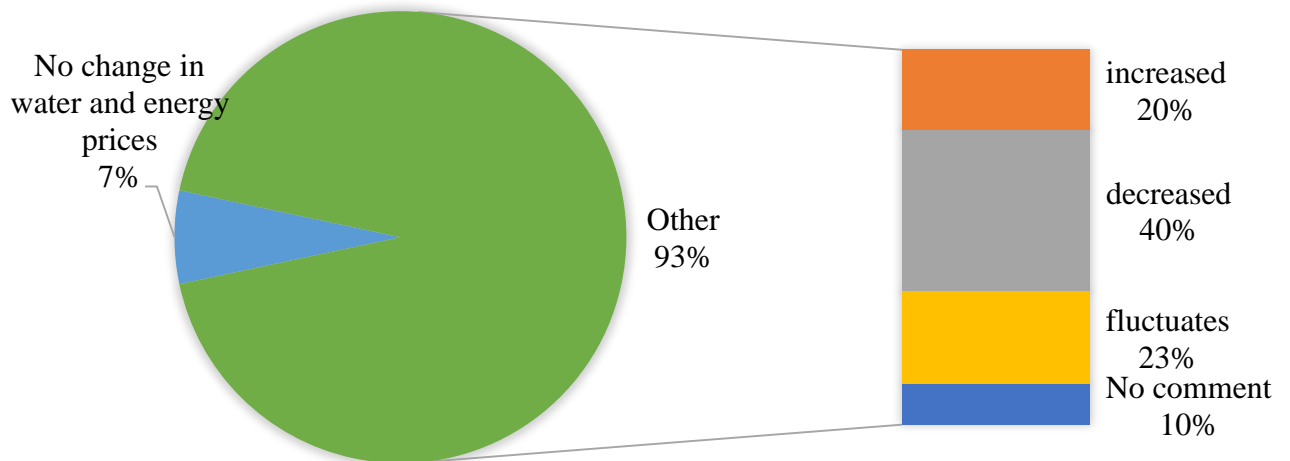
A UNICEF assessment entitled “Hydrogeological characterization of the Akkar Caza” (UNICEF, 2016) involved groundwater measurements of 24 wells in the Akkar Neogene Quaternary Basin (within the Akkar plane) which were conducted by a local company in 2016 and compared to data gathered three years prior. Results conclude that no significant drops in groundwater levels in the Quaternary Semi-Aquifer basin are likely to occur. It is possible in some cases that seawater intrusion is counterbalancing the decrease in groundwater levels that often results from pumping (ELARD, 2016). If this is the case, water quality will deteriorate, and the resource will not be suitable for irrigation.

Based on the above analysis, groundwater did not diminish over the last 15 years though demand has increased. However, this does not guarantee that the quality of water extracted is adequate for consumption or use.

### ***3. Water Quality***

Many farmers did not face any problems with the smell or color of water. However, 10% did mention that the water they were receiving tasted bad. Salinity was brought up a major concern in some villages located near the sea such as Sheikh Zneid, Tall Bibi and Kannisat Al-Massoudiyeh. It is important to note that the practice of salt extraction is very prominent in the village of Sheikh Zneid, where salterns can be found in abundance. One Farmer in this village elaborated that salinity in wells reached levels that rendered water too saline for agriculture, domestic and livestock use (Farmer-17, 2017).

#### 4. Further Remarks and Observations



**Figure 11.** Farmers perceptions regarding water and energy prices since 2011

Based on figure 12, one can notice that the majority agrees that water and energy prices have changed since the start of the Syrian war in 2011. However, opinions vary when it comes to the way prices have changed as some mentioned that it decreased while others highlighted that it increased. What can be noted from here is the fact that prices are not stable and the uncertainty in the region, once the war started, might have contributed to this alteration. What aggravates the situation further is the fact that not all farmers are able to generate profits especially since Syrian products keep on competing with local produce. The prices of Syrian products are usually lower than Lebanese crops making them more appealing to consumers, which impedes farmers' ability to make profits. One farmer added: "prior to the war, farmers would harvest and export their produce to the Gulf region through Syria. However, due to the current state in Syria, many restrictions have been placed making it harder to export goods through the

borders.” This has driven many farmers to complain about the lack of governmental strategies that protect local producers and safeguard the local market. Talking about governmental interventions in the agricultural sector, only a few farmers have complained to the relevant authorities about water-related issues but, to no avail. Consequently, it is not striking that 87% of the farmers interviewed were not satisfied with the water services in Akkar, Lebanon.

### **C. Interviews with Stakeholder**

#### ***1. Interview with Representatives from the North Lebanon Water Establishment and Litani River Authority***

The North Lebanon Water Establishment (NLWE) plays a major role in governing water resources in the whole Northern part of Lebanon including Akkar. The major concern in this research is to assess water availability in the plain of Akkar. When asked about water usage following the year 2011, the NLWE representative did show a level of concern regarding the increased water consumption in the plain of Akkar. However, he was not able to give an exact figure for this increase as not all water networks in Akkar are a hundred percent metered and not all of the water wells are legal. Agriculture was no doubt considered the main water consumer in the plain of Akkar, however, the establishment has not conducted any measurements to assess the extent of its depletion. The lack of proper water networks and outdated infrastructure has also been continuously brought up as a major concern affecting adequate water distribution. When asked about the state of water networks, the NLWE representative explained that 120 villages in Akkar remain without water networks which explains why most of the residents ultimately resort to digging-up their wells. When water

infrastructure exists, it is usually inspected but not at a frequent rate. This is mainly due to budgetary constraints that the Water Establishment suffers from, as a high number of end-users fail to pay a yearly subscription to the NLWE. In sum, the North Lebanon Water Establishment has financial constraints that seem to restrict it from fulfilling its role in monitoring water resources and ensuring adequate water delivery. When asked about the NLWE relationship with both the Ministry of Water and Energy and the Litani Water Authority, the NLWE representative explained that all parties are cooperative and on good terms with one another (NLWE-Representative, 2017).

The Litani River Authority representative, on the other hand, contradicted the last notion and explained that the LRA does not have a proper relationship with the NLWE but plans to improve the status of their relationship in the long run. This clearly shows that communication lines between both entities are not well established and in need of improvement. Monitoring wells are beyond the responsibility of the Litani River Establishment; their jurisdiction is restricted to monitoring rivers in Akkar, North Lebanon. The LRA has several stations on some rivers in Akkar where they register water levels, velocity and deduce water discharge. As explained by the LRA representative, the authority continuously conducts surface water audits and inspects infrastructure of the relevant river stations (LRA-Representative, 2017). Overall, LRA's role in Akkar is restricted to collecting surface water data which does not seem to be communicated properly with the NLWE. To achieve proper monitoring in times where water is scarce, it is important that proper communication lines exist between the relevant authorities so that data is shared and properly put to use – not the case here.

