



A Cultural Approach to Conserving Water: A Case Study on the Azraq Oasis

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HARVARD UNIVERSITY
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A Cultural Approach to Conserving Water: A Case Study on the Azraq Oasis

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A Cultural Approach to Conserving Water: A Case Study on the Azraq Oasis

A dissertation presented

by

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to

The Graduate School of Design

in partial fulfillment of the requirements

for the degree of

Doctor of Design

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Abstract

My dissertation aims to design a proposed solution by studying and better understanding the specific cultural related issues of water conservation. Water, a valuable element of life, has had and continues to have a significant impact on communities; culturally, socially, ecologically, politically, and on places globally. Conserving water is today's imperative need, and can more likely be implemented with a more specific culturally thoughtful policy design to help change the societal behavior, attitude, feeling, and awareness toward the water crisis.

Specifically, for this dissertation, I use the Azraq Oasis in Jordan as a case study. I define and investigate the cultural component of water scarcity and its role in implementing effective water conservation practices using Laureano's four cultural dimensions – cognitive (knowledge), attitude, active (behavior) and effective (feeling) parameters. I accomplished this by observing daily practices of the five sub cultural groups, the Druze, Chechens, Refugees, Minority, and Bedouins residing in Azraq. These parameters were collected through surveys, quantified and statistical models were created in order to help design a better resolution for this specific population.

The results indicated that the knowledge and behavior models are more significant than the attitude and feeling models. Survey results for daily practices for conserving water

had variations in terms of awareness (knowledge) of water conservation. All of the five sub cultural groups display positive behavior and attitudes towards willingness to conserve water. However, the one disparity is that the refugees, as much as they agreed that water conservation is needed, disagree that it is their responsibility to conserve water, but indicated that they save water wherever they can. In sum, all five cultural groups share similar feelings about water shortage and water quality seems to be their primary concern. This dissertation makes a contribution in the water use and conservation literature and provides quantifiable data of the role of the culture on water conservation for policy designers. The policy designers can then potentially implement or learn from this dissertation in their own country to design culturally sensitive policies that would potentially help eradicate water scarcity.

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Chapter 1 : Water Scarcity: A Global Issue

“Water scarcity is everybody’s business”

- Malin Falkenmark, 2007

Water, a valuable element of life, has had and continues to have a significant impact on communities; culturally, socially, ecologically, politically, and on places globally. Water is not an infinite resource and with water shortages increasing at alarming rates globally due to scanty rainfalls, population growth, urban sprawl, demand exceeding need, lack of access to safe water, deaths, diseases, crop failure and famine has resulted. Immediate attention to this growing problem is required. There is an obvious need for water for human, fauna, and ecological survival, and as such, managing water use in a sustainable manner has become crucial. The concept of water sustainability and management is meant to utilize in a manner *“that meets the needs of the present without compromising the ability of future generations to meet their own needs”* [1]. One of the key ingredients in sustainability criterion is to plan and manage water resources in such a way that basic access to water needs among people is not compromised [2].

Water conservation is today’s need. This can only be implemented with an urgent change in societal behavior, attitude, feeling, and awareness toward the water crisis. Studies have indicated the necessity to develop behavioral models that factor both internal (attitudes and habits) and external (water pricing, delivery, cultural norms etc) influences in order to change the behaviors of residents hesitant to change [16]. In California alone, droughts have played a major role in changing the perspectives and attitudes of local

residents toward conserving water [5]. This helped individuals to embrace the concept of using treated wastewater for agricultural, landscaping irrigation and industrial purposes. The other option, which is still under exploration, is using treated wastewater, after having gone through a series of purification processes, for drinking purposes – known as DPR (direct potable reuse) [6]. DPR is a promising water supply option and has actually been implemented in the cities of Big Springs and Wichita Falls in Texas, and Cloudcroft in New Mexico. Another city planning to use it is El Paso in Texas [6]. Most recently, in 2016, for the first time since the drought monitor was developed back in 1999, the state of Massachusetts in the United States, experienced a drought, where all areas except for its northwest corner were found to be ‘abnormally dry’ (Boston.Com, Boston Globe 2016) [136]. Apart from promoting water conservation, the state government imposed a mandatory restriction on water usage in some areas, such as prohibiting residents from washing their vehicles, washing of buildings, sidewalks or patios, and from filling pools [137].

Raising awareness on water conservation through social media has been found to be effective in certain states in the US. Methods such as promoting conservation on the Internet, televisions, mail, organizing water campaigns in local communities, spreading awareness in schools and rebate programs is essential for water conservation. Marketing social programs such as ‘Water- Use It Wisely’ are being executed in California, Arizona and North Carolina [4]. Texas is using a program called Water IQ in efforts to spread awareness [4]. This is to influence a change in people’s perspective, which in turn will help in modifying their attitude and behavior towards this issue. It was shown in Tempe,

Arizona that due to communication efforts to conserve water through practices such as using a broom instead of a hose for cleaning pavements and using drip irrigation, there was reportedly lower water usage [4]. Similarly, promoting water conservation through social media also resulted in cutback in water in other cities such as Orange County in Florida, Phoenix in Arizona and Durham in North Carolina [4]. Drought was also a motive to move toward water conservation in Australia; however, over there, the method in changing people's behavior and attitude involved the government implementing strict rules and policies in restricting water use, which enforced individuals to reduce water consumption [3,7, 8]. This included practices such as ensuring hoses are tight and leak free [7]. This study suggested that placing restrictions on water use versus a voluntary approach to conserve water was more effective in water conservation. Whereas, a study conducted by Roseth suggested that the driving force to conserving water was a collective concern in the community about running out of water. This concern resulted in a willingness to conserve water in the society. Although, the cost concerns in the community existed about water saving devices being expensive and the resulting cost effects on this issue [3,8]. As such, the Australian government provided water rebates to help alleviate the costs in purchasing low flow showerheads and dual flush toilets [3].

In stark contrast, in the MENA region, a 1999 study conducted in Jordan found that campaigning without enforcing water conservation resulted in little impact in water conservation in that region [13]. The purpose of this study was to evaluate the campaign on water conservation by the Jordanian Ministry of Water and Irrigation, which was found to increase awareness in locals about the existing water issues, but had no

significant impact on their water conserving practices [13]. Using a slightly different approach, Susan *et al* conducted a study by introducing water conservation awareness as a part of a high school curriculum in Jordan to evaluate knowledge, attitudes and behaviors. Students participating in an interactive curriculum were seen to gain more knowledge and also showed behavioral changes towards water conservation [14].

However, whether that resulted in greater water conservation practices is not known. It is known that farmers in Jordan and Tunisia did not approve of paying more for reclaimed wastewater in 2003 due to concerns with increased price, fresh water being available and water quality concerns [15]. Water quality versus water quantity is a sensitive issue. As much as residents would prefer continuous flow of water in their taps, the quality of water is very crucial. As such, another important aspect in sustainable water management and conservation is maintaining affordable costs of water while ensuring that the quality of water is not compromised. In Sub-Saharan Africa, due to a scarce water supply and an unsafe water quality, diarrhea has spread rapidly, causing it to be the third biggest fatal disease in children under the age of five [12]. Promoting hygiene and spreading awareness is crucial here but is that really all that is needed to resolve the problem?

Another example where water pricing and quality became an issue is the recent water crisis in April of 2014 in Flint, Michigan, an area placed under State Emergency due to the population suffering from debilitating health effects caused by cheaper priced water [10]. Due to financial constraints, the original water supply coming from treated water

plants in Detroit switched to the Flint River. These corrosive water pipelines caused the water to become contaminated with lead [10]. This resulted in a huge health crisis and unfortunately the concerns of residents were ignored and 5% of children under the age of 5 were found to have alarmingly high levels of lead in their blood [11]. The situation is still being resolved, much of which involves changing water fixtures in public amenities, replacing city's lead service lines, increasing awareness especially in schools [10].

The Flint water crisis was a shock nationally and internationally, tragically underlining that the water management crisis is not limited to developing nations alone. How can we prevent another Flint from happening? How can we prevent contamination (pollution) from happening again? How can we prevent California and Arizona from becoming the next Azraq, Jordan, suffering from drought and resulting severe water shortage?

A collective and comprehensive approach to water management is integral in solving the water crisis. This involves studying areas and regions where this problem has resulted in serious turmoil, such as the Middle East and North Africa (MENA) region and areas such as Azraq, Jordan. It involves understanding how people perceive the water problem, what their level of awareness is, understanding and studying their culture which may be impacting their attitude, and behavior, toward change.

This dissertation aims to tackle these issues, using Azraq, Jordan as a case study to analyze and learn from to prevent similar situations arising in the US and globally. I incorporate Laureano's four cultural dimensions – Knowledge (Cognitive dimension), Attitude dimension, Behavior (Active dimension) and Feeling (affective dimension)

through surveys that were created and captured the daily practices of water conservation from five different sub cultural groups (Druze, Chechens, Bedouins, Minority, and Refugees) residing in Azraq Oasis. This thesis also studies the potential factors that impacted these four cultural dimensions using statistical models.

The first section of my dissertation focuses on water scarcity as a global issue. In the second section, I discuss the water scarcity narrative - from its definition to the debate surrounding it. The third section examines the factors contributing to water scarcity in the MENA region. These factors are divided into six main categories, namely (1) population driven scarcity (2) demand driven water scarcity (3) geographical driven scarcity (4) pollution driven scarcity (5) geopolitical driven scarcity and finally (6) security driven scarcity. In the fourth section, I define and investigate the cultural component of water scarcity and its role in implementing effective water conservation practices using Laureano's four cultural dimensions – cognitive (knowledge), attitude, active (behavior) and affective (feeling) parameters. The fifth section gives an overview of what oases are, their water resources with a few detailed examples. In the sixth section, I discuss the Azraq Oasis at length - its history, along with its geopolitical and architectural significance, including the five sub-cultural groups residing there - the Druze, Chechens, Refugees, Minority, and Bedouins. I also detail the history of declining water resources in Azraq including the efforts to restore this oasis. In the seventh section of my thesis, I design a novel statistical model to analyze the Azraq Oasis incorporating Laureano's four culture dimensions as variables and present its results, including detailed methodology.

The final section discusses the conclusions and implications of the results obtained from my model, including limitations and future work.

Narrative - from Definition to Debate

“Of all the social and natural crises we humans face, the water crisis is the one that lies at the heart of our survival and that of our planet Earth,” says UNESCO Director-General Koïchiro Matsuura. He says, “No region will be spared from the impact of this crisis which touches every facet of life, from the health of children to the ability of nations to secure food for their citizens,”. “Water supplies are falling while the demand is dramatically growing at an unsustainable rate. Over the next 20 years, the average supply of water world-wide per person is expected to drop by a third” [40].

Although there is a general increasing awareness amongst experts about water scarcity, there still exist debates about the appropriate definition of water scarcity. There are differences in opinion with regards to the interpretation of water scarcity. Some experts associate the term with a physical deficiency in providing freshwater given a population size, cost water technology limitations in home deliverance, as well as food production dearth [17, 32, and 51]. Others have coined the term to define a socio and economic deficiency in the way regions manage freshwater resources regardless of the absence of a physical scarcity of water, but rather a scarcity of social resources and management methodologies [17, 32, 51]. There have been debates with regards to whether water scarcity is a physical concern or a political one. These stemmed from debates nearly 20-25 years ago about the growing global concern of water scarcity [29, 32]. In 2009, the

UNDP's Human Development Report focused on how water scarcity was largely an issue of poorly structured governmental policies on water demand and management rather than a physical depletion of available sources [22]. The argument has been that lack of policy reforms, proper water demand management and politics have negatively impacted the already existent water scarcity worldwide [29]. Furthermore, many argue that that economic water scarcity is manageable through improvements in governmental policies and water management methodologies in comparison to physical water scarcity, where conditions progressively debilitate with an increasing population and climate change [17].

Other experts define water scarcity interchangeably with water shortage [29, 55], and there are still other experts who are more cautious and have specified benchmark values with which they define water scarcity. In the following excerpt [167], Winpenny [54] eloquently addresses this issue:

“In popular usage, *"scarcity"* is a situation where there is insufficient water to satisfy normal requirements. However, this commonsense definition is of little use to policy makers and planners. There are degrees of scarcity - absolute, life-threatening, seasonal, temporary, cyclical, etc. Populations with normally high levels of consumption may experience temporary *"scarcity"* more keenly than other societies, who are accustomed to using much less water. Scarcity often arises because of socio-economic trends having little to do with basic needs. Defining scarcity for policy-making purposes is very

difficult. Terms such as water scarcity, shortage and stress are commonly used interchangeably, though have the following specific meanings:

1. Water shortage: a dearth, or absolute shortage; low levels of water supply relative to minimum levels necessary for basic needs. Can be measured by annual renewable flows (in cubic meters) per head of population, or its reciprocal, viz. the number of people dependent on each unit of water (e.g. millions of people per cubic kilometer).
2. Water scarcity: an imbalance of supply and demand under prevailing institutional arrangements and/or prices; an excess of demand over available supply; a high rate of utilization compared to available supply, especially if the remaining supply potentials difficult or costly to tap. Because this is a relative concept, it is difficult to capture in single indices. However, current utilization as a percentage of total available resources can illustrate the scale of the problem and the latitude for policymakers.
3. Water stress: the symptoms of water scarcity or shortage, e.g. growing conflict between users and competition for water, declining standards of reliability and service, harvest failures and food insecurity. Difficult to capture in numbers, though a checklist approach is possible” [54, 167].

Hence, according to Winpenny, water scarcity is an inadequacy in water management of the people and not the geography of the region. The Population Action International expands this definition further with benchmark figures: “A country, whose renewable fresh water availability on an annual per capita basis exceeds about 1,700 cubic meters,

will suffer only occasional or local water problems. Below this threshold, countries begin to experience periodic or regular water shortage. When fresh water availability falls below 1,000 cubic meters per person per year, countries experience chronic water stress, in which the lack of water begins to hamper economic development, human health and well-being. When renewable fresh water supplies fall below 500 cubic meters per person, countries experience absolute water scarcity.” [26, 30, 41,167]. These values are generally accepted and used by the World Bank and other analysts [30].

In 1999, Leif Ohlsson and Anthony Turton uniquely described water scarcity by putting together what they coined to be a “social story”, summarizing and weaving together various water scarcity narratives of distinguished pioneers who attempt to address the issue through identifying, adapting and managing the issue of water scarcity [51]. For example, the authors first discuss what they consider to be the ‘first story’, the “*Rivers running dry*” story, which describes and identifies the primary issue of water scarcity, i.e. a growing population with limited water supply, an issue which they identify has been described in depth by pioneers Peter Gleick (1993), Sandra Postel (1996), Robert Engelman and Pamela LeRoy (1995) among others, [51]. The authors describe the next “story”, as being pioneered by Malin Falkenmark (1989), of “*The numbers game*” which identifies the guidelines of calculating water stress or water scarcity or alternatively, calculates number of people per given amount of water [51]. The authors continue to describe the issues of water scarcity from a story tale perspective, fluently identifying many challenges and issues in dealing with water scarcity.

Building up Ohlsson and Turton's concept of water scarcity being a "social story", this thesis aims to identify and describe another very important critical piece of this narrative - the component of culture and its role in conserving water in a water scarce society. In order to design, plan or implement potential solutions or invigorate a residential area, it is utmost important to understand the culture, history and heritage of that community and have them involve in the process and gain their trust. Any development and measures taken to conserve water has to be culturally receptive. Cultural perspectives highly influence the outcome of any analysis and help in bridging the uncertainties about the various interactions between man, environment and the surrounding development in interpreting the data collected [154].

Factors Contributing to Water Scarcity in the MENA Region

The Thirsty MENA Region:

Water scarcity situation in the Middle East and North Africa (MENA) region is perhaps one of the most interesting cases to consider. It is highly complex with many issues that interplay at many levels. The geography, climate, increasing urbanization and population growth, political instability, unequal distribution of resources are just a few of the issues that come together and contribute to the water scarcity noted. Although the MENA region is exposed to numerous international river basins and aquifers, it is one of the most arid regions in the world. Given that agriculture in the MENA region is a very dominating water consuming sector, the arid region forces a large consumption of nearly 85% of the water resources [25, 29]. This is a significant amount compared to the world average of

60 - 70% of water consumption by an agriculture sector [29]. Furthermore, the efficacy of irrigation, 30%, is poor, in comparison to a world average of 45% [37].

The climate change further exacerbates this situation by decreasing average yields by nearly 20% [29]. Rainfall in this area is very sparse and more than 70% of the land is dry. In addition, climate change models have predicted that this region will further experience a 25% reduction in rainfall and 25% increase in evaporation by the end of the 21st century [25]. The majority of the available freshwater, 75%, in the MENA region is situated in Iran, Iraq, Syria and Turkey. However, adjacent countries such as Bahrain, Jordan, Kuwait, Libya, Qatar and Saudi Arabia suffer from a huge deficit in renewable fresh water, with values ranging well below 250 cubic meters per person per year [46].

Finally, the population growth and density dynamics of the region present challenges. The region is home to 5% of the world's population yet it contains only 1.4% of the world's renewable fresh water [26, 30]. The population continues to grow anywhere between 1% to more than 2% per year in the MENA region (compared to less than 1% in the US) [29, 30] and this increases the burden on water demand without any increase in the natural water resources. Furthermore, when assessing the population density in relation to water resources available, it is evident the region is amidst a serious crisis. The figures from the Human Development Report [21] indicate that countries such as Bahrain and Egypt have 20 persons per cultivable hectare. This is an alarming high number - the US figures compare at 1.3 persons per arable hectare [21]. Hence, among the variety of reasons, a combination of the region's geography, urbanization and

agricultural demand has led to a substantial decrease in water availability, which necessitates immediate attention.

Furthermore, with regards to the MENA region, the World Bank Report of 2008 notes the per capita water availability to be approximately 1200 m³ per capita per year, which is well below the global average availability of 7000 m³ per capita per year [25]. These values are used to indicate and acknowledge the water scarcity issue that exists in the MENA region (Figures 1.1, 1.2). It is alarming to note that in Bahrain, Jordan, Kuwait, Libya, Qatar, Saudi Arabia, the United Arab Emirates, and Yemen the freshwater availability is well below 250 cubic meters per person per year [46] (Figure 1.3).