#### **D. Additional Observation – Water Governance in Akkar Lebanon**

From being governed by fatwas and the sharia to being managed primarily by a specialized ministry, the water sector has undoubtedly faced difficulties over the years. Surface water was previously better managed and made equally available for all users upstream and downstream. Though it was considered public property, during the Ottoman empire, adjustments such as the Medjella were introduced by the Europeans to regulate the sector adequately and to ensure that water remains available for all users. Similarly, regulations were imposed on individuals extracting groundwater on privately owned land to ensure that water is protected and not misused. Though surface water has been proven to be abundant in the area despite the population surge following the Syrian civil war, it not equally available to everyone. There are constant problems between upstream and downstream users where often the prior cuts off the water flow on the latter in times of scarcity and dry weather. The outdated infrastructure and the lack of water delivery networks amplify the situation and make it almost impossible for farmers in the plain of Akkar to receive their share of this resources. Farmers consequently don't benefit from their right to receive water as this resource ends up being wasted in the sea. Because the delivery of surface water is unreliable, climatic changes increasingly becoming unpredictable and the process of getting a well permit is not well managed by the relevant authorities, farmers end-up digging-up unlicensed and unregulated wells to benefit from groundwater. The centralized authority of the Ministry of Water and Energy, the reduced role of water authorities and municipalities, the lack of proper monitoring and accountability leaves the water sector corrupt and improperly managed. The lack of communication between the relevant water authorities is a hurdle

to the development and proper governance of the sector as viable information ends-up being overlooked.

The lack of support to farmers and the agricultural sector as a whole also affects water governance as agricultural practices consume water resources the most. The stability of the agricultural sector was historically affected by the production of silk that solely focused on growing mulberry trees at the expense of developing a more rigorous plan to grow more crops. The economic focus shifted further away from agriculture afterward to concentrate its attention on other sectors such as banking and finance. Economic sectors in Lebanon never developed in equivalence to one another; the focus always shifts to activities or sectors that generate more revenue at the expense of others. Agriculture in Akkar has always been neglected, and farmers in the agricultural plain have always been vulnerable. In the late 1960s, Akkar witnessed a major agrarian movement considering that farmers were in a very weak state that resulted from the unrealistic conditions landlords implemented on sharecroppers. A program was developed to support farmers, but these governmental promises never came through. Water, agriculture and farming livelihoods are very dependent on one another and greatly lack proper management and governmental support. It is important that water governance strategies are to be developed in accordance with agriculture and farming livelihoods.

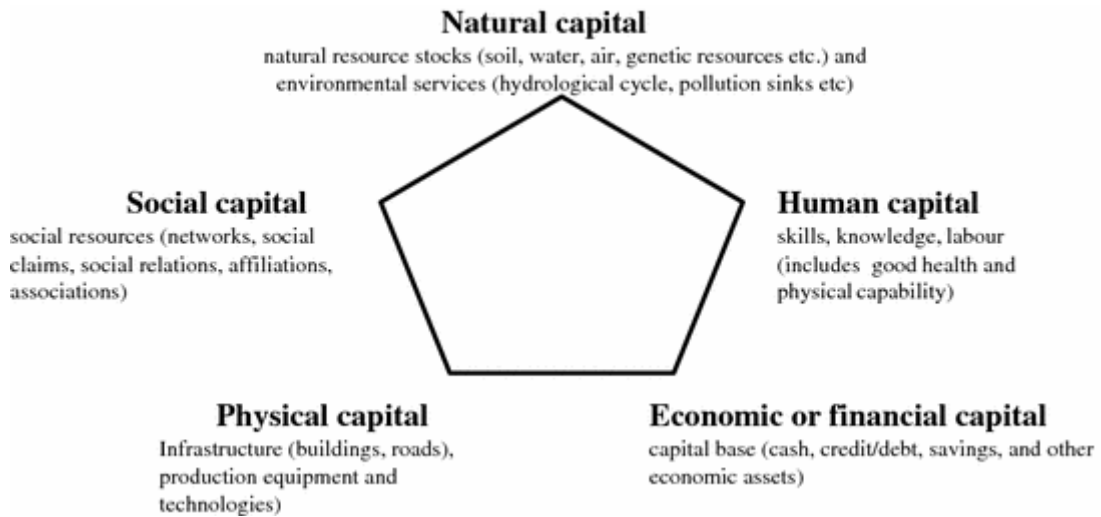
## **E. The Sustainable Livelihood Approach**

### ***1. Livelihood Assets***

As mentioned in a previous section, the Sustainable Livelihood Approach (SLA) encompasses five main assets which are: Human, Natural, Financial, Social and



physical (fig. 13). Based on the qualitative data that was collected for this study, the following observations can be noted:



**Figure 12.** The five capitals that make-up Scoones sustainable livelihood model (Morse & McNamara, 2013)

a. Human Capital

A typical agricultural household in Akkar encompasses many individuals, thus, a greater need for a sustainably larger income that can cover the essential needs of the whole family. In contrast, this can also be looked at from a positive perspective where a larger household signifies more individuals available to take up differing farming activities – meaning that a family can cut down on labor cost. Interestingly, when incomes were segregated, it was noted that larger incomes encompass larger households. Household of those who generated more than 1,000,000 LBP per month was composed of more than ten individuals – direct and non-direct family. Working in the farming industry is usually passed on from generation to generation, meaning that households are armed with adequate expertise, skills, and knowledge to carry out agricultural activities. Based on the interviews that were carried out, a large percentage

of the sample seemed to depend on more advanced irrigation techniques such as drip irrigation. However, there is a need to point out that age wise; agricultural practitioners are older. 2 out of the 30 farmers interviewed were younger than 30 years old. This can be translated into a lack of new perspectives in the domain and a bigger risk of cessation of agriculture. Age is not the only concern that needs to be highlighted. Farmers, in general, do not wish for their children to work in agriculture as the future of the sector seems bleak. The human capital in agricultural families working in the plain of Akkar seems to be diminishing.

#### b. Social Capital

Based on the conducted interviews, one can tell that the lines of communication between agricultural practitioners and the various governmental parties and, water/agricultural related authorities, are disconnected. Not only were many participants unsatisfied with the services that the water authorities are providing, but they were also disappointed that the complaints they placed were never heard. When this scenario recurrently occurs, locals tend to feel helpless, lose faith in the system and consequently take matters into their own hands. In fact, some went as far as getting in touch with political figures to intervene to provide potable water to their villages, but no aid was ever provided. Another farmer explained how the relevant water authorities are obstructing him from extracting water needed for irrigation. He explained that he has been waiting for a while for the water authorities to approve his request for the appropriate tool to extract a water pump that fell into his water well (mainly meant for irrigation) (Farmer-6, 2017 ). In addition, no proper communication lines exist between residents who live upstream and those who live downstream in terms of water

distribution. In fact, one of the participants who reside in the downstream village of Tal Bibi has expressed his frustration with the upstream farmers of Al-Hissa who, when water bodies and rivers dry out, would cut off the water supply of farmers residing in Tal Bibi – lower stream (Farmer-20, 2017). This forces farmers in this village to dig wells to compensate for this water loss. They have a right to receive that water, this violation of their rights pushed them to try to complain to the parties responsible for water allocation in the area, but no results were generated. Power play and corruption are prominent in the region; hence, as one farmer explains “even if you pay your dues, it does not guarantee that you receive the legal amount of water that is allocated to you. In addition, even when it’s your turn to irrigate and someone who is more powerful is using the water to irrigate, you have to wait until they finish” (Farmer-6, 2017).

Though several issues arise under this category, the relationship between a village’s inhabitants remains positive. As they all suffer from the same concerns, the residents of a village tend to look out for each other. The area of Cheikh Zneid suffers from major salinity problems that render its water undrinkable or usable. One of the farmers interviewed explained that he allows other residents of the village to use water from his private well because it’s one of the few sources of fresh water (Farmer-17, 2017). There is a recurrent concern between members of the host community that Syrian residents are competing with the locals over livelihood opportunities. They also are unhappy with the fact that some locals are just as vulnerable and poor as Syrians but are not receiving any aid. This makes the host community feel threatened and inferior, thus, creating some negative perceptions towards Syrian refugees (UNDP, 2016).

### c. Physical Capital

Land size is important as it reflects a farmer's ability to produce crops. As part of the Emergency Market Mapping and Analysis (EMMA) of the Agricultural Labor Market System conducted in 2013 for both the North and the Bekaa, it was estimated that in Akkar alone a total of 28,092 registered agricultural operators exist. These practitioners by default own or rent land ranging from 1 to 40 dunums (Approximately 4 Hectares), which are relatively small to medium-sized enterprises (IRC, Children, DRC, Oxfam, & aid, 2013). Similarly, around 50% of the farmers interviewed for this research study own or rent land that reaches up to 5 hectares. The second largest category of farming households encompasses farmers who own or rent land that ranges between 5 and 10 Hectares – this makes up 24% of the research sample. Though a category of larger scale farmers exists, small to medium-sized farmers can be still classified as dominant. It was noted that farmers who generate more than 1,000,000 LBP (667 USD) per month own or rent land that is larger in size and can reach up to 40 Hectares. Land size for those generating less than 1,000,000 LBP (667 USD) per month varies and can reach a maximum of 4 hectares.

Storage Facilities are important to farmers as they allow them to influence the market's supply, thus making them the principal controllers of market prices. In comparison to the Bekaa where there are 60 cold storage facilities, hardly 30 exist in the North of Lebanon. This no doubt affects the longevity of crops once harvested and renders farmers obliged to market their produce directly once gathered no matter the price (IRC et al., 2013). In parallel, we note that multiple individuals complained about the bad state of infrastructure in Akkar which is not frequently maintained by the North Lebanon Water Authority and which ends-up wasting fresh water to the sea. As stated

previously, 120 villages in Akkar are still not connected to the water network, meaning a large number of individuals still do not have access to fresh water supply. The only advantage under this category is the fact that farmers are more aware of the technological advancement taking place in the agricultural sector. This is seen in the high percentage of farmers interviewed who report using of drip and sprinkler systems in irrigation.

d. Financial Capital

On average in this study, farming families are larger in size and can reach on average a striking nine individuals. They generate a monthly average of 700,000 – 1,000,000 LBP or 500 – 660 USD. This translates to yearly income that ranges from 6000 to 8000 USD. The Minimum annual household income (USD) needed to live above the poverty line in Lebanon (table 4), states that for an individual to lead a dignified life, they require 4 USD/person/Day, and, a minimum of 2.4 USD/person/day to safeguard them from a case of extreme poverty(Kukrety, 2016). Based on this study's findings, a household made-up of 9 individuals would require an income of \$13,140/year to carry out a dignified life above the upper poverty line, and, a minimum of \$7,884/year to safeguard them from a case of extreme poverty. Based on the above, farming families in Akkar are closer to the lower poverty line. Hence, they are considered financially weak.

Poverty Lines in Lebanon	USD/Person/Day	Household Size					
		3	4	5	6	7	8
Upper Poverty Line	4	4380	5840	7300	8760	10220	11680
Lower Poverty Line	2.4	2628	3504	4380	5256	6132	7008

**Table 4.** Minimum annual household income (USD) needed to live above the poverty line in Lebanon (Kukrety, 2016)

e. Natural Capital

An area like Akkar, primarily oriented towards agricultural practices, strives on the abundance of its natural assets. Deficiency or any deterioration in the quality of natural capital can impact the whole agricultural cycle and, consequently affect crop yield. Those who were interviewed for this research shared some of their concerns and observations. One farmer explained that the number of irrigations has increased in comparison to previous years due to the climatic factor. Farmers in the plain are obliged to irrigate their land early on because rainfall occurs at a later period during the season and stops prior than usual (personal interview, 2017). Another farmer confirms this observation and further elaborates: “the inhabitants of Akkar do see a pattern of change when it comes to the climate. However, the main issue is that they sense that the amounts of rain that they are receiving are less which can impact recharge” (personal interview, 2017). Making matters worse, the quality of water has affected the productivity of the farmers in some parts of Akkar. Water quality in Akkar is further deteriorated due to pollution. Based on an assessment conducted by Chbib et al. (2018), it was concluded that groundwater attributed to the agricultural plain of Akkar is heavily polluted with pesticides. The concentrations of these pesticides in water mostly surpassed the restrictions fixed by the European Union and, in some cases included

toxins banned by the Stockholm convention (example: DDTs and HCHs). This whole situation is mostly due to the intensive unregulated use of pesticides and herbicides in the plain (Chaza et al., 2018). Farmers mainly resort to the use of pesticides to protect their crops from insects and to generate greater yield. For 1 ha of vegetables in Lebanon, almost 11 kg of pesticides were used in the year 2000 (Chaza et al., 2018). With the lack of governmental supervision, farmers will continue heavy pesticides use because of the common belief that the more pesticide used, the higher the yield. These occurrences related to changes in climate, quality, and quantity of water, seem to all be interlinked and attributed primarily to anthropogenic activities.

## **2. *Vulnerability Context***

This category comprises economic trends or resource-related shocks ranging from conflicts to natural hazards, seasonality of prices, production and even job availability. Usually, people's assets can get directly altered by these factors and can reach the extent of destruction. This largely influences people's decisions and livelihood strategies (Haidar, 2009). Lebanon is no stranger to shocks and instability, the region in all its parts has suffered immensely from crisis after crisis.

Due to its proximity to the Syrian borders, Lebanon became a hosting country that took into date more than 17% of the displaced Syrian refugees (UNHCR, 2018b). With an influx of this size, the labor market can get undoubtedly impacted especially if no proper management plan is set in place. This can create a huge burden on the host country, resulting in economic distress. Lebanon is no stranger to that as the country witnesses more social tensions and less political and economic stability. In comparison to 2007-2010 where Lebanon registered a 9.2% growth rate, 2011-2014 has witnessed a

major decline reaching 1.8% (YenÝlmez, 2017) – rendering the country unattractive for investors. Currently, no major changes are observed in relation to the annual growth forecast as it remains at approximately 2% over the medium term (World-Bank, 2018a). When it comes to the natural resources available to the public, an increase in water demand is observed. Akkar, already suffering from the absence of adequate water infrastructure, hosts 110,000 Syrian refugees who are in need of water to survive. 46% of these refugees, mainly 79% ITS residents and 41% of substandard shelters residents, end-up illegally extracting water from wells (Baylouny & Klingseis, 2018). With no exact management scheme underway, this sudden population growth, which is additionally expanding, is further normalizing the act of illegal well drilling to meet the growing water demand. It has also made water resources at risk of quality deterioration. The agricultural sector did similarly get impacted by the conflict. Syria’s location has always been strategic for Middle Eastern countries, making it an important trade hub. Lebanon, one of Syria’s trading partners, used to export around 20% of its crops to Syria. The 2011 war has hindered agricultural trade in the region and resulted in “four major developments in agricultural trade flows observed in neighboring countries in 2011 and 2012: First, there has been a decline in total agricultural trade; second, bilateral agricultural trade with Syria and in transit trade through Syria has considerably dropped; third, there has been a significant change in trading routes in the region; finally, informal trade across the borders with Syria has increased” (R. FAO, 2014)