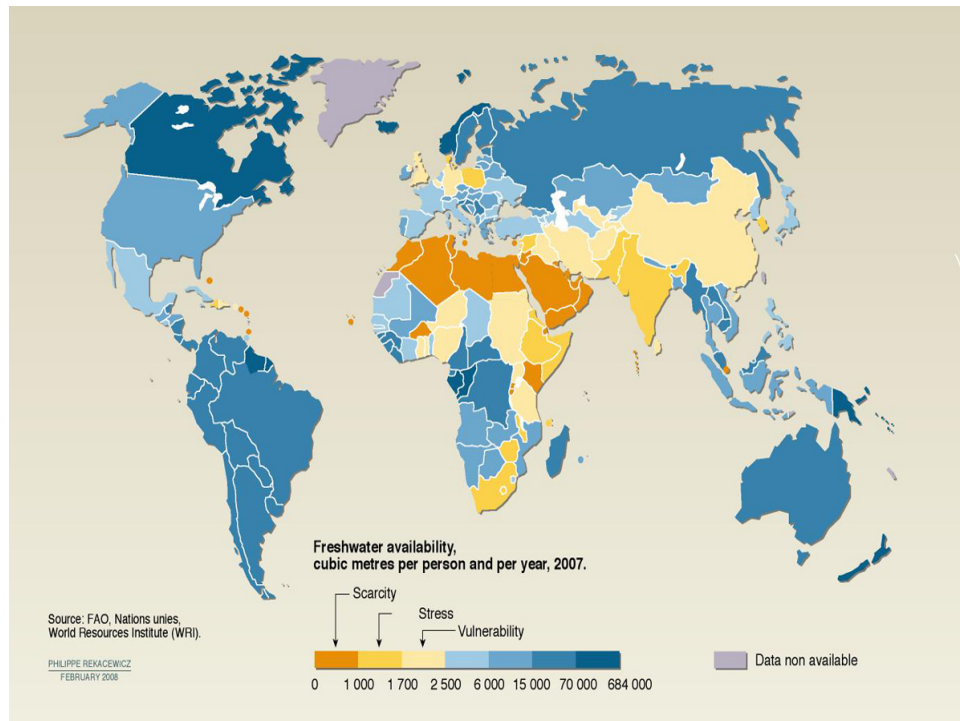
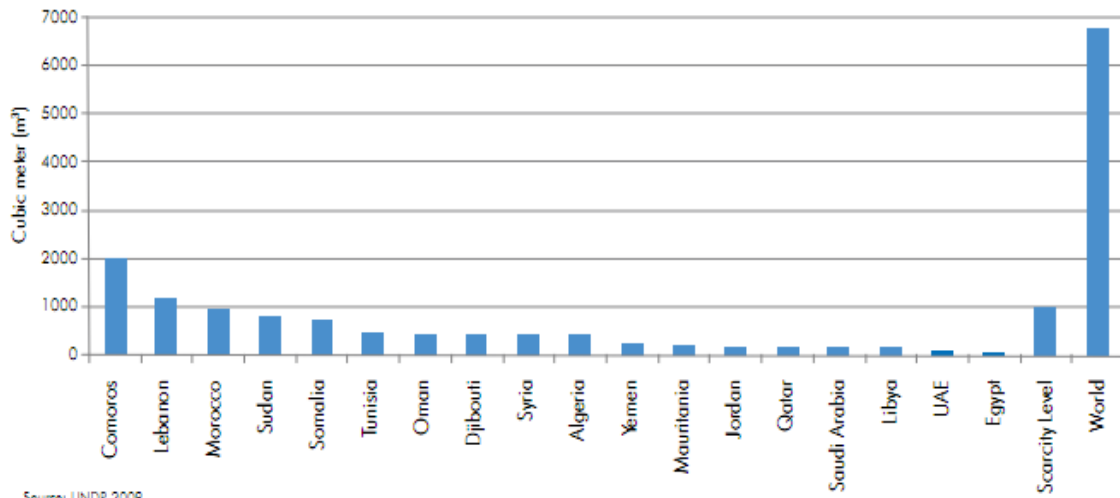
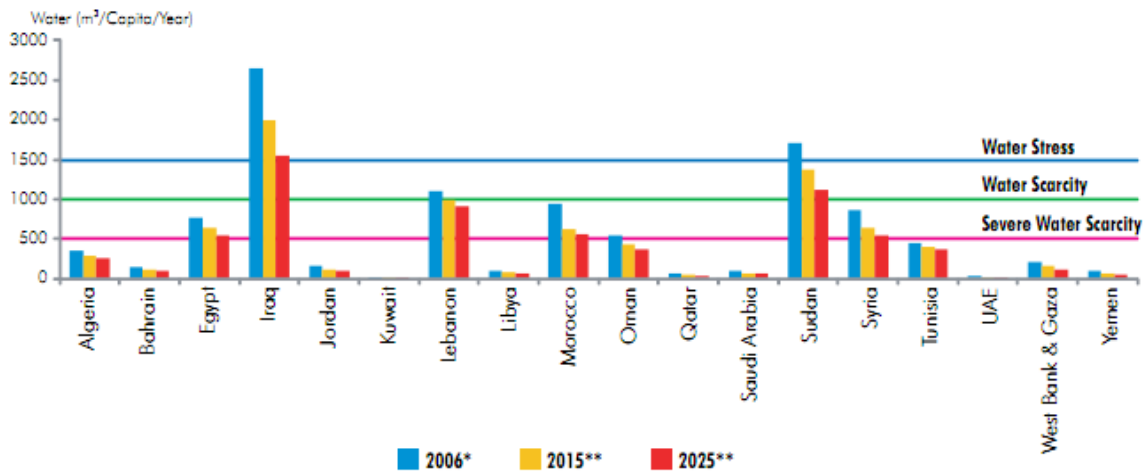


Figure 1.1 Freshwater availability worldwide and water scarcity in the MENA region [26]. It can be noted that while freshwater is generally available worldwide, the MENA region distinctly suffers from severe water scarcity.



Source: UNDP, 2009

Figure 1.2 Available fresh water resources in the MENA region in comparison to the world average, cubic meters per capita [5]. Values of freshwater resources in the MENA region fall well below the benchmark scarcity level of 500 m³ per capita.



* 2006 figures are from FAO/LINESCO
 ** 2015 and 2025 figures are projections prepared by AFED. See table 1

Figure 1.3 Future projections of freshwater resource availability in the MENA region [76]. Countries such as Kuwait and the U.A.E. have dangerously low depleting water availability.

Factors contributing to thirst

"We never know the wealth of water, till the well is dry."- Robert Fuller, 1732

As mentioned briefly earlier, there are numerous factors that have contributed to the water scarcity issue the MENA region currently faces. Debaters argue that water scarcity has largely been an identifiable cause and effect issue, e.g. politics, geography, sociological that was foreseeable [44, 45, 47]. These include natural and man-made factors such as population growth, food production, climatic change and variability, land use, water quality, water demand, water availability sectorial resources and institutional capacity, poverty and economic policy, legislation and water resource management, international waters, sectorial professional capacity, political realities, sociological issues, and lack of pricing water structures [42]. These reasons for water scarcity can be divided into six main categories, namely (1) population driven scarcity, with increasing populations placing burdens on available resources; (2) demand driven water scarcity, where demand is high in relation to the water availability; (3) geographical driven water scarcity with heterogeneous landscape and climate (4) pollution driven scarcity with pollution degrading water quality [32, 43], (5) Geopolitical driven scarcity and finally (6) Security driven scarcity.

Population Driven Scarcity

The MENA region is experiencing a rapid increase in its population. In 1989, the population was 314 million with an average increase of 2.8%, with nearly 7 million people/year, which is the second highest population boom, with the sub-Saharan being

the highest [46]. In the MENA region, 33% of the population is under the age of 15, with implications of a rapid growth in the upcoming years. For instance, it has been predicted that in Jordan, the population, which was 4.9 million 10 years ago, will double to nearly 11.7 million people by 2050 even with a 50% reduction in fertility [46]. Rapid population growth puts a strain on freshwater resources, as these are the areas where the population usually aggregate in this arid region [38, 39].

Demand Driven Scarcity

With an increasing population, there is a subsequent increase in the demand for irrigation for farming purposes. As noted earlier, the majority of water consumption in the MENA region is due to agriculture [18, 20]. Morris debates that this consumption is due to “...outdated and ineffective irrigation systems, such as open canals and surface irrigation” [72].

Another reason for the high water consumption pattern in the Arab World is because of the low or lack of water pricing structure. This brings no incentive of conserving water. Potable water consumption in the Abu Dhabi (avg. 550 liters/capita/day) region and Kuwait (avg. 500 liters/capita/day) is relatively high in comparison to developed countries like the USA, Canada, France, Germany (Table 1.1, Figure 1.4). The water consumed is proportional to the water prices. For example, in the USA water prices are approximately \$0.5/m³, in Canada \$0.4/m³, France \$1.17/m³ and Germany \$1.81/m³. In 2001, Fortin *et al* modeled individual water consumption pattern with respect to changing water prices [48]. He depicted that water use is inversely proportional to water price, with higher water price resulting in lower water demand and vice versa. Furthermore, it is

interesting to note minimal water prices in relation to water consumption in Abu Dhabi, which is about 1 cent per cubic meter, in Kuwait \$0.163/m³ and Saudi Arabia the average is in the range of 0.06 to 0.1/m³. This agrees with Fortin *et al*'s findings that due to minimal water prices, the consumption rate is immensely high in these Middle Eastern countries. Hence, the need to increase water prices is very necessary to counteract this effect [48].

Table 1.1 Water Consumption in the Arab world vs. Developed Nations

Country	Water Consumption (liters/capita/day)	Water prices (\$/m ³)	Reference
Abu Dhabi Region	~ 550	0.01	[34]
Kuwait	~500	0.163	[23]
Saudi Arabia	~200 – 280		[36]
USA, Canada	~250	USA: 0.5 Canada: 0.41	[23]
France	~180	1.17	[23]
Germany	~140	1.81	[23]

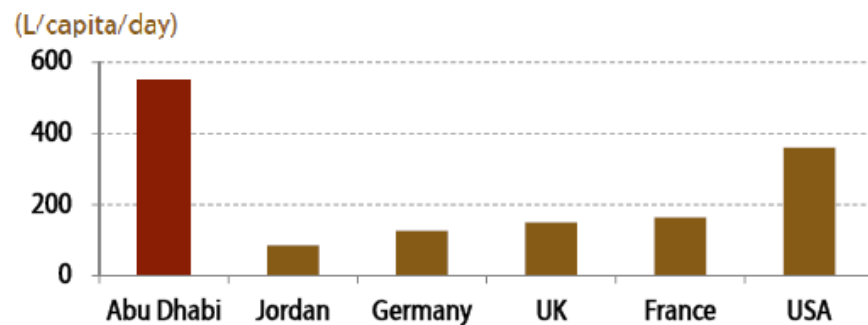


Figure 1.4 Average Residential Use of Water. [19, 24, 27, 28, 31, 33]. Abu Dhabi consumes the water residentially.

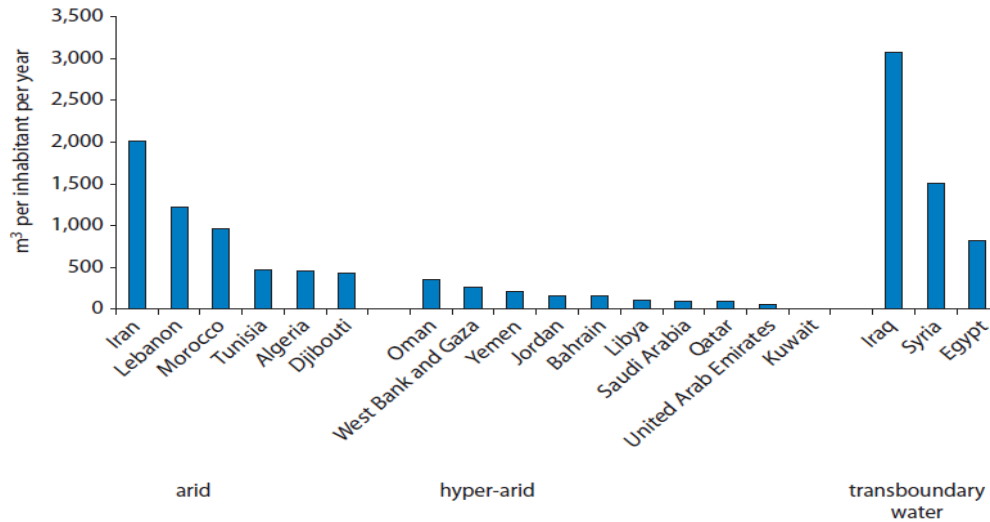
Geographical Driven Scarcity

The geography of the MENA region has also greatly contributed to the water scarcity noted in the region. It consists of a heterogeneous landscape and climate range. There

are mountainous regions with snow-covered peaks such as the Atlas Mountains and in stark contrast, dry arid desert regions such as the Empty Quarter in the Arabian Peninsula.

The dearth in the region's freshwater supply has severely impacted the freshwater ecosystems and species biodiversity, which affects fisheries, irrigated culture and a source for drinking water [76]. Freshwater availability in the MENA region is relatively low in comparison to the rest of the world (figures 1.1, 1.3). Beschorner describes this situation in the MENA region further: "...annual water supply in the region is neither reliable nor plentiful; the climate is largely arid or semi-arid with average annual rainfall levels of less than (9.8 in/yr), except on the Mediterranean coast and upland areas of Lebanon, Syria, and Iraq. Only Turkey and Iran enjoy a relative water surplus..." [53].

Furthermore, in 2007, the *World Bank: Making the Most of Water Scarcity* report sorted the region into three distinct sections based on their efficacy in managing water [29]. These sections as shown in figure 1.5, were defined as variability, hyper-aridity, and transboundary water.



Source: FAO AQUASTAT.

Figure 1.5 Total actual renewable water resources per capita in MENA region [29]. Iran, Syria and Iraq lead, respectively, in each of their sections with regards to their renewable water resources.

Variability: This section consists of countries such as Algeria, Djibouti, Iran, Lebanon, Morocco, Tunisia, and the West Bank, which geographically possess sufficient supplies of renewable freshwater but suffer from internal spatial and temporal variability of these resources within the country [29, 30].

Hyper-aridity: The countries in this section include Bahrain, Gaza, Jordan, Kuwait, Libya, Oman, Qatar, Saudi Arabia, the United Arab Emirates, and Yemen, which possess an insufficient supply of renewable water resources and heavily rely upon nonrenewable resources, such as groundwater, and desalination of available sea and/or brackish water. The main issue for this section revolves around the extraction management of aquifers to prevent depletion of available resources and agricultural trade. Furthermore, within this section, there exist two opposing economic situations, with countries such as Yemen, Jordan, Gaza suffering from relatively low per capita incomes and countries such as Libya, the Gulf States and Israel with high per capita incomes. This creates differing

challenges for these subsections with regards to the usage of limited nonrenewable groundwater sources [29].

Transboundary water: Transboundary water is defined by the UN- Water as “the aquifers, and lake and river basins shared by two or more countries – support the lives and livelihoods of vast numbers of people across the world” [161].

This section consists of countries such as Egypt, Iraq, and Syria, which are heavily dependent on international water bodies (the highest dependency noted in the world). Nearly 67% of the water supply of this section is imported [29]. Due to this, international agreements of water allocation are of great importance to this particular section as John Waterbury discusses in *The Nile Basin; National Determinants of Collective Action* [43, 57].

The sections within the MENA region delineate the non-homogeneity that exists within this region, geographically and economically. Such heterogeneity brings with it complications for establishing a general set of policies. Historically, the MENA region was viewed as a diverse set of tribes and people, and the idea of viewing the region holistically as a modern set of countries and states brings with it numerous challenges [25, 29, 30].

Pollution Driven Scarcity

Increasing pollution in rivers and aquifers contributes further to water crisis globally. Contamination from old water infrastructure to the wastewater and agriculture,

inadequate water supply, sanitation and hygiene as well as unsafe water are a few factors that negatively impact the health of the society. About 90% of the deaths are children under the age of five years old [146]. Most of these deaths are due to diarrheal diseases while 1 out of every 5 deaths in children at this young age is due to water borne diseases [146]. The developing countries in this category are mainly Ethiopia, Ghana, Haiti, Kenya, Democratic Republic of Congo, Angola, Rwanda, Nicaragua, Sierra Leone, Togo, Uganda and Zambia [146]. About 550 million people worldwide suffer from inadequate clean drinking water since 2000 [147].

Water crisis due to contamination of water resources also affected Flint, Michigan in 2014 causing sever adverse health impacts [10]. Northern China is also affected by poor water quality due to increasing pollution, insufficient water resources, poor water management and economic growth and this has negatively impacted their society [148].

In the MENA region, the countries that are affected tremendously by water- quality tribulations include Bahrain, Israel, Kuwait, Libya, Oman, Qatar, Saudi Arabia, the United Arab Emirates, and Yemen. In Azraq Jordan the wetlands were drying up and aquifers polluted. The Zarqa River in Jordan is also severely contaminated. During summer time this polluted river secretes strong stench and this in turn becomes a breeding place for rodents and insects [149].

Geopolitical Driven Scarcity

The geopolitical aspect of water scarcity cannot be ignored. The geopolitical situation of the MENA region is strongly related with water scarcity and its overall resource use, its allocation and its distribution politics within the region.

Mark Redwood describes the geopolitics of the MENA region to have an “inadvertent” effect on water scarcity in this region [71]. Mary E. Morris delves into this topic by dissecting the issue into three sets of geopolitical problems the region faces. The first issue she describes to be with regards to the Jordan and Yarmuk Rivers and the West Bank and Gaza aquifers. Here, countries such as Jordan, Israel, Palestinians of the Occupied Territories, Syria, and Lebanon face the challenge of water possession as well as water flow and its diversion with the rising complications of droughts in the area [98]. Morris predicts that Israel and Jordan are at greatest risk due to their complete usage of the water sources available. Furthermore, due to excess pollution in the area, the freshwater aquifer suffered from seepage from seawater and sewage in its groundwater sources [98]. Morris continues to describe the second issue revolving around the Tigris and Euphrates Rivers and the challenge of countries such as Iraq, Turkey and Syria dealing with limitations in irrigation, hydropower, salinization and reduced water flow. The third issue is with regards to the challenge that Egypt, Ethiopia, and Sudan face in preventing flooding, siltation, water flow and diversion [98].