As it was previously stated, the state of water in the plain of Akkar has worsened due to the use of pesticides. However, the overall environment in Lebanon has deteriorated immensely in the past couple of years as a result of the excessively talked about waste crisis. Garbage in Lebanon has been piling up since 2015, with no clear

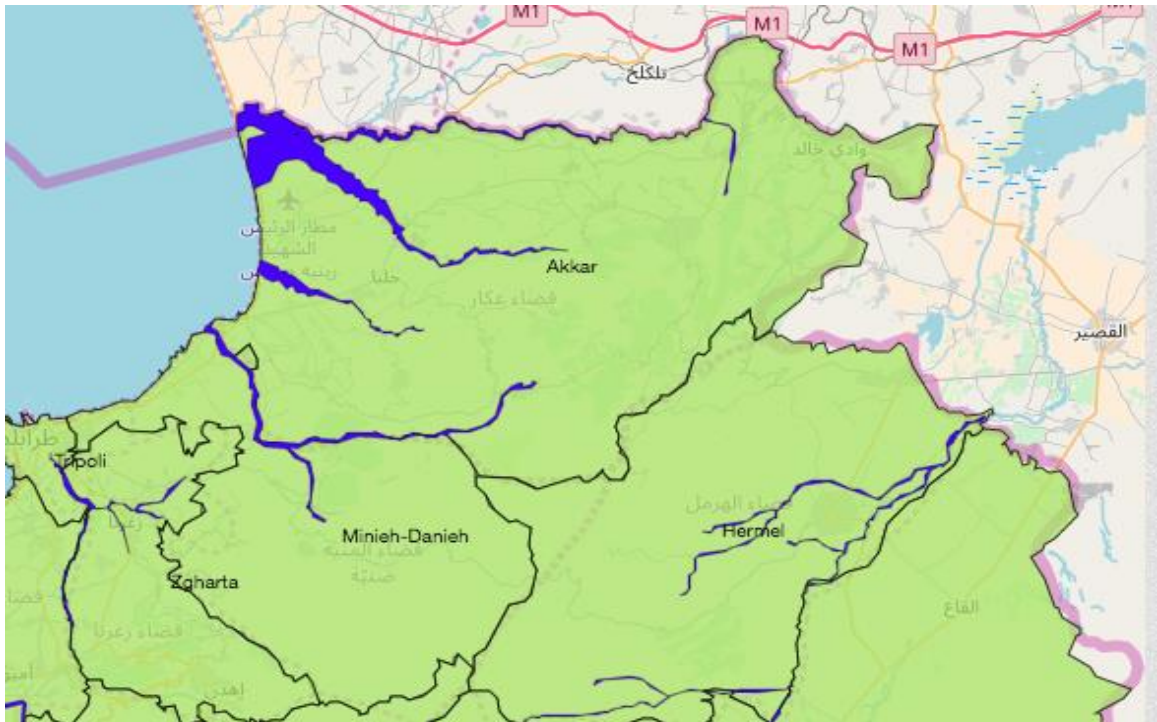


waste management plan to respond to the crisis. Slow burning and uncontrolled dumping of waste on hillsides and seashores became widely used to dispose of solid waste in Lebanon (Morsi et al., 2017). Morsi et. Al (2017) believe that as this crisis becomes more protracted amid climatic changes, health risks become more severe. Toxins and pathogens have found their way into most household's water sources through the country's inadequate water systems, amplifying harmful effects on the environment, on natural assets and individuals (Morsi et al., 2017).

Though data is still lacking, locals have recently acknowledged a fluctuating change in climatic conditions. In 2014, Lebanon was part of many regions that faced a severe drought, illustrated by “extremes in low rainfall, the extent of the long dry periods, and three exceptional rainfall events that interspersed these. The drought itself was thought to be due to a large-scale winter blocking event that prevented weather systems from reaching the region” (Udasin, 2014 as cited in (Herring, Hoerling, Kossin, Peterson, & Stott, 2015)).

Though this dry event was followed by the wet climate of 2015 (Shaban & Houhou, 2015), an IPCC assessment report indicated that more droughts are likely to occur with higher intensity in the Mediterranean region. The IPCC forecasted that the eastern Mediterranean region would witness a decrease in precipitation levels by 20% to 30% in the time period ranging from 1986–2005 to 2081–2100 (Eduardo, Nadim, Marina, Ricardo, & Flavio, 2014). The PRECIS model gives similar results for Lebanon, whereas it is expected that in 2040 temperature will rise by 1°C on Lebanon's coast and 2°C in its mainland. During the same year, rainfall levels are expected to decrease as well by 10-20% (Eduardo et al., 2014). In 2090, Lebanon will witness a 3.5°C to 5°C increase in temperature coupled by 25–45% increase in rainfall. This

showcases that dryer weather will predominate Lebanon's climate in the future (Eduardo et al., 2014). Climatic scenarios in Lebanon are not only restricted to a dryer climate; they encompass the recurrent occurrence of floods. Several floods have struck in Lebanon in the past century with areas adjacent to the Al-Kabir River and Oustouane River in the plain of Akkar being at higher exposure risks (Kabout, 2011 as cited in (Abdallah, 2012)). A high number of seasonal streams and 15 perennial rivers occupying the coastal zone are susceptible to flooding, with the plain of Akkar, North of Lebanon as an example. Based on the Flood Assessment Risk, it has been estimated that out of the 788,973,871 Km<sup>2</sup> Total area of Akkar, a total of 36,810,112 Km<sup>2</sup> are prone to hazards in winter (CNRS, 2018). The occurrence of these climatic events is most likely to occur either throughout the wet season, following a storm or at the beginning of the spring. Whenever they do happen, horrific damages will undoubtedly affect agricultural plots of land and constructed buildings (Abdallah, 2012). Overall under this category, external shocks and alterations that occurred during the past few years have impacted the livelihood assets of farmers in Akkar. The figure below illustrates the areas in Akkar at risk of flooding, cross-cutting the agricultural plain of Akkar and part of the Ostuene watershed.



**Figure 13.** Flood Risk Assessment Map of Akkar (CNRS, 2018)

### **3. Policies & Institutions (Transforming Structures & Processes)**

The political environment in Lebanon continues to fluctuate with bleak prospects. Based on the January 2018 country report generated by The Economist Intelligence Unit, Lebanon’s political stability prospects for 2018-2020 are predicted to remain highly insecure with the possibility of additional political crises. Consequently, the private consumption and investments being at a disadvantaged position are not as a surprise to anyone. Also, “industrial and agricultural exports will also remain squeezed by high insurance costs and the costly alternative trade routes that need to be used because of the lingering war in Syria” (World-Bank, 2018a). The political weight of the national government still lies in the centralization of its authority. Lebanon’s overall administrative system is inadequate and challenging. Sectarian influence, bureaucracy, the government’s lack of proper management and information technologies and the

absence of support to policy-making and planning have generated difficulties in the country's governance strategy. In addition, the dependence on the private sector is at its peak in Lebanon. This is mainly due to the following restrictions in the public sector: constraints in its ability to implement public policies and cover the areas of its responsibility, corruption and its inadequate services that generate gaps that end up being compensated by the private sector (Haase, 2018). The privatization of services and commodities and the centralization of governmental power have also been covered in depth throughout section 2, where the evolution of the water sector has been discussed in depth as well. An important notion needs to be mentioned here which is the privatization law of 221 which assigns the responsibility of policymaking, national planning and water resource management to MEW. Giving much of power to one party makes it more difficult for end users like the farmers of Akkar to reach out to the government in case of a problem arises and, it makes service delivery overall more challenging. This renders farmers weak and in a position where they must rely on themselves to access basic rights and services.

#### **4. Livelihood Strategies**

As it has been mentioned previously, the Syrian war has generated an additional population pressure on Lebanon, meaning that there is an increase in competition over income and resources between the inhabitants. Though it has been proven that water availability is still somewhat abundant in Akkar despite the population surge, one cannot deny that farmer's approach to water extraction can be seen as problematic on the long term. In a situation where shared resources are involved, a tragedy of the common's scenario emerges. Based on the SAGE Encyclopedia of Political Behavior

(2017), the tragedy of the commons refers to a collective-action problem where communal resources are misused to a state beyond repair. It is when the individual benefits outweigh the interest of the whole community, which eventually drags everyone down and places them at a disadvantaged place ("The SAGE Encyclopedia of Political Behavior," 2017). When things are excessively unregulated, the whole ecosystem can be at stake. With no proper infrastructure in Akkar and no clear management plans underway, the vast majority of farmers have resorted to digging up private, illegal and unorganized wells for irrigation and drinking purposes – not taking into account the long-term effects of these individualistic actions on the whole plain of Akkar.

The surge in groundwater pumping can also be attributed to the fact that agricultural land size in Akkar is increasing, meaning production is increasing. Based on an unpublished analysis about trends of cultivation in the Akkar plain conducted by Dr. Hadi Jaafar, a significant statistical difference was concluded while comparing cultivated land between the periods of 2009-2012 and 2013-2016 ( $P < 0.05$ ). A significant increasing trend has also been observed in cultivated areas in the Akkar Plain between 2009 and 2016 for both cultivated areas in winter ( $P < 0.05$ ) and irrigated areas in summer ( $P < 0.01$ ) (Jaafar, 2017). Due to their low incomes and the lack of other livelihood opportunities, it can be suggested that farmers are persisting in the sector and are consequently resorting to agricultural expansion. To them, this provides a means to increase their earnings and provide for their families. However, once crops are harvested, farmers find themselves facing a problem marketing their produce. With the Lebanese/Syrian borders closed, dumping of foreign produce in the local market and the lack of governmental agricultural subsidies, the Northern Lebanese farmers find

themselves selling their harvested crops for minimal prices with growing debts to be repaid. Hence, it comes to no one's surprise when a growing number of farmers are encouraging their children to take other vocational paths. As long as there are no proper support or management strategies to the agricultural sector in all its aspects, this production cycle will persist until its complete collapse. The state that farmers are in and the livelihood strategies they are adopting is a result of an already weak sector governed by corruption and a lack of proper management plans. This is not only the case of farmers in Akkar; farmers in Central Bekaa are also suffering (Allam, 2011). In addition to water shortages that affect their production, they are unable to meet the growing expenses of agricultural inputs, compete with foreign imported commodities, sustain their external exporting markets, or keep up with the varying preferences of customers. To sum up, the agricultural sector is diminishing, and without any support, it is set to fail completely (Allam, 2011).

The previous section gives us an overview of some general livelihood strategies depended by farmers, however as we have seen previously, farmers fall under different income categories that share similar characteristics. Table 5 contains some observations based on income and water use. The primary observation from the below is that farmers who generate more than 667 USD per month, have larger households and own more physical assets. They only rely on private wells for irrigation whereas those generating less than that always amounts couple groundwater with another source of fresh water such as from streams and rivers. In terms of irrigation techniques, we note that those who generate more than 667 USD per month do not rely on surface water techniques, they only use water-saving irrigation techniques as they have the financial means to do so. In parallel, it is possible that those who generate less than 667 USD have felt that

water is not always available because they rely on surface water which is not always made available to farmers. In addition, they do not have the financial means that farmers with higher incomes have to invest in digging-up various wells to irrigate.

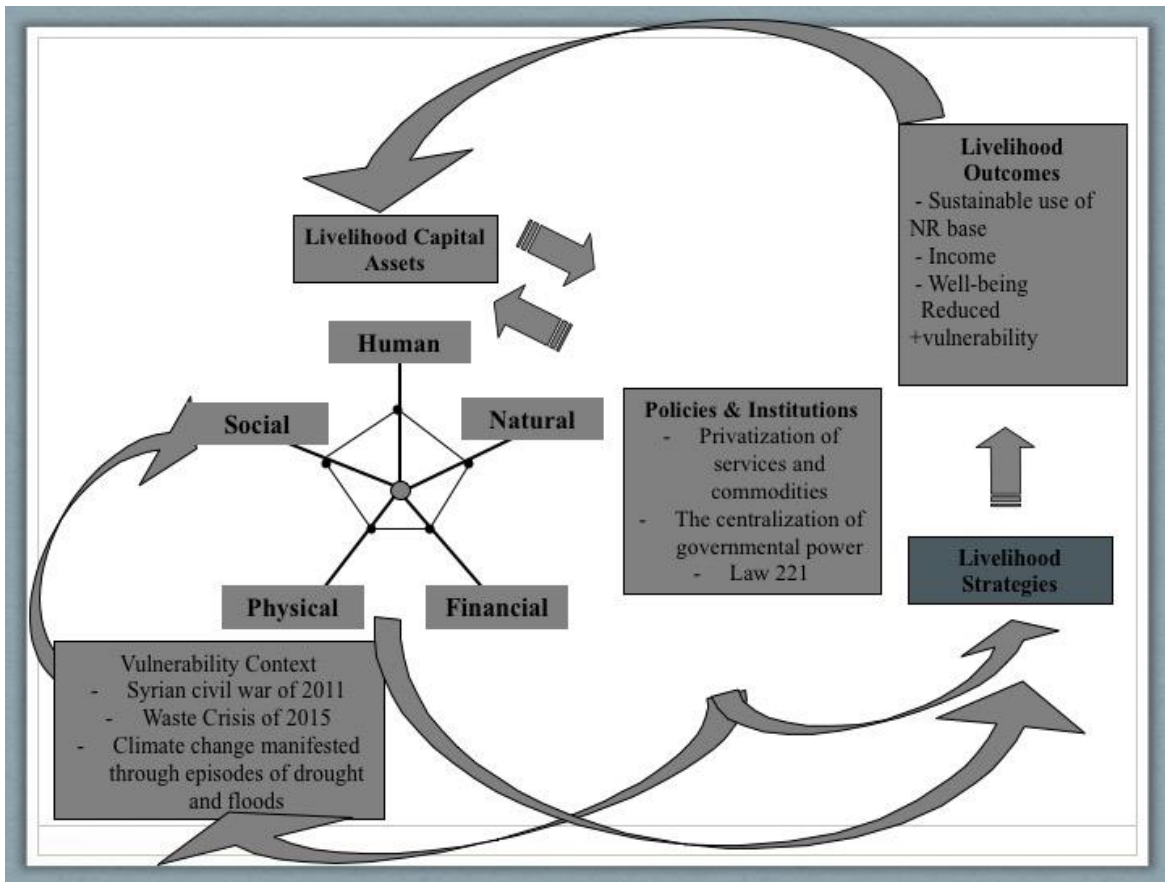
<i>Income per month</i>	<i>Household size</i>	<i>Area</i>	<i>irrigation water</i>	<i>irrigation system</i>	<i>Availability of water all year around</i>	<i>Drop groundwater for agriculture</i>	<i>Change in water availability in the region</i>	<i>Water problems</i>
<i>&lt; 200 USD</i>	Seven individuals on average	the majority have 4 Ha	Private wells; 30% natural sources (rainfed, river)	Surface and drip irrigation	yes (17% said no)	Yes (All)	Yes/no (half believe it did while the other half believe it didn't)	Mostly no; some suggested that water is polluted
<i>200 - 467 USD</i>	Eight individuals on average	The majority have less than 2 Ha	Private wells; 30% natural sources (rainfed, river)	Surface, sprinkler	Yes (17% said no)	Yes (Majority some said no)	No	Mostly no; some suggested that water is polluted
<i>467 - 667 USD</i>	Seven individuals on average	25 Ha	river	Surface, sprinkler	no	yes	Yes	Pollution
<i>&gt; 667 USD</i>	11 individuals on average, however, this includes extended family	Can reach-up to 40 Ha	Private Wells	Drip and sprinkler	Yes (All)	No	No	Mostly no; one mentioned that it was a bit calcareous