However, it has been noted that the countries on the Arabian Peninsula suffer from physical water scarcity issues more so than geopolitics behind water scarcity [98].

Water scarcity and the socio-economic dynamics: Undoubtedly, the water scarcity situation has significantly impacted the socio-economic dynamics in the MENA region.

It was stated in *The Middle East and North Africa at Risk 2010* report that “The amount of water available per person [in the MENA region] by 2050 is expected to fall by more than half due to growth and climate change trends. With agriculture accounting for more than 85% of freshwater withdrawals and energy-intensive desalination being the only scalable source of water supply in the region, more integrated approaches to water management are required, particularly in linking water scarcity to food and energy security” [18]. As such, the main areas that will be affected by water scarcity and directly impact the socio-economic dynamics will be: water security, food security, water wars, viewing water as an economic good versus natural right and finally the educational sector.

Security driven water scarcity

There exists a vital relationship between water scarcity and water security in the MENA region. The Water Scarcity and Humanitarian Action states “[water security] is defined by the predictability of water supply and often the presence of contingency measures to compensate in times of water scarcity” [17]. It can be argued that water security is linearly proportional to water scarcity, with increasing water scarcity increasing the need for water security.

Water security acts as a region’s defense system in ensuring that citizens have their basic water needs fulfilled and is protected from shortages [52, 93, 94, 96]. Water security exists at an individual, national and international level. At the individual level, water security focuses on protecting livelihood at times of drought, whether it is directly

through protection against dying of thirst or prevention of suffering from famine due to the negative impact water scarcity has on crops, cattle and the food chain [93]. For example, Syria has been suffering from the worst drought in 18 years, which has severely affected its wheat production. In 2009, wheat production in Syria was reduced by 50%, to merely 2 million tons [101].

At the national level, water security becomes compromised by threats to the economic sector engendered by water scarcity, such as in the irrigated agriculture sector (particularly in the MENA region), power, tourism, environmental habitat and the industry in general. The water scarcity issues in Iraq have negatively impacted the agricultural sector economically. In Iraq, wheat production fell 80-98% from normal levels. It was predicted that in 2009, the total wheat production in Iraq was 1.3 million tons, which was 45% reduction from the previous year [101]. As such, focuses on implementing effective governmental policies to increase water security are necessary in the MENA region.

Water security and food security: As can be seen, water security and food security are undeniably linked. Water security impacts crops, agriculture, amongst other areas, which in turn impact the availability and quality of food.

Water Wars: Water wars have resulted from nations attempting to increase their food security. Usually, in these countries, water levels are well below the water stress benchmark and towards water scarcity levels due to the arid desert climate and landscape.

As such, their national policies heavily focus on increased food production for importing in cases of trade or water embargoes resulting from politics [93, 94, 96]. Such policies engender huge costs in food production; misuse of non-renewable sources such as fossil water, all of which further decrease food security, especially for the low-income population.

Even though increasing water security will also increase food security, the inverse does not hold. Rather, increasing food security through higher crop cultivation, agriculture, livestock will in fact, further exacerbate water security due to over expenditure of water given a known dearth. An estimated 30-40% of food production in the world is dependent upon irrigated land [35, 38, 49, 50]. Agriculture alone utilizes 70% of the world's freshwater supplies and nearly 95% in some developing countries [17]. Furthermore, 20% of the world's fish production is from freshwater aquaculture. In the MENA region alone, 75-90% of the water sources are utilized for agriculture [47]. Hence, a symbiotic relationship can only exist between the water and food security through proper water supply and management solutions and methodologies. Increasing trade is another solution, although it presents with its risks of uncertainty in prices, supplies, and embargoes on food trade among others [49].

In my dissertation, I adopt and extend Jaegar *et. al.*'s definition of water scarcity to be viewed as “*the marginal value of a unit of water affected by natural and human systems*” with a focus primarily on culturally driven water scarcity. The reason for this adoption is based on the concept of this definition that “*one input into society's decision-making*

process, one however that may help foster improved policymaking and targeted research, as well as better communication and understanding among the many groups involved in anticipating and alleviating water scarcity” [164]. Jaegar et al builds a conception framework about water scarcity being variable across spatial and temporal domains and its uses are valued by the cultural norms of the society [164]. It seems from previous studies that 'culture' and the role of culture has been present but was either not recognized or perhaps implicitly has played from a minor to no role in the models. My thesis sets to work with the 'culture' construct at an explicit, salient level and uses culture to explain or understand water use in the Azraq region. Hence, in my perspective, culture stands to have a greater impact on water usage/shortage and is the missing link – cultural driven water scarcity is what needs to be considered.

Chapter 2 : Water Culture: The Missing Link

While discussing the issue of water scarcity in this region, one of the missing components in traditional Water Management is culture. Sian Supski and Jo Lindsay visions that culture “frames all human activity, even though it is acted out in different ways, dependent on dynamics of community, gender, ethnicity, class and geographic location” [143, 166]. Luzzozi defined culture as being the “knowledge and values shared by a particular society” [162]. Thompson et al. in his book “Cultural theory” discusses the socio-cultural viability that defines how ways of life maintain (or fail to maintain) themselves [163]. The key ingredients of this theory include values and beliefs, social relationships and way of life [163]. Whereas Hoekstra builds up on Thompson’s cultural theory of four perspectives with a conclusion that water issues are also value driven [154, 163].

Wescoast has indicated in the ‘Cultures of Irrigation that “cultural concerns influence irrigation systems and policies across the nation, but they have been neglected in scientific research and policy analysis. It would be an error to assess irrigation problems today without studying the full record of the experiences that created them and that might lead beyond them.” [66]. While his focus was on the US, the concept is very applicable to the MENA region. Harvard’s anthropologist Caton views water not just as a resource but also as a “substance that connects many realms of life” [68]. Not only is water a connector but functions as an indicator as Susan Miller describes it [70]. It is very important to understand the historical perspective to progress forward. Furthermore, as Picon indicates in ‘Constructing Landscapes by Engineering Water’, a ‘cultural change’

is required to solve the water scarcity problems [69]. In order to change a culture, the culture must first be understood and accounted for.

Initiating social change in the attitude and perspective of individuals in this region with regards to the water reuse is arguably, harder, but also less costly. Setting up educational programs to help farmers, government advisors, and citizens as a whole to spread awareness could be very beneficial here. While the case of Azraq Oasis in Jordan can be seen to be the result of mismanagement of resources and poor planning, the Jordanian natives have attributed the drying of the wells to being a 'curse' due to prevailing cultural beliefs. This has discouraged many attempts at trying to properly rectify the situation or trying to learn lessons from this for the future. As such, in this way, an additional element of educating the natives as to causes and how trying to rectify the situation can be of benefit before trying to implement any solution.

One example of a cultural issue is the debate over grey water in the MENA region. Grey water is wastewater from sinks, tubs, showers, and washing machines in households. Grey water is a type of recycled water and is one of the options that can be used to conserve the existing water resources. Grey water use is not a new concept for the United States and for the MENA region. In the US, studies suggest that liberal grey water regulations, which make grey water economically attractive, encourage residents to make use of it. However, many cultures continue to find its use for everyday services unacceptable, against their religious beliefs and difficult to use. Furthermore, in the few places where grey water is used in the MENA region, notably Jordan, grey water has

been used in an uncontrolled manner, leading to health hazards [89, 90, 91]. Other issues that fall under cultural factors include the readiness of a population to use water responsibly or pay for it, even though they are accustomed to view it as a free resource, or cultural norms about water rights and water use.

In this way, culture becomes a very important component to include in any model towards resolving water problems. As such, a novel approach to incorporate the region's culture and history should be taken in an effort to implement change and promote water conservation practices.

Possible Solution to the Crisis? Water Management

Water as a right versus economic good

An important resolution to the water scarcity noted issue in the MENA region is efficient water management. The region is now utilizing advanced technology to reduce water consumption. Some of these advancements include work in Iran where dams are being constructed under high seismic risk; work in the Arabian Peninsula (Saudi Arabia and the Gulf) with desalination of salty sea and brackish water; work in Jordan and Tunisia encouraging farmers to install water-saving irrigation technologies; work in Egypt to manage irrigate and drainage networks, work in Morocco focused on privatizing urban water utilities; work in Tunisia focusing on efficient public sector water utilizes; and work in Yemen which utilizes flash flood flows to irrigate crops among others [47]. Unfortunately, this has not improved conditions due to the lack of policy reforms that discourage excess water expenditures and due to the lack of awareness amongst the

public in general [56]. The public views water as a natural right historically and culturally and this brings with it challenges in terms of introducing public reforms.

This particular debate revolves around whether water is a natural right or an economic good. The Dublin Principles (International Conference on Water and the Environment (ICWE) in Dublin, 1992) clearly stated the argument that water should be treated as an economic good and should be available for drinking and sanitation at an affordable price. However, given the water scarcity issue in the MENA region, citizens in Syria were forced to buy water off the black market due to the severe drought the nation experiences [58]. It is therefore imperative to address this issue in the MENA region such that governmental policies can regulate appropriate water pricing for residents of such countries.

Another alternative may be grey water use, which is one of the options to conserve the existing resources. However, there are debates with regards to its use. Many cultures, especially in the MENA region, continue to find its use for everyday services unacceptable and against their religious beliefs. Even when a few countries in this region use grey water, such as Jordan, it is used in an uncontrolled manner that poses a health risk [71]. Also, currently no standards for recycled grey water have been developed in the MENA region, which restricts the technology choices. This is another area that requires governmental policies and standards as to the safe usage of such alternative resources.

Educational Awareness

There has been some progress in the MENA region in bringing about awareness regarding the water crisis. This has been mainly in the education sector, particularly in the Gulf Region, with universities such as MASDAR Institute of Science and Technology (MIST) in Abu Dhabi and King Abdullah University of Science and Technology (KAUST) in Saudi Arabia, increasing their research focuses on alternate water saving technologies and preventative water-borne diseases. However, implementation and translation of this research to the public sector is challenging. There is a gap that exists between research and its implementation in these countries. A vast majority of the population is still unaware of the severe water crisis that exists in the region.

One of the pressing needs to conserve water is through understanding culture, understanding people, their needs and involving them in saving water efforts and promoting recycled water programs along with gaining people's trust. Thus, culture becomes a key ingredient to execute water conservation practices. For water culture, Laureano groups a set of attitudes, beliefs, values, knowledge and behavior into four dimensions – cognitive, conative, active and effective dimension [124]. In my dissertation, I adopt these four cultural dimensions (cognitive, attitude, active and effective dimensions) discussed below to see the impact of these cultural dimensions on water conservation in the Azraq Oasis. It is important to note that, as seen in this chapter, culture is manifest in many different ways and defined, measured in even more numerous ways. I choose, however, to focus on these four cultural dimensions for my dissertation.

Cultural Dimensions

As mentioned earlier, a novel approach to incorporate the region's culture and history should be taken in an effort to implement change and promote water conservation practices. Thus, culture becomes a key ingredient to execute water conservation practices. Laureano et al. [124] proposed to classify cultural factors into four dimensions, called cognitive dimension (Knowledge), conative dimension (Attitude), active dimension (Behavior) and affective dimension (feeling) dimension. I designed the survey for my thesis with questions capturing the following cultural factors, which are grouped into these dimensions:

Knowledge (Cognitive) Dimension

This dimension has to do with the level of knowledge and awareness people have about issues related to water scarcity, and the players (individuals, groups and institutions) that use and consume water resources [124].

This consists of,

- Knowledge about local water management schemes.
- Knowledge about organizations that have jurisdiction in water related matters.
- Knowledge about groups of players involved in the water sector (irrigation communities, hydrographic confederations, etc.).
- Knowledge about the water recycling/gray water use.
- Knowledge about water problems [124].

Attitude Dimension

Instead of the conative dimension, which refers more to impulse, I will adopt the attitude dimension for the analysis in my thesis. This refers to the degree to which people approve or disapprove of measures to regulate water management and distribution (water rates, assessing priorities in times of scarcity, management schemes, financial resources for investments in infrastructures, policies to increase water supply or reduce demand, etc) [124].

Here we have,

- Degree to which users/farmers approve of the criteria for allocating water in times of scarcity.
- Degree to which society/farmers approve of possible measures to reduce agricultural water demand.
- Degree to which users/farmers approve of possible measures to increase water supply: grey water use/ treated wastewater, building reservoirs, water treatment plants, transfers, etc.
- Degree to which users approve of new water pricing schemes.
- Beliefs regarding water.
- Degree to which society/farmers perceive water as being a public or private good and approve of water management schemes [124].

Behavior (Active) Dimension

This refers to how individuals and groups of people in a society behave with regard to water consumption and water conservation [124].

This dimension includes,

- How individuals behave differently with regard to water use.
- What type of social environment exists i.e agriculture/industrial based, rural/urban based.
- Behavior towards ecological concepts understanding of the environment.
- Behavior towards water saving/usage [124].

Feeling (Affective) Dimension

This dimension includes the *feelings* people express about the consumption and distribution of water (for example, the perception of whether there is a problem of water scarcity or not, beliefs about the causes for water shortages, views about inefficient water use, etc.) [124].

More specifically, this includes,

- Perception of the severity of the water problem.
- Feeling about the causes for the water problem.
- Opinions on inefficient water use [124].

These are further discussed in the methodology section where I use Azraq Oasis in Jordan as a case study and see the impact of these four culture parameters on water conservation in a village with different sets of population groups.

Why study the Oasis?

Needless to say, studying the impact of cultural factors on water usage and conservation is not a trivial task. In a typical urbanized environment, it is difficult to isolate other variables and factors, such as city pollution, that might also be playing a role. Furthermore, it would be impossible to ascertain any changes in the behaviors or on water usage and conservation. However, an oasis presents a very unique opportunity. An oasis has limited uses of its water; mainly for land cultivation and animal grazing. It has a somewhat defined boundary that can be measured and studied over time. Hence, who uses the oasis, how/when it's used and for what purpose the water from the oasis is used can all be readily tracked. Oases are within an arid environment and hence, the water issues are prominent. For these reasons, I selected to use an oasis to study the impact of four different cultural factors on water usage.

In particular, my selection of the Azraq oasis was largely due to how the Azraq region presented an even more interesting academic case. Not only was there a plethora of historical data that captured the decline of water resources in the area, but also the region, itself, had a rich diverse cultural history. It became an area that absorbed refugees from a variety of the different cultures as well as it continued to be a home to different local cultural communities from the region. Given these factors and understanding that the Oasis is associated with the settlements around water supply and a larger irrigable region, we define the 'Azraq Oasis' region to be the area that includes the Azraq basin, the villages in the center of the basin as well as settlements of the Refugees that are west of

the Basin. It is geographically divided into segments largely their settlement based on ethnicity. In addition, the government of Jordan was very forthcoming and willing to help in collecting additional data. All these factors helped make the Azraq oasis an ideal candidate to conduct my study.

Chapter 3 : Oasis

De Haas (2002) defined oases as “agricultural sites in [an] arid environment where agriculture is normally impossible without irrigation”. An oasis is always associated with the settlement and the palm grove - the cultivated area [73, 74, 75]. Dates are by far the most subsistence crops in most desert regions. Hence, I define an “oasis” as both a local area of a perennial surface water supply and a larger irrigable region that when irrigated can become “like a regional oasis”. As such, in my dissertation I use the region of Azraq Oasis as a study area.

The International Union for Conservation of Nature (IUCN) describes oases as important socio-ecosystems for local communities, which also play a key role in migratory bird routes and as a refuge for vulnerable and endangered species. In the Sahara, two-thirds of the population lives in oases [78]. About 85% of the water consumed in the region is used for agricultural purposes [76, 77]. Although the share of the agricultural sector of the GDP has dropped in the past decades, agriculture is still a relevant sector of income especially in the non-oil based countries [Figure 3.1]. A significant fraction of the work force is still employed in the agricultural sector.

RELEVANCE OF THE AGRICULTURAL SECTOR

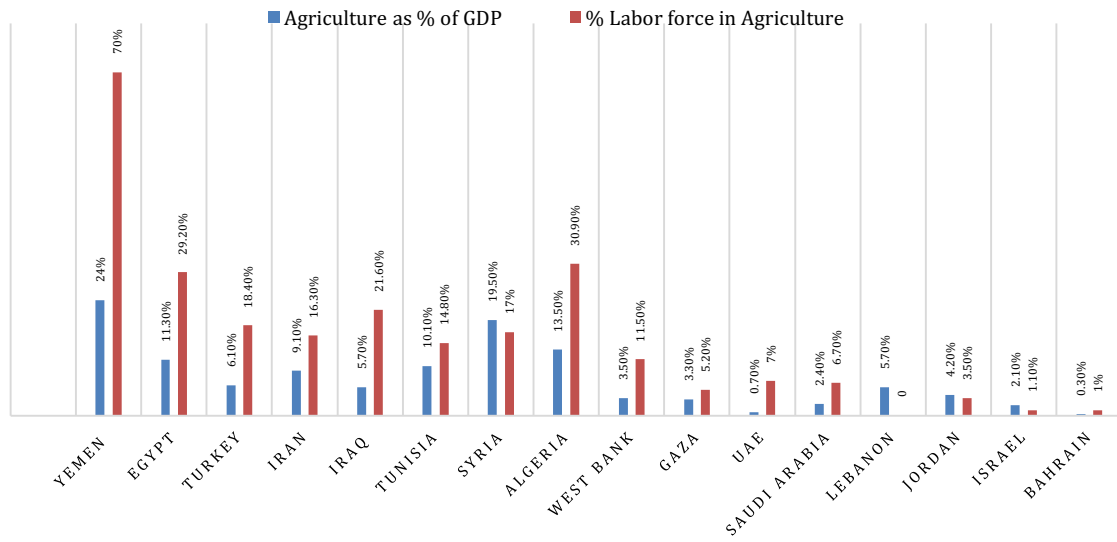


Figure 3.1 Relevance of the Agricultural sector¹.