**Table 5.** Farming profiles based on income

## **5. Livelihood Outcomes**

One cannot deny that the Syrian civil war has contributed to a surge in population and resource demand. Contrary to Martin's findings (2011) which deduced that the vulnerability to water resources in the Nepalese catchment was increasingly triggered by an increase in population and climatic changes, this research has proven that the lack of proper infrastructure and water networks will remain the primary cause of water mismanagement in Akkar, Lebanon. This issue which Akkar has been facing since before the 1950s is mainly due to the lack of initiatives to fix the state of infrastructure. Obstacles such as bad governance stand in the way of its improvement. Also, features of the feudal system still appear in the monopoly of water distribution. Interviews reveal that farmers often have to pay water charges to gain access to what is rightfully theirs. Though water resources were deduced to remain available, water extraction and pumping are not being regulated nor managed properly, external factors such as the waste crisis and privatization trends are gradually taking their toll on water resources. In parallel, the agricultural sector, the main source of income for farmers, is largely mismanaged. Though production seems to thrive, marketing of crops is becoming more of a hurdle, leaving farmers with debts rather than profits. Farmers in Akkar are more vulnerable than ever, as they are left with no governmental nor financial support when problems arise in the agricultural sector – leaving them alone to find whatever way to generate an income and provide for their families.





**Figure 14.** The Sustainable Livelihood Approach for Farmers in Akkar, Lebanon

## F. Limitations

To begin with, comparing water availability across villages was difficult as the sample size was not large enough to determine which areas have felt the change in water use more significantly. In terms of interview limitations, not all farmers in Akkar felt comfortable enough to share information about their income which restricted the findings. In addition, sometimes farmers had difficulty estimating or giving answers to some of the technical questions asked - forcing us to skip questions as they were unwilling to answer.

## CHAPTER V

### CONCLUSION

The state of water in the agricultural plain of Akkar, North Lebanon, was at the center of this study. This was coupled with an extensive overview of the evolution of the sector throughout different periods of conflict and war. Because water management goes beyond policies, laws and regulating authorities, it was important to shed light for a change on the profiles of end-users and primary consumers. Hence, the Sustainable Livelihood Approach was adopted in this research to understand water management from the perspective of the farmer who, at the end of the day relies heavily on this resource in his day to day practice. Our findings highlight that the quantities of water available in the plain of Akkar are still abundant despite the sudden surge in population. Privatization and the centralization of authority have not generated any positive outcomes; they instead triggered more corruption, pollution and a category of individuals that feel the need to overstep laws and regulations to fend for themselves and their families. The relevant authorities have always been at the center of inadequate management and governance. However, one cannot deny the fact that end-users are also responsible for preserving resources. The lack of liability amongst farmers and their exhibited behavior is currently not problematic as water is still available. However, on the long term, the situation might evolve to more negative consequences. Because the proper approach to governance involves multiple actors and can be divided into different layers, the formulated recommendations will be categorized accordingly.

From a technical perspective, the rehabilitation of water networks and the construction of water storage facilities such as dams or artificial lakes is highly

encouraged. The water infrastructure in Akkar needs rehabilitation to ensure proper water delivery to households. Suitably constructed culverts can divert river water to different plots of land for irrigation purposes, ensuring that everyone gets equal shares with minimal risks of flooding. As inefficient water use, has been mentioned repeatedly by farmers, it is important that dams or water conserving structures are constructed to conserve fresh water for dryer periods.

From an environmental perspective, signs of climatic change and pollution are becoming more and more prominent. With no immediate intervention, we are at risk of damaging our freshwater reserves, consequently affecting the whole food cycle. It is important that more comprehensive studies take place to estimate the gravity of the situation and to predict better environmental interventions. These studies should assess water availability (be it surface water and groundwater) in various areas in the plain of Akkar and compare the findings to deduce where water availability is more at risk.

From a governmental perspective, it is important to note that the management of the water sector needs to be re-evaluated as it is putting most of the responsibility on the Ministry of Water and Energy (MoEW). The water authorities and the relevant municipalities are left with disconnected lines of communication with the MoEW and thus, less authority to manage processes. This centralized system is not responding to the needs of farmers, who place complaints which are almost always left unanswered. The process of applying for a well permit is time-consuming and complicated. Farmers would rather do things illegally then go into the hassle of requesting a permit legally. When these patterns occur, people will tend to feel less liable to follow the rules and regulations, which is the case currently. It is important that relevant authorities re-evaluate their structure, roles, and responsibility. Hence, as a mitigation measure, a

bottom-up participatory approach is recommended where municipalities and end-users such as farmers partner-up with the government. Individuals need to feel involved in and liable to the choices they make, to ensure that they take the incentive to manage resources. This brings us to the nudge concept which explains that people “should not be forced to act in certain ways, but rather gently encouraged to act in ways that are better for them or help them by stopping bad habits formed over time. This idea of a “gentle push” or “nudge” is based on libertarian paternalism and favors invitations to change behaviors, rather than the introduction of constraints and sanctions to obtain behavior change” (Binns & Low, 2017). This invitation to change encourages people themselves to take the incentive to abide by rules that manage and conserve water resources.

Finally, as we have seen previously, different farming profiles have a different approach and understanding of water use. Thus, water management interventions should be constructed in a way that fits the different livelihood categories. Based on this study, it was concluded that those who generate higher incomes used only groundwater and did not feel any change in water availability. This is an important source of information that allows us to construct awareness sessions about water management techniques that fit this category that can afford systems. It is also recommended that future assessment studies deduce more farming profiles which share similar characteristics and understanding to water use before developing any plans of actions. To conclude, this is a primary study covering several aspects of water management in the plain of Akkar. More comprehensive research covering the water-food-nexus is encouraged to produce more complex plans of action.