Ground water resources are over-exploited due to uncontrolled, excessive pumping of water and evaporation losses are high due to the hot and arid climate. Along with water scarcity, technological know-how is often also scarce and economic means are very limited with the exception of the oases in the oil countries. Furthermore, the little precipitation there is (60 ~ 100mm/year), typically rains down abruptly and in short intervals, causes flash floods [76, 77]. Recurrent drought, inadequate drainage systems, drying wells and salinity is also causing palm trees degradation [61]. Decreasing and deteriorating water quality of the underground water resources threatens the fragile ecological equilibrium of the oasis. Farmers on the other hand are still consuming large quantities of surface water for irrigation. This gives rise to water logging and risks the shallow water table rise and permanent soil salinization. Due to the water logging and salinity problems it is necessary to come up with strategies for improved and sustainable

¹ I compiled Numbers from the CIA World Fact Book 2016

agricultural production in oasis like in case of Azarq Oasis discussed in detail in chapter four [68, 128].

Oases and water resources

Artesian wells, dug wells and springs are the traditional water sources in oases. Qanat systems appeared in the 12th century. Qanats are excavated channels, providing water from underground [68]. They tap a water source at a higher elevation, typically an aquifer, and the water flows through the underground channels to the irrigated areas. Presumably qanats originated in Persia and then spread all over the Arab world and even along the silk route up to China. Today most qanats have dried up due to lack of maintenance. Only a few are still in use. These qanats are an important factor in determining where people lived.

Today, wells powered by diesel and electric generators are used to pump ground water. The wells are exhausted due to excessive over extraction. Dams and reservoirs on larger scales are used to harvest floodwaters. Desalination is a more recent technology that separates freshwater from salt water through a series of processes. It is costly because of the expensive infrastructure and the large amounts of energy that is required for pumping water from the source (sea and/or ground water) to desalinate. This is particularly true for the Middle Eastern countries that are located in a hyper saline zone, which increases the need for energy for desalination [63, 77]. Due to the high cost, desalinated water is mostly used for domestic water use and not for agriculture. Costs have, however, been dropping quickly over the past years, reaching between USD 0.5/m³ and USD 0.68/m³ in

2009, down from about USD 1.0/ m³ a decade earlier [102, 103]. The MENA region is core for investing and utilizing these desalination technologies. Since 1990, desalination technology has been used to provide more than half of its water needs [103]. Other than cost and energy, the disposal of the brine generated in the process is a challenge the technology faces.

Illustrative Examples of Oases

Each oasis in the MENA region is unique, vary in sizes and some examples of these varying characteristics are highlighted here. The Siwa Oasis in Egypt is flourishing and utilizes outdated agricultural technologies [65,72]. In Syria, the implementation of drip irrigation helped reduce the water consumption by about 45% in specific areas. Similarly, the sprinkler techniques, in other areas of Syria, reduced water consumption by 20% [67]. The Azraq Oasis in Jordan, due to over exploitation of its water, has deteriorating water quality, a loss of habitat and decreased biodiversity [70, 71]. In stark contrast, oases in Abu Dhabi such as the Liwa Oasis is an increasingly popular tourist destination, is known for date farming, and uses modern drip irrigation systems and greenhouses [73]. Also, the Al Ain Oasis in Abu Dhabi is developing into a tourism and recreational city. Al Ain's oasis is known for its subterranean irrigation system (called "falaj"), channeling water from boreholes to water farms and palm trees. Aflaj Al Foah is the name of a proposed residential development located on the northern edge of a string of seven historical date palm oases and villages in Al Ain, Abu Dhabi, which were supplied by traditional aflaj water systems in southeastern Arabia [73,74]. While there is plenty of water available in the Al Hasa Oasis in Saudi Arabia, bellowing desert winds

damage its agricultural fields and pollute the water supply [74]. Due to soil salinization, the historically and culturally rich Al Diriyah Oasis in Saudi Arabia has been unable to cope with growing demand for water. Artesian wells are used in the Draa and Ziz oases of Morocco, but these oases also suffer from soil salinization. The traditional system of irrigation canals that were supporting the fragile ecosystem in the Tozeur oasis in Tunisia have either dried up, endangering them [62].

In the next chapter, I will discuss the Azraq Oasis, which remained a central melting point in Jordan for a long time due to its abundant water resources, which served many populations until its resources depleted.

Chapter 4 : Azraq Oasis

*“The righteous (will be) amid Gardens and fountains (of clear-flowing water)”
-15:45, Holy Quran*

Overview

Culturally, water has been considered to be sacred in the Middle East, with narrations describing tribes such as the ‘Quraish’ in what is now modern day Saudi Arabia to be revered due to their duty of providing water to pilgrims visiting the holy site of Mecca. The waterscapes, the diverse cultures, ecosystems and geographic positioning of Azraq make it quite unique. Given that water has historically been considered holy in the Middle East, the tale of the Azraq Oasis, is a tragic one in which it was once a beacon of life, with a small village, situated in the heart of Jordan’s northeastern arid desert. Azraq, which is derived from the Arabic word meaning blue, possessed a unique beauty; the treasure of fresh cool waters, in a region where this was considered a holy gift. Azraq’s strategic location also allowed for a contemporary sanctuary for the refugees coming into Jordan who brought with them their own unique practices.

Azraq spans approximately 3500km², providing water, luscious vegetation and fauna to key ancient villages in the past. For a long time through the 1960s, the Azraq Basin, an underground water source, covering an area of about 12000 km², remained a central meeting point in Jordan. Water drains in this steep Azraq basin from all directions toward the center. [59, 60, 61]. It served as the main stopping point for travelers passing through the land and a hub for human development – a famous route used by pilgrims for the Islamic sacred pilgrimage known as the Hajj, as well as an area where nomads would

provide water to their camels and goats. The Azraq Basin was also a staging ground for migrating birds from Europe to South Africa. Despite the bustling activities at the time, water abstraction from the underground basin remained at reasonable levels as the people of Azraq pumped water only for subsistence and smallholder agriculture [62, 63]. In the 1960's, however, due to a massive increase in agriculture, population boom, and uncontrolled excessive extraction of water, water stress resulted in the area. Other factors have also further contributed to the depleting water sources such as the region's high evaporation rates (3,000mm), dry and hot climate with temperatures ranging between 36.6°C (97.8°F) to as high as 45°C (113°F), scanty rainfall, the mean annual of which falls below 150 mm and further decreases to less than 50 mm toward the Azraq basin, as well as the recent influx of refugees from Syria and Iraq [61,64, 65, 82].

In addition, there is also a poverty issue -- Jordan is ranked the fourth poorest water scarce country in the world and falls far below the international poverty line of 500m³ per year, with the per capita share being less than 146m³ per year [59,61].

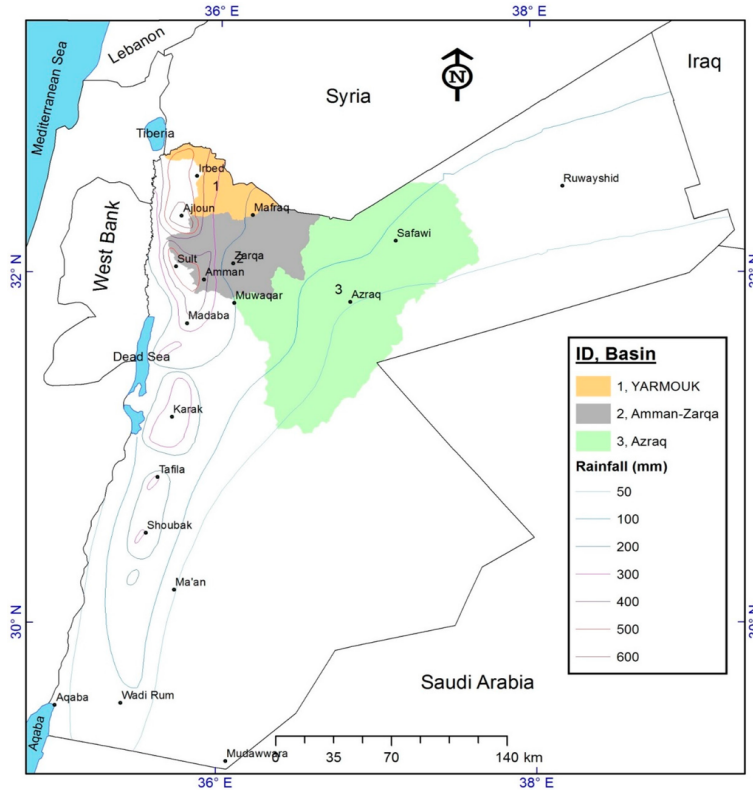


Figure 4.1 Map of Azraq (Green Area) ²

Azraq is about 80km east of Amman and lies in the center of a large drainage basin, 94% of which falls with the Jordanian territories, a small portion, 5%, extends into Syrian borders in the North and 1% extends into Saudi Arabian borders in the South [80, 81, 83,89]. Precipitation run-offs mainly recharge this drainage basin from the northern Syrian border side and due to Syria’s construction of a dam to make use of this water; the amount of flood flow entering this basin from its northern border has decreased [80,81]. At the center of the basin the oasis developed. This wetland covers an area of about 75 km² and includes areas of low, moderate and high salinity in the form of a fresh water

² Al-Bakri, Jawad, Sari Shawash, Ali Ghanim, and Rania Abdelkhaleq. "Geospatial Techniques for Improved Water Management in Jordan." *Water* 8, no. 4 (2016): 132.

lake, marshes, and a mudflat region known as Qa', respectively [80]. Due to excessive pumping of ground water, these wetlands have since dried [62,63].

The Azraq Basin is one of the three most important and commonly used basins in Jordan.

A list of these basins and their categorical use is listed in table [4.1] below.

Table 4.1 Water Balance of Three Important Basins and Their Use in 2014, Ministry of Water and Irrigation, Jordan [60]

Basin	Safe Yield	Yield	Yield	Percentage of Excess Use Agricultural Abstraction/Safe Yield (%)	Percentage of Excess Use (Abstraction/Safe Yield * (%))
	(MCM)	(MCM) Agricultural Use	(MCM) Non-Agricultural Use		
Amman-Zarqa	88	104	9.4	118	224
Yarmouk	40	48	92.4	120	144
Azraq	24	67	21	279	367

As noted from the table above, water consumed from these basins for agricultural purposes far exceeds the safe yield of water consumption. Safe yield is defined as “*the attainment and maintenance of a long term balance between the amount of groundwater withdrawn annually and the annual amount of recharge. Hence, safe yield limits the groundwater pumping to the amount that is replenished naturally*” [165]. The safe yield of the Azraq basin is 24 million cubic meters (MCM) and the abstraction rate for total water use purposes is 88 MCM per year, which is consistent with the severe water decline problem in the entire basin [81]. In particular, the percentage of excess water used in Azraq, including for both agricultural and non-agricultural purposes is in the range 367%,

which is not only very high but also the highest in comparison to the other basins [60, 80].

As mentioned earlier, given these factors and understanding that the Oasis is associated with the settlements around water and Palm grooves, we define the 'Azraq Oasis' region to be the area that includes the Azraq basin, the villages in the center of the basin as well as settlements of the Refugees that are west of the Basin.

Historical decline of Water resources in Azraq

In 1965, the Azraq oasis was recognized as a Reserve by the Royal Proclamation due its many attractions including the migrating birds between Africa and Europe that would uniquely be found here [116].



Figure 4.2 (a) Azraq - Past³



(b) Azraq - Present⁴

³ <http://www.otigroup.com/visitjordan/reserves/reserves1.htm>

⁴ <https://jordanjournal.wordpress.com/2012/03/09/amman-to-azraq-the-end-of-an-oasis/>

Historically, Azraq provided natural habitat to unique flora, fauna, aquatic and terrestrial species that included the Azraq killifish and *Aphanius sirhani* [117]. About 33 known species of water birds and about 209 species of birds are known to have existed in this oasis out of which about 347,000 waterfowl have been noted [116]. This oasis also lodged numerous deer, bear, ibex, oryx, cheetah and gazelle which later became extinct by hunters [107].

In 1977, Azraq Oasis was declared the Ramsar Convention Site [80]. This Convention on Wetlands, is an international agreement signed by many different governments around the world that provides the foundation for national action and international cooperation for the conservation and wise use of wetlands and their resources [115]. This was signed in Ramsar city of Iran in 1971 [115]. The declared Wetland Reserve included areas of Qa Al Azraq, the marshes and the pools fed by the southern springs constituting an area of 1,245 ha [116].

In the 1980s, however, the demand for water in the main city of Amman exceeded the local resources and the city turned to the oasis of Azraq for its water supply from the Azraq Basin and Lake [63]. The cheap water and empty land attracted agricultural investors who had no regard for water preservation, planning or smart agricultural planning. Toward the end of the 1980s, the quantity of water pumped from the basin exceeded two times its safe yield and degradation rapidly emerged [62, 63]. By the early 1990s, all natural springs and surface water sources disappeared and dried up— farmers and stakeholders made attempts to rectify the situation but without government mandated

regulations and policies, without proper water planning and use, the water sources dried up, the migrating birds mostly stopped coming and there are now artificial wells kept in place for tourist attractions [63]. The darkest period for the Azraq Oasis was these two decades (1980-1990-2000). The Azraq lake shrank to about 80% and bringing this oasis back to how it once was remains a monumental task [80].

Drying Wetlands in Azraq

For a short period in 1932, the Iraqi Petroleum Company (IPC) extracted ground water and transported it from North Azraq to Safawi (town near North Azraq) and from Safawi to Mafraq [103, 110]. Around this time, mainly the locals in Azraq used water, and the government had not tapped into the waters of Azraq to fulfill needs of Amman. In the 1960s, due to massive increase in agriculture, population boom, uncontrolled over-extraction of water resources resulted in increased signs of water stress in the area. The government focus was to fulfill the demand and increase water supply by any means necessary, while neglecting to focus on managing what was causing the demand itself. In the early 1960's, the Druze-Irbid pumping scheme was developed, which utilized the pipelines laid by the IPC in order to extract water from the pools of North Azraq to satisfy the water demand in the northern cities of Jordan [103, 105]. Because the pumping stations were in the vicinity of North Azraq, the springs that flowed into North Azraq went through a decline of water levels as well, leading to drying and loss of the marshes and the ecosystem in the area [89, 103].

In 1977, the Jordanian government tapped into other water resources to quench the thirst of city of Amman, and settled on Azraq as a water source. In 1978, the Amman Water and Sewerage Authority (AWSA) drilled about 15 wells in Northwest Azraq. In the 1980's, pumping from the Southern pools started, as the northern springs disappeared, and the pumping station was established in South Azraq⁵. In 1981, four more wells were drilled. These wells served both Amman, as well as other northern cities, and Azraq. The water was pumped from these wells to three reservoirs of different capacities, the largest one holding 12000m³ of capacity. Water from this reservoir was pumped using engines and transported via pipes to Amman and through gravity was transported to Azraq under constant pressure [103]. These distributing pipes have different diameters and can take up to certain pressure. In summary, in the 1980's, the northern springs in North Azraq dried and around 1992, the southern springs started disappearing [89, 112]. This had a domino effect; the local livestock and animals' populations of water buffalo, cows, sheep, and horses could not be sustained. Birds, fish and other water species also disappeared. The natural fabric of Azraq as a whole was affected by the mismanagement, uncontrolled, and illegal water abstraction of the water resources in Azraq Oasis [80, 89]. This not only affected the quality and quantity of the water but also dried out the wetland [80].

The government administering and taking control of water in Azraq created a sense of invasion of free spaces within the villagers – thus bringing in the conflict of access and control between the federal water authorities and the local villagers [103]. The shift and

⁵ Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), emails and text messages exchanged with author, October 2012 – August 2017.

balance of cultural power between the actors in water distribution played an important role in Azraq [103].

In 1994, ‘the Azraq restoration project’ was initiated in order to restore the dried oasis by the Royal Society for Conservation of Nature (RSCN). The Global Environmental Facility (GEF) funded this project. RSCN and the Ministry of the Environment created an artificially maintained wetland by pumping groundwater into the lake [113,114,116]. This was done with an agreement with the Ministry of Water and Irrigation Jordan (WAJ) [114]. Currently, less than 5% of the oasis wetland has been restored [114], though the number varies in literature. This reserve in the South Azraq has been divided into two protected areas; the Azraq Wetland Reserve and the Shaumari Reserve [103]. Hazem Khreisha, the manager of the Royal Society of Conservation for Nature (RSCN) describes Azraq’s situation by email as;

“As you know Azraq Oasis was described as a paradise in the eastern desert until 1980s but as a result of over pumping and extractions of water, illegal drilling of artesian wells...etc. affected significantly on the water level and led to depletion... RSCN in cooperation with GEF (global environment facility) executed a project of rehabilitation of Azraq Oasis and aimed at restoring 10% of the original oasis and they succeeded and signed an agreement with WAJ Water Authority of Azraq to provide the reserve with 1.5 -2.5 MCM annually with a total cost of 250000 \$ paid once”⁶.

Water Authority in Jordan (WAJ) had to reduce the water supply in Azraq in order to accommodate the growing need of water in Amman, but other cities in Jordan as well, this resulted in continuous supply of water being disrupted from 7 days to 4 days to 3

⁶ Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), email to author, October 9, 2012.

days a week in 2012 for the residents of Azraq [89,103]. In 2013, with water being supplied through Disi aquifer water has once again reached the taps of the villagers for 7 days a week.

A current water flow diagram based on the literature review and information provided by Azraq manager Hazem Khreisha⁷ is shown in Figure 4.3. The diagram indicates water being pumped and transported to the city of Amman from Disi Aquifer (located between the southern border of Jordan and Northwestern border of Saudi Arabia). The water is then transported to the Azraq Oasis as per the agreement to restore this oasis (about 1.5 – 2.5 MCM annually). The old station located in North Azraq was moved to South Azraq once the springs disappeared in the North. Two new wells are dug for refugees in the west of the Azaq Oasis.

⁷ Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), emails and text messages exchanged with author, October 2012 – August 2017.

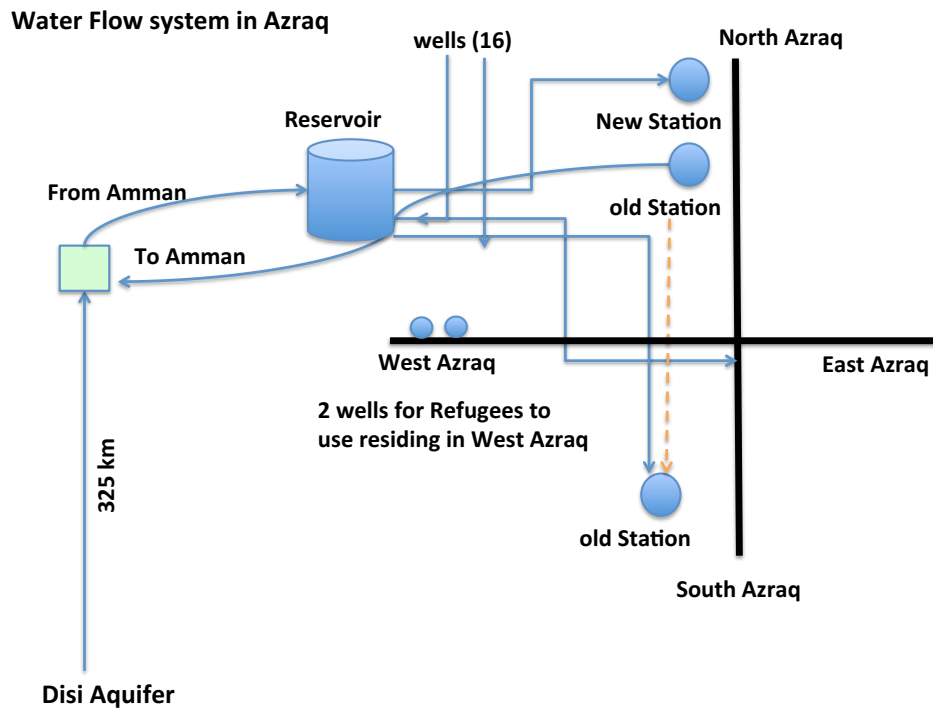


Figure 4.3 Water Flow in Azraq

The Disi Aquifer

It wasn't until 2013 did Jordan find some relief for its water crisis. The Disi aquifer, approximately 320 km south of Amman, is shared by both the Northwestern Saudi Arabian border and the southern border of Jordan, but the aquifer disproportionately borders Saudi Arabia (90%) versus Jordan's 10% [93, 95]. In 2013, Jordanian Authorities initiated the Disi Water Conveyance Project, which would pump about 100 MCM per year water from the aquifer and transferred to the city of Amman through an underground pipe system. The Jordanian Authorities supply water from Amman to Azraq as per their agreement to restore the Azraq oasis.

“With regards to establishments of new Syrian refugees in Azraq, Jordanian Government resorted to accelerate of operating procedures of Disi Aquifer (southern Jordan) to cover large parts of Amman and some other governorates, especially that refugee numbers have increased significantly, leading to speed up the creation of two camps in Azraq, one of them a capacity up to 5,500 refugees and other non-specific, but an estimated with 100 000 refugees and this figure is equivalent to 10 times the population of Azraq .

You know that we have an agreement with water authority of azraq to provide us with 1.5 - 2.5 MCM water annually since rehabilitation and restoration of an oasis in 1994. So since then we take water from them but less than what is stipulated in the agreement. Currently we take 600 000 cubic meter.

Fortunately, since operating of Disi aquifer in July 2013 and water supply to the reserve coming without interruption as in the past. In fact before that water uses for the reserve or for domestic use were 4 days a week...maybe because they have not received refugees yet :)

Right now, International organizations preparing and putting the final touches on azraq refugee camp and it is in the final stages to receive them”⁸.

Aligned with the water usage issue, next I will discuss water use in the agricultural sector in Azraq and the type of crops cultivated in this region. Harmonizing water use in this sector is essential to conserve available water resources.

Water uses in Agriculture

⁸ Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), email to author, February 25, 2017.

“We need a Blue Revolution in agriculture that focuses on increasing productivity per unit of water – more crop per drop”- Kofi Annan Secretary-General of the United Nations, 2000.

About 65% of the water consumed in Jordan is due to the agricultural sector, and about 36% of the population is employed in agriculture, despite Jordan’s many water shortages [103, 117]. The same problem exists in Azraq; water used in agriculture poses a threat to the water resources, and the area is considered ‘unfit for farming’ due to the water shortage, type of crops cultivated, irrigation methods used and because of the large amounts of land used for leisure by wealthy non-locals’ residents [103].

The main irrigated crop in Azraq is the olive as shown in the figure below [61]. Olives are cultivated in large amounts in Azraq mainly because they hold a significant cultural value, considered holy, as mentioned in the Holy Quran, and are a traditional crop that is supported by the government. Olive oil is widely used among locals, and olives are cultivated both in the Northwest and Northeast of Azraq. Olives are also drought resistant crops. Surface water is used to irrigate olives and barley in small farms [61]. Olives (39%), fruit trees (17%) and vegetables (32%) are the main irrigated crops in Azraq. Fruit trees include peaches, apricots, table grapes, pomegranate and date palm other fruits and vegetables include tomatoes, water melon, melon, eggplant, zucchini, cauliflower and lettuce [61, 103]. Other crops include alfalfa.

Watermelons in Jordan are part of the culinary culture and Jordan exports on daily basis about 400 tonnes of watermelons and melons to mainly Gulf Countries [160]. Due to the significance of watermelons in Jordan, especially during the summer, Architect Hashim

Sarkis, portrayed the importance of watermelons by designing and displaying hills of Amman using these fruits in a design week (September 2016) in Jordan [123]. The cultivation of watermelons, however, requires ample water usage, about 400 liters (100 gallons), which has also contributed to water shortage [118, 119]. May be in this particular context importing watermelons would help in saving water in this water scarce region.

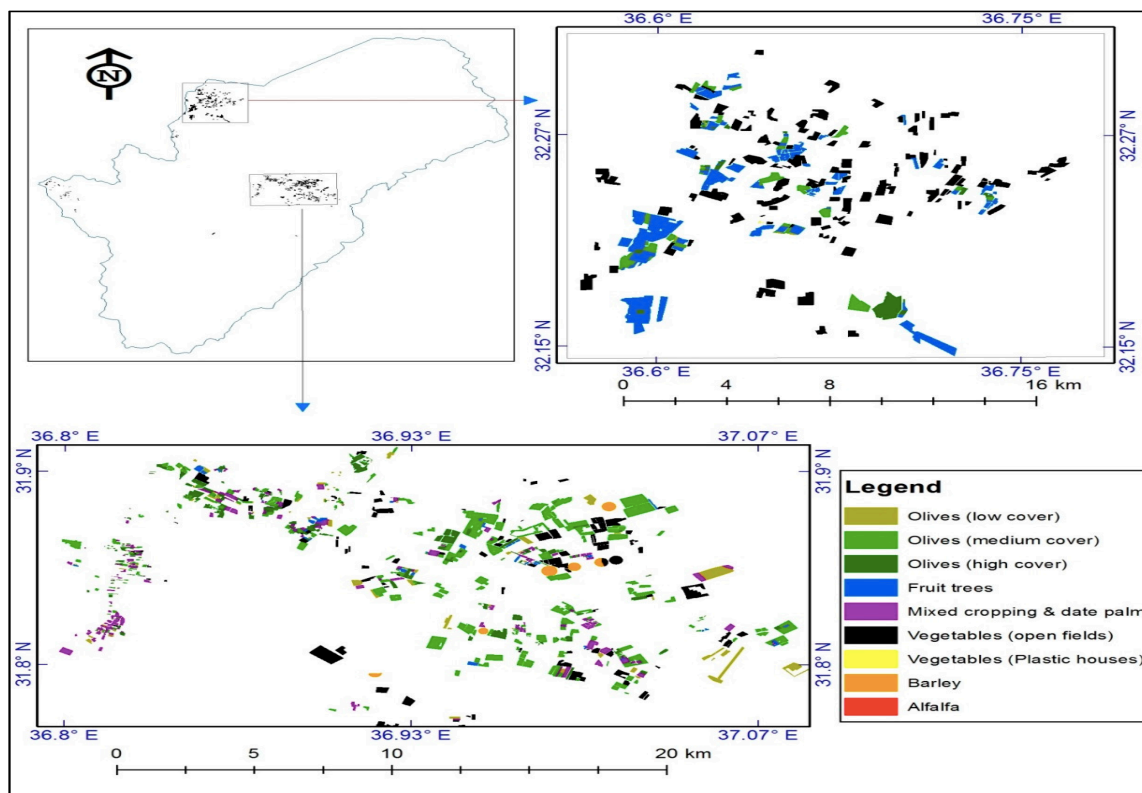


Figure 4.4 Map of irrigation in Azraq Basin from remote sensing data 2014⁹

Irrigation consumes large amounts of water, exceeding safe yields in Azraq. The percentage of over abstraction of ground water in Azraq, including both the agricultural and non-agricultural purposes, is in the astronomical range of 367% [60, 80]. The water extraction alone for agricultural purposes account for about 67 million m³ per year, as per

⁹ Al-Bakri, Jawad, Sari Shawash, Ali Ghanim, and Rania Abdelkhalq. "Geospatial Techniques for Improved Water Management in Jordan." *Water* 8, no. 4 (2016): 132. doi:10.3390/w8040132

the latest figure in 2014 by the Ministry of Water and Irrigation (WAJ) [60]. This indicates a decline and lowering of water table by 20m from 1985 to 2003, during which irrigation was at its boom [60]. It is more imperative than ever that a shift in the attitudes of farmers and locals is required to conserve water in the oasis. Water used as an infinite source for agricultural purposes in Azraq has added significantly to the water shortage problem. Promoting knowledge in cultivating water-resistant crops in Azraq and in Jordan in general is required for conserving water.

Geopolitical significance

As mentioned earlier, the geopolitical aspect of water scarcity cannot be ignored in Jordan. Mark Redwood describes the geopolitics of the MENA region to have an “inadvertent” effect on water scarcity in this region [71]. Jordan, although one of the few politically stable countries in the MENA region, lies in the eye of the Arab cyclone with turmoil in neighboring Syria, Iraq, and Palestine [79]. It has offered shelter to its neighbors not just recently but history dating to the 1920s, show records of when Druze and Chechens migrated from Syria and Russia into Jordan. In particular, Azraq has and continues to provide shelter to refugees that have crossed into its borders.

Architectural Significance

Water has long been viewed as holy in the Middle East. The recognition of water conservation has long been taught, some dating to 1438 years ago through various sayings about not wasting water “Even if were on the banks of a flowing river” (Hadith-Sunan Ibn Majah 425).

Castles

Azraq is known for its castles. The Islamic architecture and Islamic art of these various desert castles serve as a great example that the designs of the past still stand to here today to impress the present, and will be here tomorrow as well for future generations to marvel at. Many of the desert castles are built from limestone and basalt with various frescoes on the inside of their walls. The function of these castles ranged from its use by the army as fortresses for defense, to places of rest, to quench thirst - water reservoirs, leisure, for holding arts and cultural festivals/events, hunting, meetings with other tribal groups, and hospitality for pilgrims and other caravans en route to Mecca and other places. Qasr al-Azraq (Blue Castle) is one of the main fortresses in Azraq, described next.

Azraq Castles

Aside from its rare water source, the other treasure Azraq is known for is its castles, or 'Qsar' in Arabic, and their rich cultural history. Azraq itself has a long rich history dating all the way back to the Paleolithic era. However, the earliest record of the start of the structuring and building of the castles dates back to the Nabatean period. Under the Roman rule in the 3rd century, the castles of Azraq were further established. Qasr al-Azraq (Blue Castle) is one of the main fortresses built during this time, constructed with black basalt stone and almost square, it was initially built by the Romans but then further modified by the Mameluks in the Middle Ages [121, 122]. There are slight indentions at the paving stones of the front entrance, engraved by the guards [122].



Figure 4.5 (a) Azraq Castle – Entrance¹⁰

(b) Azraq Castle – Room Entrance¹¹

The mosque was added in the middle of Qasr al-Azraq after the Roman period. The majority of the castles were built during the time of the Umayyad dynasty from 661-750 A.D. One of the major strategic significance of Qasr al-Azraq, has been their closest proximity to the only oasis for almost twelve thousand miles within an arid desert. The general set up of these desert castles is made up of a bathhouse, agricultural enclosure, a mosque, water reservoir, and a grand space providing not only room for meetings, but also served as a defense for the wide fortress. For example, since the Umayyad period, Qasr al-Azraq served as an important defense fortress, but is most remembered for its use as a defense fort in the 20th century by Thomas Edward Lawrence during the Arab revolt against the Ottoman rule from 1917-1918. The Druze settled in Azraq in the 1920s and occupied Qasr Al-Azraq, which contained a water reservoir that helped them graze cows and goats. Currently, the pumping station is also located near Qasr Azraq.

¹⁰ <https://photographylife.com/what-to-photograph-in-jordan/5>

¹¹ <https://photographylife.com/what-to-photograph-in-jordan/5>

There are many castles along the boundary of Azraq as seen in the map [figure 4.6] below. Amongst the most well known and best preserved castles have been Qasr al-Azraq, Qasr Kharana, Qasr Amra, Qasr Uwaynid, and Qasr Usaykhim, just to name a few. Many of these castles now serve as tourist spots for many who visit, intrigued by the castles architecture, and rich history. Qasr Amra (28 km from Azraq) is famous for being built for the purpose of a luxurious bath house with beautiful mosaic floors in the bathrooms [107]. Qasr Kharana, an isolated rectangular palace, is a well preserved two story castle with shallow cistern in the courtyard indicating limited water supply and lack of bath. It is located 15km from Qasr Amra and 55km east of Amman. The second floor rooms of this castle contains decorative details such as stucco moldings and sculpted plaster roundels presenting beautiful architectural layout. The castles served for defense purposes and private meetings [153].

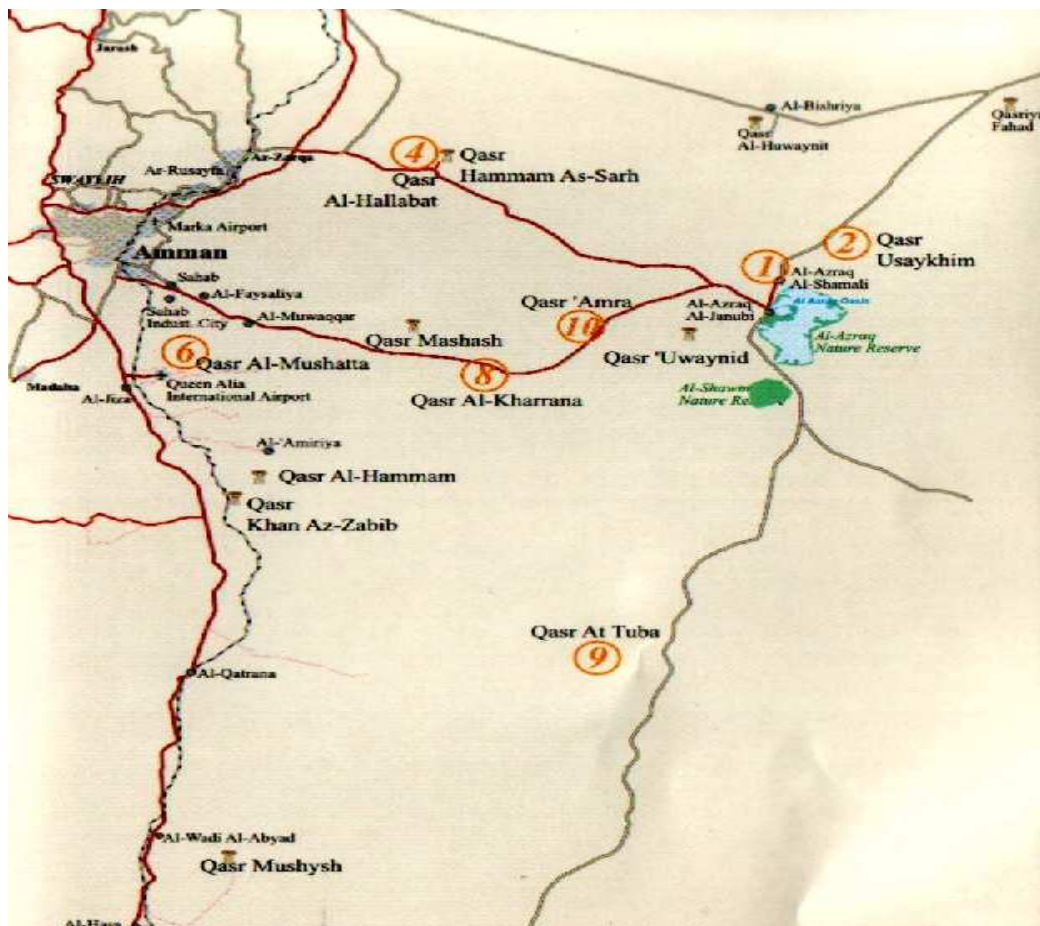


Figure 4.6 Map indicates the castles in Azraq and the castles are numbered¹²

¹² Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), text message to author, November 8, 2016.

Historical significance



Figure 4.7 Diversity in Azraq Pictures from a celebration of World Wetland Day 2014 on Monday, 04.21.2014¹³

The different cultural groups in Azraq play a key role in the consumption of its waters as well as its conservation. Four of these groups, including the locals and immigrant populations have been living in Azraq Oasis for a long period of time. The fifth cultural group is new and consists of the refugees who have fled from the turmoil and war torn zones of Syria and Iraq mainly through Jabel Druze, the mountain situated in the northern border of Azraq. Hence, Azraq is a melting pot of diverse subcultural social groups. Azraq has a modest population of about 12000¹⁴ people not including refugees.

Interestingly, majority of the Azraq's population now consists of Refugees. Approximately, 14000¹⁵, out of which 7000 have settled in various villages and others

¹³ Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), email to author, April 23, 2014.

¹⁴ Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), emails and text messages exchanged with author, October 2012 – August 2017.