# APPENDEIX I

## Farmer Questionnaire English

### A. **First Section:** Demography

#### 1) Gender

1. Male
2. Female

#### 2) Age group

1. < 29
2. 30 – 49
3. 50 – 64
4. 65

#### 3) Type of family:

1. Direct
2. Joint/extended

#### 4) Household:

Number of Male adults in the household:  
Number of Female adults in the household:  
Number of male children:  
Number of female children:

#### 5) Number of employed family members in the household |

Type of employment (Agriculture related):

#### 6) Family's monthly income:

1. < 300.000 LBP
2. 300.001 – 700.000 LBP
3. 700.001 LBP – 1.000.000 LBP
4. 1.000.001 LBP

B. **Second Section:** Water Usage, availability and pricing

1) Which of the following sources of drinking water are accessible in your area?

1. Private water wells
2. Public tap
3. Community well
4. Household water supply (piped)
5. Other

Specify what is the drinking water source if the W1 chosen was “5” or other

2) Which of the following domestic sources of drinking water is accessible to your household?

1. Private water wells
2. Public tap
3. Community well
4. Household water supply (piped)
5. Other, specify:

Specify what is the drinking water source if the W1 chosen was “5” or other

3) Do you plant any crops?

1. No
2. Yes, specify type of crops

Specify type of crops

4) What is the area you use for planting every year/Ha?

5) What is your crop Yield/Ha?

total crop yield

The unit of the total crop yield

The yield of crop number one in W3\_specify

The specific unit for the yield of the first crop specified.

The yield of crop number 2 in W3\_specify

The specific unit for the yield of the second crop specified

The yield of crop number 3 in W3\_specify

The specific unit for the yield of the third crop specified

The yield of crop number 4 in W3\_specify

The specific unit for the yield of the fourth crop specified

6) What are the sources of water you use for agriculture?

1. rainfed
2. Private water wells

3. Public tap
4. Community well
5. Household water supply (piped)
6. Irrigation Cannel
7. Others, specify:

If the W6 chosen was 7, you specify the sources of water used for agriculture

7) What type of irrigation system do you use?

1. Surface
2. Furrow
3. Border
4. Basin
5. Sprinkler
6. Drip
7. Micro-sprinkler
8. Bubbler

Can you estimate the amount of water you use for irrigation?

Unit used for the estimation of the amounts of water used for agriculture

8) Can you give an estimate of the flow-rate for the irrigation systems relevant to you?

Flow-rate for drip irrigation

Unit for the drip irrigation flow-rate

Flow-rate for Bubbler irrigation

Unit for the Bubbler irrigation flow-rate

Flow-rate for furrow irrigation

Unit for the furrow irrigation flow-rate

Flow-rate for sprinkler irrigation

Unit for the sprinkler irrigation flow-rate

Flow rate for other types of irrigation

Flow-rate for other types of irrigation

9) Are the amounts of water you are receiving sufficient?

1. Yes
2. No

Please explain why:

10) Is water available all year around?

1. Yes
2. No

11) Which are the most difficult months:

12) Specify the number of irrigation/season/year:

13) Specify the number of seasons/year:

14) Specify the duration of each irrigation and pricing:

Duration of each irrigation

How much each irrigation costs

Unit used for pricing

15) Have you noticed any drop in groundwater levels over the last 5-10 years?

1. No

2. Yes

16) By how much (referring to Q.15)?

Unit used for the groundwater drop estimation

17) Have you noticed any drop in groundwater amounts available for irrigation over the last 5-10 years?

1. No

2. Yes

18) Please specify (referring to Q.17)?

Unit used for the groundwater drop estimation

19) Do you believe that water availability in your region has changed after 2011?

1. No

2. Yes, how?

20) Specify how water availability has changed after 2011

21) Do you usually face problems with the quality of water you are receiving?

a: Taste

b: Smell

c: Appearance

d: Pollution

22) Did these problems get amplified after 2011?

1. Yes

2. No

23) Do you pay for water?

1. No

2. Yes



24) If yes, what is the cost of water/m<sup>3</sup>?

Unit for the cost of water

25) What is the rate of payment/m<sup>3</sup>?

26) How much do you pay for diesel and electricity and other energy, respectively?

27) How much they pay for diesel

28) How much they pay for diesel

29) How much they pay for other sources of energy

30) Did you notice any change in water and energy (diesel and electricity) prices after the 2011?

1. No
2. Yes, how?

31) Specify the change in prices

32) Have you ever placed any complaints to your water provider?

1. No
2. Yes, if so to who?

33) Specify the type of complaint and to who it was made

34) What was the result of that complaint?

1. Actions were taken immediately
2. Actions were taken after a while
3. No actions were taken

35) Are you currently satisfied with the water services in Lebanon?

1. Yes
2. No, state reasons

Specify reasons why they are or are not specified?

36) Have any recent water management projects (post Syrian war) taken place in your region?

- a. No
- b. Yes, name them

Specify the projects if found in their areas

37) Suggestions to improve water services in Lebanon

## APPENDEX II

### Farmer Questionnaire Arabic

القسم الأول: الديموغرافيا

1. الجنس:

- ذكر
- أنثى

2. الفئة العمرية

- < 29
- 30 - 49
- 50 - 64
- 65

• نوع الأسرة:

- مباشرة
- المشترك / موسع

3. الأسرة:

- عدد الذكور البالغين في الأسرة:
- عدد البالغين الإناث في الأسرة:
- عدد الأطفال الذكور:
- عدد الأطفال الإناث:

4. عدد أفراد الأسرة الذين يعملون في المنزل | نوع العمل (المتعلقة الزراعة):

5. دخل الأسرة الشهري:

• LBP 300.000 >

• 300.001 – 700.000 LBP

• 700.001 LBP – 1.000.000 LBP

• > 1.000.001 LBP

استخدام المياه، وتوافر والتسعير: القسم الثاني

1. أي من المصادر التالية من مياه الشرب يمكن الوصول إليها في منطقتك؟

- آبار مياه خاصة
- صنوبر عام
- ابار مشتركة بين جميع أفراد المجتمع
- إمدادات المياه المنزلية (الأنابيب)
- خيارات أخرى

2. أي من المصادر المحلية التالية من المياه الصالحة للشرب يمكن ان تصل إلى منزلك؟

- آبار مياه خاصة
- صنوبر عام
- ابار مشتركة لجميع أفراد المجتمع
- إمدادات المياه المنزلية (الأنابيب)
- خيارات أخرى

3. هل تزرع اية محاصيل؟

- لا
- نعم، حدد أنواع المحاصيل

4. ما هي المساحة التي تستخدم لزراعة كل سنة / هكتار؟

5. ما هو عائد المحاصيل الخاصة بك / هكتار؟

6. ما هي مصادر المياه التي تستخدمها للزراعة؟

- البعلية
- آبار مياه خاصة
- صنوبر عام
- ابار مشتركة بين جميع أفراد المجتمع
- إمدادات المياه المنزلية (الأنابيب)
- قناة الري
- خيارات أخرى، حدد :

7. ما نوع نظام الري الذي تستخدمه؟

- الري السطحي
- ري بالأثلام
- ري الحواشي
- ري الجياض
- ري بالرش
- ري بالتنقيط
- نظام المرسّات ميكرو
- الري الفوار