¹⁵ Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), emails and text messages exchanged with author, October 2012 – August 2017.

remain in the camps. Azraq has a strong tribal system and as such many ethnic groups are identified through their tribal names beginning with the Arabic word “Banu or Bani.”

North Azraq

Overview

North Azraq, or *Azraq Al Shomali* as it is known in Arabic, houses about 7000 people, the majority of which are from the Druze community, in particular from the Ma’rouf Druze tribe [89]. The Druze are an immigrant population in Azraq that escaped Syria through the Jebel Druze mountain passage during the Syrian revolt against the French in the 1920’s, these Druze who entered Azraq were about 232 rebels from Syria and about 70 other rebels with their families joined them from Lebanon¹⁶[89]. North Azraq mostly comprises of municipal buildings, district offices, a few government offices/agencies, schools, adult and professional educational centers and recreational places such as desert castle and fort [84]. Structurally, it is connected by paved roads, including a junction of roads leading to another town in Jordan known as Safawi town or toward Iraq in the northeast [84, 85].

Druze

Historically, the settlement of Druze in Azraq is quite recent, only dating back to the 20th century when the Druze fled as described earlier during the Syrian revolt in the 1920’s.

¹⁶ Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), emails and text messages exchanged with author, October 2012 – August 2017.

This revolt, famously known as ‘The Great Druze Revolt’, was initiated by Sultan al-Atrash, a Druzi leader of Syrian ethnicity [100]. The British and French had placed orders to prevent any Syrian from crossing the Jordanian border between sunset to sunrise [101]. However, the Druze who had fled to Azraq near the Syrian borders were able to supply food and water to the Syrians fighting in Syria [99]. During this revolt, a mere twenty-two Druze families fled from Syria to the Azraq Oasis, where they took refuge in Qasr Azraq (“Blue” Castle) located near the northern springs, pools and heart of the Azraq Basin. In Qasr Azraq, these families were able to protect themselves against attacks from other tribes in the Azraq Oasis as well as from wild animals in the area [59]. The Druze were responsible for building the first house outside the castle, eventually leading to the village recognizing their presence, such as that North Azraq is also known North Druze [59, 89].

The Druze in Jordan are an important pillar in the formation of the Jordanian Government, such that, in 1921, the first Prime Minister of Jordan, Rasheed Tlei’a, was a Druzi resident of Lebanese descent, who eventually served two terms as Prime Minister [59, 99]. Following tribal tradition, the Druze are called ‘Bani- MA’arouf’ (Tribe of MA’arouf) [59]. Currently, 7000 people are living in the North Azraq village comparing the largest concentration of the Druze community.

The oasis played an integral part for the Druze in this region, providing luscious vegetation, fauna, and water to village and their animals, in particular cows and camels, which they had brought with them. These animals became a source of cheese, yoghurt,

meat and milk [89]. The Druze are known to be loyal to their community and attach themselves patriotically to the land – caring for the native soil, community and territory no matter where they go. The Druze are known to be peaceful, living in the same towns and houses for years without issue [59]. In the sixteenth century, their income relied mainly on silk production [59].

Contribution to the Economy

Given their history of giving back and integrating into their settled community, it is not surprising that the Druze took up influential positions in the Jordanian government and contributed to as well as introduced the salt industry, though at a small scale, in Azraq [89]. In particular, the Druze utilized the salinity of the Azraq Oasis by extracting salt from within its mudflats, resulting in the development of a salt industry, which helped establish Azraq's local economy [89, 102].

This business eventually grew, such that in 1955, the Druze established a savings and loan economic organization and later on in 1973, established the Azraq Cooperative Society, which managed, extracted, produced and distributed salt by taking small loans and savings from the Jordanian government [102, 103]. The Azraq Cooperative Society was a collective effort by the villagers of Azraq to establish the local economy and consisted of about 97% Druze and the rest were Chechens, Minority and Bedouins [89,102]. The salt industry spread to the East of Azraq, where not only a large number of Druze worked but also included Chechens and Bedouins in the workforce. This

developed into a trade market route for trading salt as well as a stopover for the travelers/caravans en route to Saudi Arabia and Iraq [89].

Unfortunately, by the 2000s, the salt industry declined, pushing the Druze to take up positions in the government sector, local organizations or in agriculture, which was not their area of expertise [59]. With a lack of agricultural expertise including no knowledge of growing water-resistant crops and compounded with no policies regulating water resources and land ownership, an excess of water was pumped for inefficient agricultural practices, greening private properties for leisure, as well as for use in illegal wells.

South Azraq

Overview

South Azraq, or *Azraq Al Janubi*, is home to about 3500 people mainly comprising of Chechens, tribal Bedouins, of which the Bani Sakher tribe is the largest tribe to be living in Jordan, along with minorities [84,85]. The Chechens, a group of Muslims who escaped from religious persecutions in Russia¹⁷, came and settled in South Azraq toward the end of the 19th century. The Bedouins settled here mainly for water, pasturing and farming.

South Azraq is at a distance of about 7 km from North Azraq [89]. South Azraq consists of rest houses, including the well known Azraq Lodge and Azraq Rest House, restaurants, and service areas [84]. The Azraq Lodge, which once served as a British Military Field

¹⁷ Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), emails and text messages exchanged with author, October 2012 – August 2017.

hospital in the 1940's, was later transformed by the Royal Society for the Conservation of Nature (RSCN) into an eco-lodge [86]. The Chechens, Bedouins and Minorities of Azraq manage this lodge. In particular, a Chechen family runs the restaurant of this lodge where they offer home-cooked ethnic Chechen food¹⁸ [86]. These small businesses not only provide a source of income for the local community but also attract and promote tourism and ecotourism.

The Azraq Wetland Reserve and the Shaumari Reserve are both located near the Azraq lodge. The Shaumari Reserve breeds wild species, notably oryx, comparatively better than the Azraq Wetland Reserve, where restoration is needed due the shrinking marshes and subsequent declining wild life [87]. As mentioned in the earlier section, the road from South Azraq leads to Saudi Arabian borders in the southeast [84, 85]. This particular route is used for trade and for pilgrims of the Islamic faith travelling for the religious rite of Hajj. South Azraq also contains headquarters for NGOs, agricultural directorate offices, municipality and a few schools for both boys and girls [84].

Chechens

The Chechens (“Shishan” in Arabic) are Muslims from the mountainous area of Chechnya in Russia. Chechen is part of the Caucasian languages [104]. They fled to Jordan in the 19th century from Russia where they were persecuted for being a minority

¹⁸ Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), emails and text messages exchanged with author, October 2012 – August 2017.

and being of the Muslim faith and as such feared oppression of their cultural and religious freedom resulting from the communist revolution in Russia [83, 89, 103].

The Chechen dispersed throughout the Levant; some fleeing to Syria, Turkey, Iraq and some entered Jordan, where they either settled in Zarqa along the Zarqa river, or in South Azraq by the springs. The Chechens integrated very well in the Jordanian tribes and the Jordanians welcomed them as their own [59]. In particular, due to their loyalty to Jordan, which they consider their country, the Chechens are hired in the security forces and army. Quotas have been established to help maintain space for the Chechens to be represented in the Jordanian Government.

Contribution to the Economy

The Chechens brought to Azraq water buffalo, along with practices such as fishing, cattle grazing, hunting as well as bringing with them the traditional Chechen food cuisine. The Chechens currently run restaurants and a popular kitchen in the renowned Azraq Lodge¹⁹. Before the ecological collapse of the Azraq Oasis, the Chechens used to enjoy spacious flourishing gardens of date palms, eucalyptus, tamarix and pomegranates [59, 83, 135]. The Chechens used the Azraq marshes by cutting and drying the reeds for use for either cattle fodder, roof thatching or for establishing what became a market for basket weaving and making mats [83,103,105]. The Chechens also dug ditches to lower the water levels, but this was practiced on a small scale [103].

¹⁹ Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), emails and text messages exchanged with author, October 2012 – August 2017.

The marshes and its ecosystem of Azraq have helped its diverse ethnic groups in establishing an economy for their survival, including but not limited to and depending on the season: salt extraction, reed cutting and drying, grazing cattle [103, 106]. Small scale farming, hunting, and ditch digging are also practiced [103].

Middle Azraq (Hamzeh Quarter)

Overview

Middle Azraq, also known as the Hamzeh Quarter, is home to approximately 1200²⁰ people comprising of the Hweitat tribe of Bedouins and minorities consisting of Kuwaiti and Iraqi families. The minorities settled here after they fled Iraq and Kuwait during the Gulf War of 1992. The Royal Family of Jordan provided these tribes with land and houses. From these minorities, the Zayadi tribe, which is of Iraqi descent, is the most prominent. Their main occupation is trade. The families of the Hweitat tribe of Bedouins came from South Jordan in the 1960s. There are three schools in this area [84, 88]. Middle Azraq is the least populated out of all of the villages in the various sections of Azraq.

Bedouins

The Bedouins, “desert dwellers”, or “Badu” take pride in identifying themselves as true Jordanians [59, 107]. Bedouins introduced the tribal system in the Arab culture, in which the tribe, or “Qabila”, is run on a code of loyalty and honor [107]. The vast majority of

²⁰ Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), emails and text messages exchanged with author, October 2012 – August 2017.

the Jordanian population comprises of Bedouins that mostly live in tents made with black goat hair, called “beit al-sha'ar, (house of hair) [107]. Historically, the Bedouins are known as desert wanders, or “Terhaal”, a set of people who temporarily reside in one location for a few months to graze their animals (sheep, goat or camels) and then move to another location once the fodder is exhausted in that area [107]. These Bedouins usually drive pick-up trucks, which help transport their animals, as well as possess kerosene stoves for cooking and plastic water containers [107].

Bedouins are known for their genuine hospitality and belief of providing help to all travelers that they come across [107]. One of the tourism activities in Jordan involves exploring the Bedouin lifestyle by visiting tents and eating their traditional cuisine called ‘kabsa’, a lamb meat dish with herbs served with rice and garnished with pines and/or nuts and served in a large dish [111]. This meal is traditionally eaten together in a single large dish while seated on floor mats.

A heavy concentration of Bedouins settled in South and Middle Azraq in the 20th Century. They initially came to Azraq to graze their animals [103, 110]. The prominent Bedouins tribes that settled in Azraq are the Bani Sakher, Sirhan, Hweitat and the Rwala tribe [83, 103, 105]. The Bani Sakher tribe would move between northeast to southwest of Azraq for grazing their animals, the Sirhan tribe would graze their animals in northeast of Azraq and the Rwala tribe would graze while passing Azraq enroute to Syria and/or Saudi Arabia [83,103,105]. Their temporary settlement would depend on the rainfall and fodder present in the area [103].

Contribution to the Economy

The Hweitat tribal families started arriving in Azraq from the southern part of Jordan [59]. The Hewitat and the Bani Sakher tribe depend on trade and agriculture in Azraq and have secured positions in the Government as well [59]. The Jordanian Government's permitting private land ownership in the 1960's attracted many of the Bedouins to partially settle. They contributed in cultivating marginal areas with rainfall less than 250 mm [59].

Minority

The minority group consists mostly of Palestinians, Iraqis, and Kuwaitis. They are multi generation as well as single generations. They are fewer in number as compared to Druze, Chechens, Bedouins, and Refugees residing in Azraq. This is the reason for placing them in the minority group. The first wave of Palestinians entered Jordan to seek refugee during the first Arab-Israel war in 1948 [89]. Jordan accommodated these displaced Palestinians [107]. Similarly, Minorities from Iraq have been residing in Azraq since Gulf war in 1990.

Contribution to the Economy

The Palestinians took an active role in the agricultural sector of Azraq and cultivated the empty lands [89,108]. Palestinians were treated equally as the local Jordanians and they took positions in government and participated in the parliament elections in 1950 [107].

Due to the Gulf War in 1990, which lasted until February of 1991, many Iraqis fled from Iraq to Jordan. This included many wealthy Jordanians who had been living in other Arab countries due to the Gulf War in 1990. During this time of displacement, there was an increase in greening the farm landscapes in Azraq [103], however, 90% of these local farms were privately owned by wealthy non-Jordanians [103]. Because many of the owners employed a largely foreign workforce, consisting of mostly Egyptians, these privatized and industrial sized farms didn't benefit the locals, who were relegated to a more isolated, small-scale farming that fueled their own, almost separate, economy [103]. These privately owned farms are located in the North East of North Azraq.

East Azraq

Overview

East Azraq contains large mud flats, salt extraction sites and farms²¹. These farms are mostly privately owned farms and are located in the North East of North Azraq and is known as the 'Al Mazari' (the farms) area – “the farms” --- in Arabic [103]. The land is unlicensed, so the investors have built houses for leisurely purposes. These farms serve as a source of income for Azraqi locals, who have benefited from the influx of foreigners [84].

Water used for agricultural purposes augmented from 1.5 MCM/year (in early 1980's) to around 30 MCM/year in this decade alone [103, 109], showing just how significant the growth of farming was for the people of Azraq. Incredibly, this figure does not even

²¹ Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), emails and text messages exchanged with author, October 2012 – August 2017.

account for the unrestricted and unenforced extraction of water from well digging [103], as a result, the water levels in Azraq were even further depleted throughout this decade.

West Azraq

Overview

West Azraq is home to about 14,000 refugees, and their population exceeds even that of the native inhabitants of Azraq. West Azraq mostly contains refugee camps²², consisting of the Azraq Camp and Zarqa Governate. These camps are located about 25 km away from the native Azraq villages. As of 2016 out of the 14,000 refugees, about half of the refugees (7000) have left these camps either with the permission of the Jordanian Authorities or of their own volition²³.



Figure 4.8 (a) Refugee Camps in Azraq²⁴

(b) Refugees at the Azraq Camp²⁵

²² Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), emails and text messages exchanged with author, October 2012 – August 2017.

²³ Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), emails and text messages exchanged with author, October 2012 – August 2017.

²⁴ <https://www.worldvision.org/about-us/media-center/new-refugee-camp-opens-jordan-syrian-humanitarian-crisis-continues-grow>

²⁵ <https://www.japantimes.co.jp/wp-content/uploads/2016/02/f-syrianrefugees-b-20160202.jpg>

Refugees

The crisis in Syria initially began with peaceful protests by the civilians against the government regime of President Bashar Al-Asad as part of the Arab Spring. However, this quickly spiraled out of control, leading to bloodshed and violence as the government retaliated. This resulted in a brutal civil war in Syria, now considered a humanitarian crisis [92]. As a result of the war, Syrian refugees started fleeing from Syria in 2011 to neighboring countries, and the refugee crisis continues to this day. Jordan opened up its borders for Syrian refugees from the very start of the Syrian crisis. and the Syrians have taken refuge and cities throughout Jordan. The United Nations Commission for Refugees (UNHCR) statistics indicates about half a million Syrian Refugees have entered Jordan since 2011 [93].

In contrast, the Azraq refugee camp only started accepting Syrian refugees around April of 2014 in order to accommodate just a portion of huge wave of refugee populations [90] As previously mentioned, refugee camps in the West of Azraq is a home for 14,000 refugees, more than the number of native residents living in Azraq itself. These camps are located about 25 km away from the Azraq villages. Out of the 14,000 refugees, about 7,000 refugees have left these camps either with the permission of the Jordanian Authorities or on their own responsibility to the urban areas. Those who have left the camps are spread across the Azraq villages, living as tenants²⁶. Their eagerness to leave

²⁶ Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), emails and text messages exchanged with author, October 2012 – August 2017.

the camps is well understood—the Azraq Camp are home to extremely harsh temperatures and living conditions, to top it off the metal structure of the camps and no electricity makes it even more difficult for the refugees to stay. Astonishingly, the water conditions at Azraq and Zarqa are comparatively better than other camp sites like the Zaatari Refugee Camps in Jordan, where they have problems with continuous water supply, leading to a limited amount of the precious resource, causing refugees to have to resort to stealing water [91]. Previously, water was distributed to the campsites by trucks, but now boreholes have been drilled near the refugee camps and wells are used instead.²⁷[96]. Also, a very simple solar system is used that is able to light the caravans only of the refugees²⁸.



Figure 4.9 (a) Refugee Children carrying water in Azraq²⁹



(b) Refugee Children drinking water in Azraq³⁰

²⁷ Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), emails and text messages exchanged with author, October 2012 – August 2017.

²⁸ Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), emails and text messages exchanged with author, October 2012 – August 2017.

²⁹ <http://www.jordantimes.com/news/local/over-half-syrian-refugees-jordan-are-children%E2%80%99>

³⁰ <https://english.aawsat.com/mohamed-al-daameh/lifestyle-culture/azraq-refugee-camp-now-runs-solar-energy>

The stakeholders involved in providing clean water for refugees include the ACTED (Agency for Technical Cooperation and Development), UNICEF (United Nations International Children's Emergency Fund), UNCHR (United Nations Commission for Refugees) and Mercy Corps. The Azraq Camp, which was originally envisioned by the Jordanian Government and the United Nations to be the world's largest refugee camp, stands largely empty because of the harsh living conditions that refugees would have to face. This is yet another example of poor planning and management from not considering the harsh climatic culture of the desert environment.

While the Jordanian government was preparing to open its doors for Syrian refugees, the difficulties that would occur from the spike in water demand due to over population of Azraq was a huge concern in the very beginning. Even before they had opened up its borders to Syrian refugees, Jordan was aware of its dire water needs and were looking into counteracting the severe issues at hand by looking into alternative water sources, and had been unsuccessful. The levels of ground water in Jordan were being extracted much faster than it could be replaced, and thus, were quickly being depleted.

Institutional stakeholder

The Royal Society for Conservation of Nature has, with combined efforts through local, national, international agencies, attempted and continues to try to restore the once flourishing oasis back to life through research, dialogue, planning and management. The key stakeholders in this arena are;

Local Stakeholders:

Their jurisdiction is Azraq Oasis. The local stakeholders include Azraq Cooperative Society, Azraq Municipality, The Friends of Azraq Society, Department of Land and Survey, Azraq Cultural Forum, Azraq Ladies Cooperative Society and Azraq CBOs community-based-organization (CBOs) such as the Al Azraq Shumali cooperative society and Farmers.

Azraq Cooperative Society: This cooperative society originally founded in 1956 comprises of about 85% of the Druze residents. Their main goal is to produce, process, and market salt – manage salt industry but due to lack of resources and poor planning this industry is suffering³¹. This society also contributes in improving and managing the Azraq Oasis.

Azraq Municipality: responsible for water and wastewater management, developing, and implementing policies in Azraq.

The Friends of Azraq Society: endorses environmental conservation, sustainable development, and focuses on promoting economic growth and social welfare for the people of Azraq³².

Azraq Cultural Forum: This forum formed in 1996 is mainly responsible for promoting culture and heritage and organizing culture festivals in the area³³.

³¹ <http://www.druzeheritage.org/popups/1.pdf>

³² <http://al-hakawati.net/english/Environment/azraq-wetland.asp>

Land and Survey Department: deals mainly with property and land tenure issues³⁴.

Azraq Ladies Cooperative Society: focuses on promoting women's contribution to support their families³⁵.

Azraq CBOs community-based-organization (CBOs): empower local residents and farmers and promotes their involvement in agricultural development in Azraq.

National Stakeholders

Their jurisdiction is not limited to Azraq but is spread throughout Jordan. National stakeholders include; *Ministry of Water and Irrigation (MWI) -Water Authority Jordan (WAJ)*; MWI collaborates with WAJ, the Water Authority of Jordan and other water companies throughout Jordan [152]. They generally manage water resources in Jordan, where WAJ mainly deals with planning and managing the basins, and providing all services from drinking water to sanitation to water reuse services to the country.

Ministry of Environment (MoEnv); focuses on improving quality of life, conserving natural resources, formulating environmental impact assessment regulations³⁶, focusing on implementing polices, and improving the wetlands in Azraq Oasis--declared as the Ramsar Convention Site.

³³ <http://www.druzeheritage.org/popups/1.pdf>

³⁴ <http://www.fao.org/ag/agp/agpc/doc/counprof/jordan/jordan.htm>

³⁵ <http://www.druzeheritage.org/popups/1.pdf>

³⁶ <http://moenv.gov.jo/En/AboutUS/Pages/default.aspx#.WP6lfVPyvMI>

Ministry of Agriculture (MOA); deals with livestock and rangelands. It prepares, develops, and protects, grazing plans for rangelands, animal production and animal health³⁷. Data information for the type of crops produced in Jordan along with their water requirements. In Azraq, MOA is responsible for creating guidelines for agricultural production.

Jordan Badia Research and Development Center/ The Higher Council for Science and Technology (HCST); is responsible for conducting environmental and socio-economic research in the town of Safwa³⁸. In Azraq, it is responsible for conducting research on ground water management³⁹.

Arab Women Organization (AWO); responsible for empowering Arab women in gender related projects, raising awareness regarding culture, social, and economic issues in Arab women and are highly invested in helping out displaced and refugee women⁴⁰.

International Stakeholders

They don't have jurisdiction to implement policies but they can conduct studies, provide expertise, and provide financial assistance/aid etc. International stakeholders include

³⁷ <http://www.fao.org/ag/agp/agpc/doc/counprof/jordan/jordan.htm>

³⁸ <http://www.fao.org/ag/agp/agpc/doc/counprof/jordan/jordan.htm>

³⁹ <http://www.badia.gov.jo/>

⁴⁰ <http://english.arabwomenorg.org/>

International Union for the Conservation of Nature (IUCN), The United Nations Development Program (UNDP), The United States Agency for Development (USAID), ACTED (Agency for Technical Cooperation and Development), UNICEF (United Nations International Children's Emergency Fund), UNCHR (United Nations Commission for Refugees) and Mercy Corps.

The stakeholders involved in providing clean water for refugees include the ACTED (Agency for Technical Cooperation and Development), UNICEF (United Nations International Children's Emergency Fund), UNCHR (United Nations Commission for Refugees) and Mercy Corps.

Donors

Donors include IUCN Water and Nature Initiative (WANI), Italian Ministry of Foreign Affairs (DGCS), European Union (EU) and Global Environmental Facility (GEF).

Each stakeholder plays a critical role in helping to conserve water in the Azraq Oasis. As Jordan is a nation with many competing needs, the funding from the International stakeholders would be essential and directed for the use of water management. The International stakeholders are also in a position to provide their expertise to benefit the Azraq area in terms for conserving and managing their water resources. The National stakeholders need to use the funding and expertise to create policies that can be implemented in the culture of Azraq. The local stakeholders are critical to implement the policy and be able to manage the implementation of the policies.

Together all the stakeholders are then able to help water usage in a way that is customized for Azraq Oasis that takes into account the ethnic and cultural diversity specific to this place.

The following chapter, analyzes the internal statistics and the impact of the four culture parameters (Knowledge, Attitude, Behavior and Feeling) on water conservation in a village of Azraq with these different sets of population groups (Druze, Chechens, Minorities, Bedouins and Refugees). It assesses as to how can these social groups help towards water crises? For this, surveys were conducted and these issues are discussed in length in the next chapter.

Chapter 5 : Cultural Analysis

The literature review on water conservation in Azraq reveals that there is limited data that explains the influence of the cultural groups on water conservation in Azraq, especially with the recent refugee immigrant population entering Azraq. As such, this thesis sought to study the factors impacting cultural aspect of water conservation. In order to study these factors, I created a survey, which captured the daily practices of water conservation among different social groups.

I collected data on Knowledge (cognitive dimension), Attitude dimension, Behavior (active dimension) and feeling (affective dimension) towards water use and conservation from five different ethnic cultural groups -Druze, Chechens, Bedouins, Minority and Refugees residing in Azraq and studied which of those significantly impact daily water use and conservation in Azraq. For example, one question is whether the use of certain technology or the refusal to use grey/recycled water is based on sentiments, feelings (affective dimension), on attitudes towards conserving water, on behavior concerning water use (active dimension), or on a combination of these dimensions. Furthermore, the influence of knowledge (cognitive dimension) on the three other factors has to be accounted for. As such, the survey captured all of the four cultural dimensions.

Hence the research questions answered in my thesis are;

1. How does the current water shortage influence the daily water conservation practices in Azraq?
2. What factors significantly have an impact on the four cultural dimensions of water conservation in Azraq?

Methodology

I collected data for my thesis using qualitative methodologies; specifically, surveys. In particular, methods outlined by Babbie (2010, twelfth Edition) in ‘Survey Research Methods’ as well as ‘The Basics of Social Research’ were used to develop, distribute and analyze the surveys.

Survey Development:

Laureano et al. [124] proposed to classify cultural factors into four dimensions, called cognitive dimension (Knowledge), conative dimension (Attitude), active dimension (Behavior) and affective dimension (feeling) dimension. As mentioned earlier, I designed the survey with questions capturing the following cultural factors, which are grouped into the four dimensions and they are cognitive (knowledge) dimension, attitude dimension, behavior (active) dimension, and affective (feeling) dimension.

In addition, the survey questionnaire included the following demographic variables:

- Names: in order to ensure that the same person was not surveyed twice, the survey collector recorded the names
- Gender: While it is expected that the survey respondents will mostly be male, this variable was still captured.
- Cultural Affiliation: Azraq contains many different sub-cultural groups. The survey collector, Mr. Hazem Khreisha, the manager of the Royal Society of Conservation for Nature (RSCN) and his staff recorded each sub-culture group the survey respondent belonged to. More specifically, the following sub-cultural groups were targeted: Druze, Bedouins, Chechen, Refugees, and Minorities (old

Azraq inhabitants - Palestinians, Iraqis, and Kuwaitis). As such, five different sub-cultural social groups were surveyed.

- Geographic locations: Azraq is divided geographically into thirds of segments according to population concentration in village areas: the ‘North Azraq (Azraq Al Shomali)’, ‘South Azraq (Azraq Al Janubi)’ and ‘Middle Azraq’. Refugee camps are located in the west of Azraq, with an estimated population of about 14,000 refugees from Syria. About 7000 of the refugees escaped from camps and are now scattered in the villages of the Azraq (in the North, South and Middle of Azraq), either with the permission of the Jordanian authority or at their own responsibility ⁴¹. The survey also captured the geographic location of the survey respondent.

Survey data collection from Azraq:

Mr. Hazem Khreisha manager at the Azraq Wetand Reserve of the Royal Society for the Conservation of Nature (RSCN), and his staff helped in recording the surveys manually. Sami Tarabieh, Protected Areas Management Specialist, also provided information and documents to help facilitate information about people of Azraq.

The Managers are in a unique position, as they have worked in the field and constantly come across the water problems and issues that are faced by the people of Azraq, so they have a deep level of understanding of the individuals that they are surveying.

⁴¹ Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), emails and text messages exchanged with author, October 2012 – August 2017.

Furthermore, they are aware of the technical limitations and policy constraints that also must be taken into consideration. As such, I interviewed and continuously stayed in touch with these managers from Boston using texts and emails phone calls, in order to obtain their perception and understanding of the current landscape and for obtaining the survey data.

Survey Distribution and Collection

It took about three months for the conduction of the surveys manually. The manager and his staff had to translate the survey in Arabic and then conduct the survey in Azraq. I sent the English version of the final surveys even though the staff translated the survey in Arabic but they used the English version survey. I received the completed surveys with the names of the individuals on them via emails from the manager. The manager took consent from each individual before conducting the survey as per my request.

The survey was distributed to target at least 20 people within each sub-cultural group. The Manager was requested to travel to the four geographic locations (North, South, Middle and West Azraq) and within each location, to find and survey respondents. In total, 97 surveys were collected from all 5 five social groups from different segments of Azraq. The survey questionnaire included;

- Demographic characteristics of the respondents; included their age, gender, income, education and number of household members
- The four cultural parameters (Knowledge, Attitude, Behavior and Feeling)
- Out of the total sample (n=97) of survey respondents, 11 were farmers.

- Survey is attached in the appendix A
- The exact cost of data collection from Azraq totaled the amount of \$735.

This cost of data collection was covered by my personal funds.

Survey Collection Challenges:

The biggest challenge was that very few females responded to the surveys and the majority were males. It was difficult to get surveys answers from females. It is unclear if it was because of cultural reasons, if they did not have available time, or were if they hesitant in providing personal information. It would have been interesting to compare the response on conserving water from women of different tribal sub-cultural groups. Studies have indicated that gender in conserving water plays a huge rule [125]. Zelezny et al described in their study that women, as compared to men, related greater affinity towards environmental attitudes and behaviors, and they have higher levels of socialization and are also socially responsible [127, 150]. Women play an important role in saving water as they mainly manage the household.

The other challenge team conducting the survey faced was getting permission to enter the refugee camps. A special permit was required to enter into the refugee camps located on the west of Azraq, which was a hurdle that would have further delayed the survey response collection time. This problem was tackled by getting the surveys filled out from the refugees who had left their camps, and were residing in the villages as tenants. The reason for their leaving is believed to be the harsh climatic conditions at the campsite.

As informed by the Hazem Khreisha, the manager via email:

“Conducting surveys was really difficult and needed time and efforts. I did not expect that much and have coincided with bad weather depression in the area and sometimes I resort to call them and sometimes meet with them. I distributed some survey to two of my staff to assist me to achieve them on time as scheduled in turn I will also reward and compensate them for that. There was also some problems with transportation to houses and families because they live in different places in the area that's why we rented cars.”⁴²

Survey Data Analysis:

The survey data files were entered into an excel sheet. I used the statistical package for social sciences (SPSS version 2007) to analyze the survey data and compare the difference between the five different social groups residing in Azraq.

The first step in the analysis was to understand the frequencies of each variable in the survey dataset. The frequencies showed the variations in the dataset and also showed how many individuals actually answered each question in the survey. A table with all the percentages of the cultural aspects and the demographics of the survey respondents was created using crosstabs in SPSS (Table 3). The survey had questions regarding the four cultural aspects of water conservation in Azraq Oasis. The internal consistency (reliability) of these questions in each cultural group was measured by creating a scale for each cultural aspect. The Cronbach Alpha's test (reliability test for the scale) was used to evaluate if questions (item) in each group were related and had any correlation, and if the questions in each cultural group are measuring the same construct.

The second step was to create a scale for each of the four cultural domains (Knowledge, Behavior, Attitude and Feeling). For this, the questions in each group that showed higher

⁴² Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), email to author, January 5, 2016.

cronbach alpha value were used to create scales for each cultural domain. The variables (questions) in the survey were collectively checked for correlations between each other. The variables that did not show any type of correlation were taken off from the analysis. Once it was confirmed that the variables in the analysis aligned and hang with each other, then the scale was created for water conservation for each of the four cultural domains (knowledge, behavior, attitude and feeling). The survey questions that asked the respondents about their knowledge, their attitude, their feeling and their behavior for conserving water were collectively viewed to create the scales. The scale for each cultural domain would include only the questions that would measure that particular construct. The scale for each cultural area was validated using the cronbach alpha test of validity as mentioned earlier. The values of cronbach alpha (>0.7) for each scale confirmed that the questions that were included in the scale did hang together and did measure the same construct. These scales were then used as dependent variables to build the generalized linear regression models. The independent variables were the social demographics (Age, Gender, Income and Education) and the five social groups in these models (Table 5.5). The four regression models representing the four cultural domains also estimated the R^2 and F values along with the significant p values. Generalized linear regression was specifically used, since the dependent variables in all 4 models are continuous and not binary variables. A generalized linear regression method is also useful here because some of the dependent variables scales do not have a normal distribution and is instead skewed. The distribution/frequency of the knowledge and attitude scales are skewed towards left (Figures 5.1, 5.2) while the distribution of the behavior and the Feeling scales are skewed towards the right (Figures 5.3, 5.4 below).

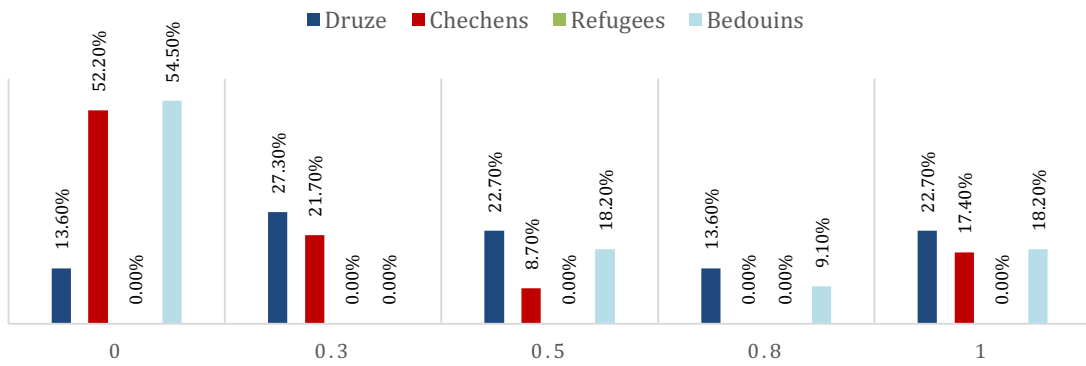


Figure 5.1 Knowledge Scale

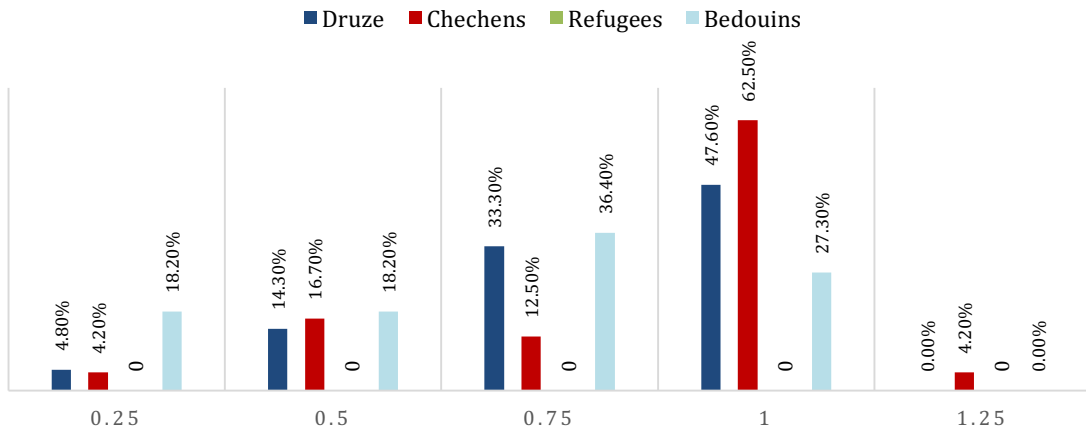


Figure 5.2 Attitude Scale

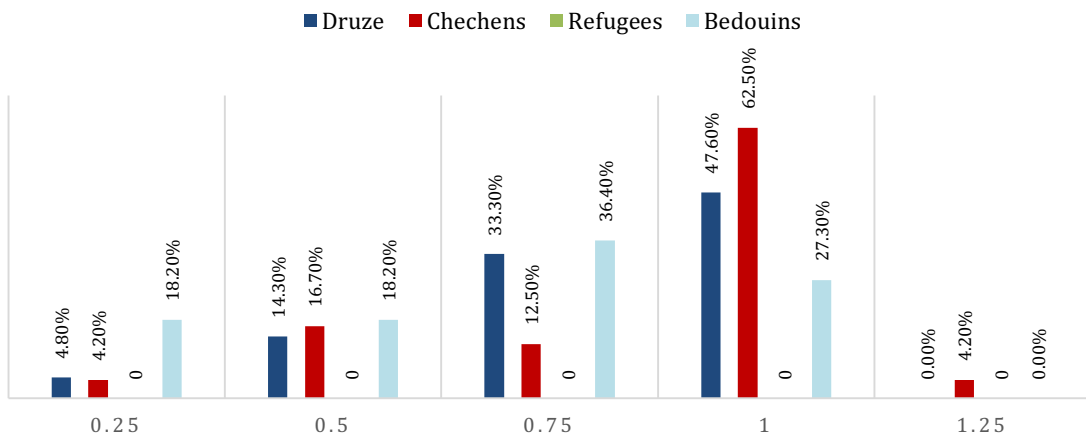


Figure 5.3 Behavior Scale

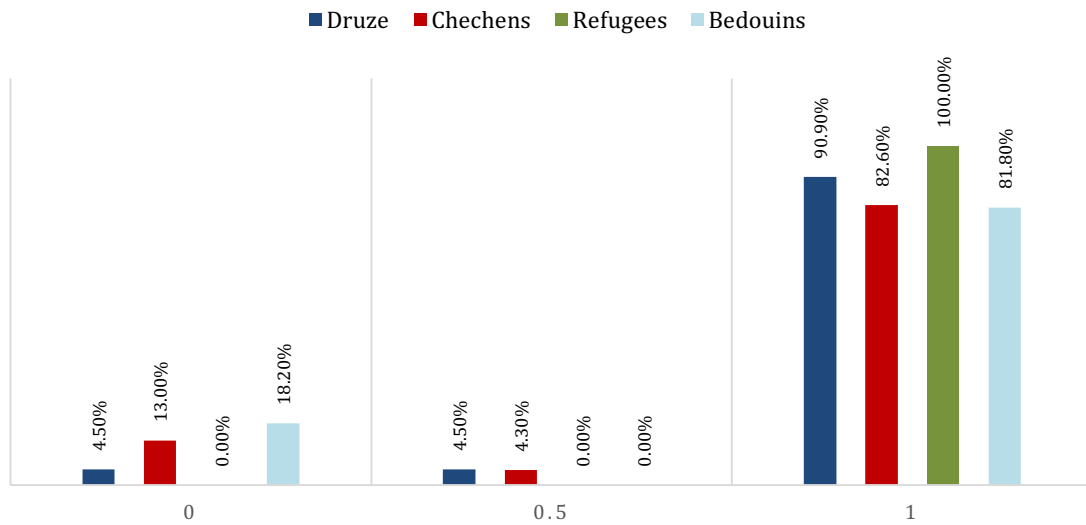


Figure 5.4 Feeling (Affective) Scale

The idea here is to analyze and study the potential factors affecting the cultural aspects of water conservation as mentioned earlier. This would help to strategize and better manage the cultural aspects of managing water in Azraq - this cultural aspect of water conservation has long been taken much too lightly and it does not get the attention it requires.