8. هل يمكنك تقدير كمية المياه التي تستخدمها في الري؟

9. يمكنك ان تعطي تقديرا لمعدل التدفق المياه لأنظمة الري ذات الصلة لك؟

• ري بالتنقيط

• الري الفوار

• ري بالأثلام

• ري بالرش

10. هل كمية المياه التي تحصلون عليها كافية؟

• نعم

• كلا

11. يرجى توضيح السبب:

12. هل المياه متوفرة على مدار السنة؟

• نعم

• كلا

13. ما هي الأشهر الأكثر صعوبة:

14. حدد عدد الري / الموسم / سنة:

15. تحديد عدد الفصول / السنة:

16. حدد كل مدة كل من الري والتسعيرة:

17. هل لاحظت أي انخفاض في مستويات المياه الجوفية خلال السنوات 5-10 الماضية؟

- نعم
- كلا

18. بكم (بالعودة إلى سؤال رقم 15)؟

19. هل لاحظت أي انخفاض في كميات المياه الجوفية المتاحة للري خلال 5-10 سنوات الماضية؟

- نعم
- كلا

20. الرجاء التحديد (بالعودة إلى سؤال رقم 71)

21. هل تعتقد أن وفرة المياه في المنطقة الخاصة بك قد تغيرت بعد عام 2011؟

- كلا

• نعم، كيف؟

22. هل في العادة تواجه مشاكل مع نوعية المياه التي تحصل عليها؟

- طعم
- رائحة
- مظهر
- تلوث

23. هل ساءت الحالة بعد عام 2011؟

- نعم
- كلا

24. هل تدفع للحصول على المياه؟

- نعم
- كلا

25. إذا كانت الإجابة بنعم، ما هي تكلفة المياه لكل متر المكعب؟

26. ما هو معدل الدفع لكل متر المكعب؟

27. كم كنت تدفع عن كل من الديزل والكهرباء وأنواع الطاقة الأخرى (في حل إستخدمه)؟

28. هل لاحظت أي تغيير في أسعار الماء و الطاقة (وقود الديزل والكهرباء) بعد عام 2011؟

• كلا

• نعم، بكم ؟

29. هل سبق لك أن وضعت أي شكاوى لمزود المياه الخاصة بك؟

• كلا

• نعم، إذا كان الأمر كذلك لمن؟

30. ما كانت النتيجة من هذه الشكاوى؟

• تم اتخاذ الإجراءات فوراً

• اتخذت الإجراءات بعد حين

• لم يتم اتخاذ الإجراءات

31. هل أنت راض حالياً عن خدمات المياه في لبنان؟

• كلا

• نعم، أذكر الأسباب :

32. هل تم مؤخراً تنفيذ أية مشاريع لإدارة المياه (بعد الأزمة السورية) في منطقتك؟

• كلا

• نعم، أذكر البعض :

33. هل لديك أية إقتراحات لتحسين الخدمات المتعلقة بل مياه في لبنان ؟

## APPENDEIX III

### Governmental Entities Questionnaire English

1. Do you conduct annual water audits?
  - a. Yes, if so how often?
  - b. No
2. Do you monitor water usage?
  - a. Yes, if so how often?
  - b. No
3. Have you noticed a change in water usage in comparison to 2011?
  - a. Yes
  - b. No
4. If yes, why?
5. Is your system 100% metered?
  - a. Yes
  - b. No
6. Do you have any water management programs? (if the answer is yes, please describe it)
  - a. Yes
  - b. No
7. Do you usually evaluate the environmental impacts of water projects that are/will be implemented? (If the answer is yes, what is your criteria)
  - a. Yes
  - b. No
8. Do you usually inspect the infrastructure?
  - a. No
  - b. Yes, if so how often?
9. Which sector consumes most of our water resources?
10. How is the state of water consumption in Akkar after 2011 in comparison the years before that?

11. Have you conducted any studies to assess the water status in that area after 2011?
  - a. No
  - b. Yes, specify:
  
12. Do you follow any specific legislations that standardizes the quality and the quantity of water? If so, what are they?
  
  
  
  
  
  
  
  
  
  
13. Have you made any agreements with local or international parties in particular after 2011? If so, with who and what kind?
  
  
  
  
  
  
  
  
  
  
14. How do you assess the water agreement with Syria over the Akkar basin?
  
  
  
  
  
  
  
  
  
  
15. How is your relationship with the government and Litany authority? Are you facing any problems? If yes, of what sort?
  
  
  
  
  
  
  
  
  
  
16. How often do you hold meetings?
  - a. Weekly
  - b. Monthly
  - c. Yearly
  - d. Other
  
  
17. Do you keep water records?
  - e. No
  - f. Yes



18. If yes, are you willing to share them with us for scientific purposes?

19. Any projects or collaborations in the near future?

## APPENDEX IV

### Governmental Entities Questionnaire Arabic

1. هل تجرون تدقيقات سنوية بخصوص المورد المائية ؟
  - كلا
  - نعم، كم مرة؟
  
2. هل تقومون بمراقبة إستخدام المياه ؟
  - كلا
  - نعم، كم مرة؟
  
3. هل لاحظت تغييرا في استخدام المياه بالمقارنة مع عام ٢٠١١ ؟
  - كلا
  - نعم
  
4. إذا كان الجواب نعم، لماذا؟
  
  
5. هل النظام الخاص بك ١٠٠٪ مقنن؟
  - كلا
  - نعم
  
6. هل لديك أية برامج لإدارة المياه؟ (إذا كان الجواب بنعم، يرجى وصف ذلك)
  - كلا
  - نعم
  
7. هل في العادة تقوم بتقييم الأثار البيئية التي سوف يتم تنفيذها (إذا كان الجواب نعم، ما هي المعايير الخاصة بك)؟
  - كلا
  - نعم
  
8. هل فالعادة تقومون بتفقد البنى التحتية ؟
  - كلا
  - نعم، كم مرة؟

9. أي قطاع يستهلك الكم الأكبر من الموارد المائية ؟

10. كيف هي حالة إستهلاك المياه في عكار بعد عام ٢٠١١ بالمقارنة للسنوات التي سبقتها ؟

11. هل أجريت أي دراسات لتقييم الوضع المائي في تلك المنطقة بعد عام ٢٠١١ ؟

• كلا

• نعم، حدد:

12. هل تتبع أية تشريعات محددة التي تقوم بتوحيد نوعية وكمية المياه ؟ إذا كان الأمر كذلك، ما هي؟

13. هل قمتم بالإتفاق مع أية منظمات محلية أو دولية بعد عام ٢٠١١، إذا كان الأمر كذلك، مع من ؟

14. كيف تقومون بتقييم الإتفاقية مع سوريا بخصوص حوض مياه عكار ؟

15. كيف هي علاقتك مع الحكومة ومصحة الليطاني هل تواجه أي مشاكل؟ إذا كانت الإجابة بنعم، من أي نوع؟

16. كم مرة تعقدون إجتماعات ؟

• أسبوعي

- شهريا
- سنوي
- خيارات أخرى

17. هل تقومون بالإحتفاظ بسجلات متعلقة بالمياه؟

- كلا
- نعم

18. هل أنتم على إستعداد لمشاركتم اياها لأغراضٍ علمية؟

- كلا
- نعم

19. أي مشاريع في المستقبل القريب؟

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