Results

Demographic Characteristics:

A table with all the percentages of the cultural aspects and the demographics characteristics of the survey respondents was created using crosstabs in SPSS (Table 5.1). The demographic characteristics included gender, age, education level, income and location of their residency (South, North or Middle Azraq). The survey indicated that the 23% of the Druze responding to the survey resided in the North Azraq, 23% of the

Chechens were residing in the South Azraq, Bedouins and minorities were from North, South and Middle Azraq, whereas the 9% of the refugees resided in North of Azraq, and the rest were scattered over the rest of the villages.

Age of the local survey respondents ranged between 23 years to 68 years old. Farmers were between 38 years to 68 years old. 8% of the Refugee in the survey respondents were females. In the survey, 22% of Chechens respondents were men. Similarly, 17% of Druze respondents, 10% of Bedouins respondents, 21% of Minorities respondents, and 9% of the refugees were also men in the survey.

Only 11 farmers participated in the survey. Out of the 11 farmers 4 were Druze, residing in the North Azraq. 3 of them belong to the Chechens groups from South Azraq, 3 of them were minorities from North Azraq and 1 belongs to the Bedouin tribe from North Azraq. The education level was very low. Almost all of the respondents only had high school education or less, very few had college education. 10% Druze, 15% Chechens, 14% Bedouins, 14% Refugees and only 5% of the Bedouins had completed their high school or had less education than high school. The income of the villagers of Azraq lies in the range of medium to low class. 10% of the Druze and 12% of the Chechens belong to the medium earning class whereas the 16% Refugees are poor and don't earn as shown in table 5.1.

There was an open-ended question in the survey regarding water prices or paying for water, which was grouped in two categories, local villagers and farmers. The locals paid

between 30 to 70 JD (Jordanian Dinar) per six months (\$42 to \$98 per six months), a few elderly villagers in their late 60's responded that they don't pay anything, whereas farmers paid somewhere between 400 to 2000 JD per three months (\$564 to \$2820 per three months) and between 800 to 4000JD per six months (\$1127 to \$5636 per six months).

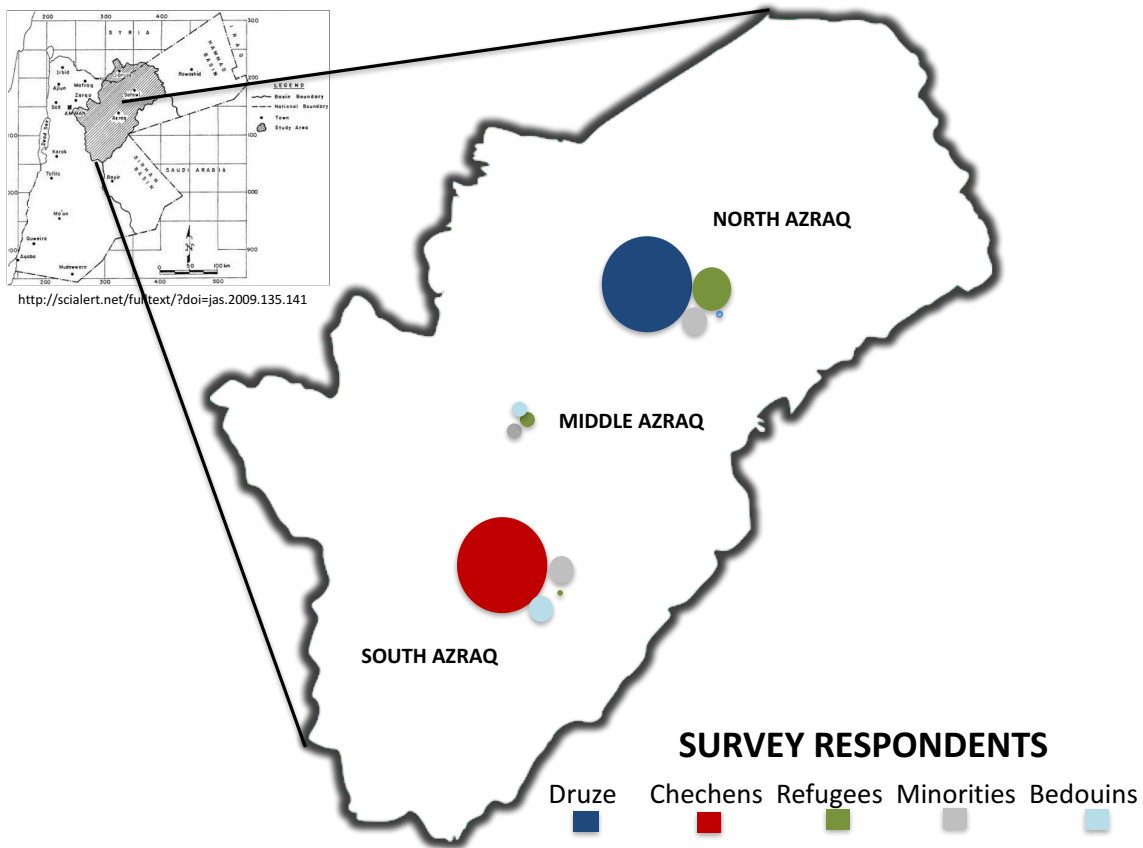


Figure 5.5 Survey Respondents; 23 respondents were from Druze community (all from North Azraq), 23 Chechens respondents were from South Azraq, 18 Refugees responded (9 from North Azraq) (2 from South Azraq) (4 from Middle Azraq) (3 didn't indicate their location), 12 Bedouins (2 from North Azraq) (5 from South Azraq) (3 from Middle Azraq) (2 didn't indicate their location), and 21 Minorities responded (7 from North Azraq) (11 from South Azraq) (3 from Middle Azraq).

Table 5.1: Demographic Characteristics of Respondents of Five sub cultural groups (Percentages %)					
	Druze	Chechens	Bedouins	Minorities	Refugees
Location					
North Azraq	23	0	2	7	9
Middle Azraq	0	0	3	3	4
South Azraq	0	23	5	11	2
West Azraq	0	0	0	0	85
Gender					
Female	5	2	1	0	8
Male	17	22	10	21	9
Income					
Rich	4	2	3	2	0
middle class	10	12	4	6	0
low middle class	6	10	3	10	1
Poor	1	0	1	3	16
Education					
High school or less	10	15	5	14	14
Some college	3	3	2	1	1
College	2	3	2	3	1
University Level	7	3	2	3	0

Daily Practices of Water Conservation in Azraq

Knowledge about water conservation:

The perception and awareness level of water shortage in the Azraq community among different social groups is shown below in table 5.2. It is indicated that 77% of the Druze, 80% of the Chechens, 86% of the Minorities and 64% of the Bedouins seem to have an understanding about water coming out of their taps.

As far as the source of water is concerned, everyone seems to understand that how water gets into their taps is through wells – 18% of the Druze, 17% of the Chechens, 10% of the Minorities and 37% of the Bedouins believe water comes from wells. Everyone seem to have little bit of information about this except for Refugees as they know they have water coming from taps but are not aware of the source (see table 5.2 below). In terms of awareness of the water organizations, 59% of the Druze are aware of the organizations dealing with water related issues and 32% of them have information of the players involved in water sector in their community.

Knowledge Statement	Druze	Chechens	Refugees	Minorities	Bedouins
I think I have enough water to use in daily basis	55	68	77	70	60
I think water shortage has any effect on me or individuals in my household	91	71	47	48	64
I am aware of any ways in which water is conserved in my area?	82	42	65	33	35
I have tried to reduce the amount of water you use on the basis of any water saving programs?	41	38	0	43	27
I get my water from taps	77	80	100	86	64
I get my water from wells	18	17	0	10	37
I think farmers are trained or given technical training before handling new irrigation technologies	5	8	0	4	0
I am aware of my local water management polices/ schemes	31	21	0	19	27
I have knowledge about the organizations that control the water related matters	59	25	0	19	46
I am aware of the group of players involved in the water sector of your area (irrigation communities, hydrographic confederation etc)	32	17	0	24	27

Out of the all groups, 24% Refugees indicated that water conservation is not a very important issue but 64% of them agreed it is an important issue. Similarly, 94% of the Refugees are under the mindset that no restriction should be placed of any kind to enforce water conservation, whereas 73% Bedouins were somewhat in the range of agreeing that

conserving water is a very important issue, but at the same 64% of them agree that voluntary restrictions can be placed for saving water, but it should not be mandatory. Just like Bedouins, 63% of the Chechens were also in the range of agreeing with water saving, being that it is a very important issue, but 45% of the Chechens have their perception is that it would be helpful to get financial assistance from the government so that water efficient technologies can be purchased (Figures 5.6, 5.7). Also, 77% of the Druze on the other hand seems to have positive awareness level about conserving water, and at the same time 59% of them have an opinion that Government can place voluntary restrictions to save water. Among Minorities, 43% of them recognize that water conservation is a very important issue but 33% of them agreed that there should be no water restrictions to save water.

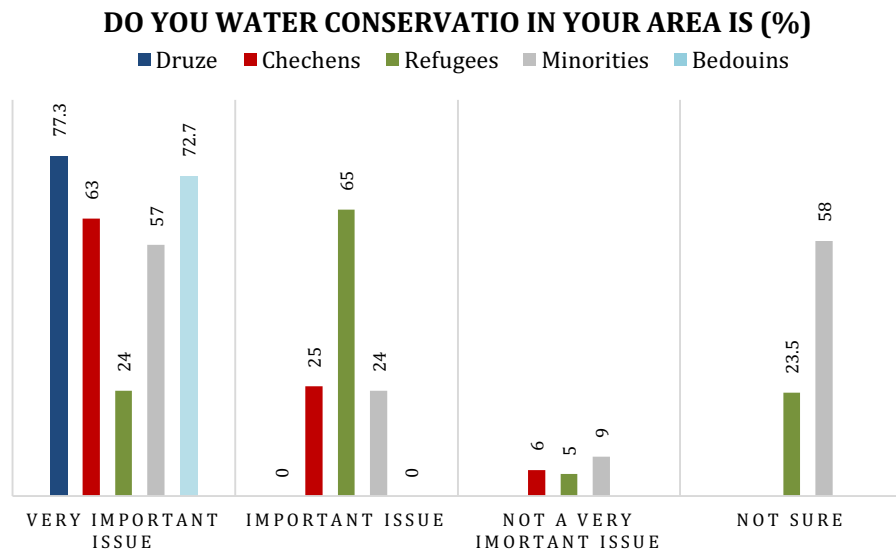


Figure 5.6 Perception of Residents of Azraq about Water Conservation (%)

APPROACHES TO WATER CONSERVATION IN YOUR AREA (%)

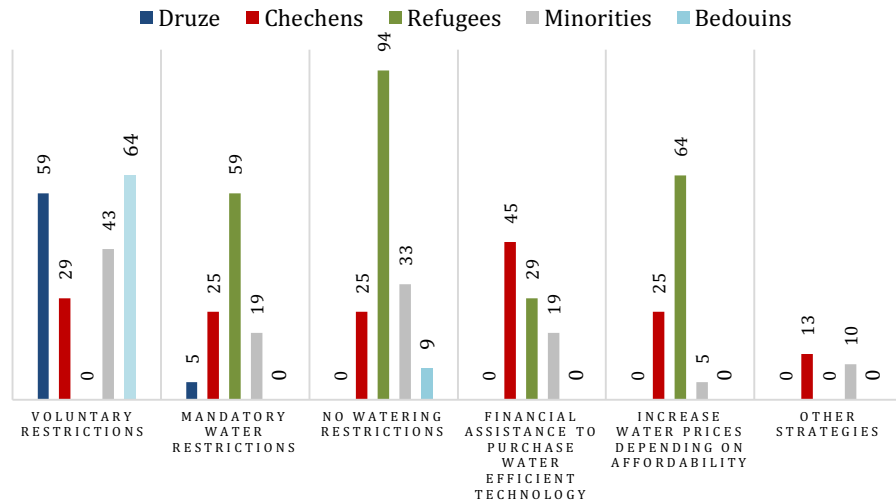


Figure 5.7 Perception about approaches to Water Conservation among residents of Azraq (%)

Attitudes about water conservation:

Table 5.3 below illustrates the attitudes of five sub cultural groups in Azraq about conserving water through their statements and this shows their difference of opinion, the level of agreement and disagreement about this pressing issue that is faced by Azraq. All the five sub cultural groups – 91% Druze, 80% Chechens, 95% Minorities, 100% Refugees and 91% Bedouins indicated strong positive attitudes towards conserving water. They agree that conserving water is important, that this problem affects them, and that themselves should make efforts for conservation, and it is an area where attention is needed. However, the one disparity is that the refugee’s respondents agreed as much as the others that water conservation is needed and is important, but they don’t believe that it is their responsibility to conserve water. At the same time, 71% of them strongly indicate though it is not their responsibility they still save water wherever they can. Interestingly, 46% of the Bedouins tend to agree more that conserving water highly

depends on location, whereas Druze, Chechens, Minorities seems to somewhat disagree, but Refugees completely disagree. All of the five sub cultural groups don't agree that conserving water alone will diminish all water problems. Druze and Chechens don't feel pressured to conserve water, whereas others don't agree with them.

*Attitude Statements	Druze	Chechens	Refugees	Minorities	Bedouins
I am positive about water conservation	91	80	100	95	91
Water conservation is necessary because of water shortage	73	63	82	71	91
Water conservation isn't my responsibility	36	50	0	48	64
I am not concerned at all about water conservation	18	25	12	19	18
More attention is needed for water conservation	73	58	29	43	64
I advocate water conservation among my family and friends	23	21	6	19	27
Water shortage issues don't effect me	9	4	0	5	0
I conserve water wherever I can	36	42	71	43	36
I feel no pressure to conserve water at the moment	18	17	6	5	9
I only conserve water if water conservation does not inconvenience me	9	4	0	24	9
I only conserve water if water conservation does not cause additional expanses for me	9	4	0	5	18
I only conserve water if water conservation does not take more time	9	4	0	24	9
The need for water conservation depends on location	23	36	0	39	46
It is a challenge to convince others to conserve water	23	21	12	4	18
I could make more effort to conserve water	14	21	12	19	18
Water conservation is important	77	86	94	91	91
Water conservation ALONE can save water problems of my country	5	4	0	10	9

*Attitude statements taken from M. Gilbertson et al "does water context influence behavior and attitudes to water conservation" March 2011

Behavior about Water Conservation:

There was an open-ended question for farmers in the survey regarding if they were using any techniques for conserving water in farming. To this almost all the farmers responded they use drip irrigation; about 23% of local respondents of Druze, 29% Chechens, 9% of

Bedouins and 14% Minorities indicated they use drip irrigation. Drip irrigation is highly effective in applying water directly to the soil, so the water losses due to runoff and evaporation are less compared to sprinklers, but sprinklers cover a larger area [145]. For watering gardens outside their homes, about or more than 50% of all social groups indicated they use handheld hose for watering lawns/gardens. It is unclear if the survey respondents used a nozzle when they use hand held hoses. Refugees didn't respond to this question (Figures 5.8, 5.9). Again, this doesn't come as a surprise because Refugees have recently come to Azraq and are adjusting to the environment. Almost all of them agreed that the quality of crop that they cultivate is good (Figure 5.8).

Also, all of the them agreed they have water meters and they pay for water except for Refugees which make sense as they are newcomers in Azraq and are in the phase of settling down and coping up with the difficulties they have and are facing. Also, 64% of the Druze, 71% of Chechens, 46% Bedouins, 43% minorities and only 6% refugee indicated they tend to save water at home. It is interesting to note that 53% of the Refugees showed their willingness to make efforts to conserve water in the communities (table 5.4). This could be true, as they can't conserve water within a larger community since they are not fully settled, but they have the potential of promoting efforts to conserve water in community once given a chance. They all seem to make efforts to save water at their homes and Chechens (71%) seems to be making the most effort and 14% of them save water from sinks /showers/baths for other uses and 8% of them use rain water tanks for storing water. Refugees (35%) indicated that don't know how to store water. Also, 86% of the Druze responded that they make sure their taps don't leak and use

dishwashers only when they are fully loaded. Only 6% Refugees said they have washing machines and 18% of the Refugees dont wash their clothes less often and 88% of them use bucket to take bath (table 5.4).

WHAT TYPE OF WATERING SYSTEM DO YOU USE (%)?

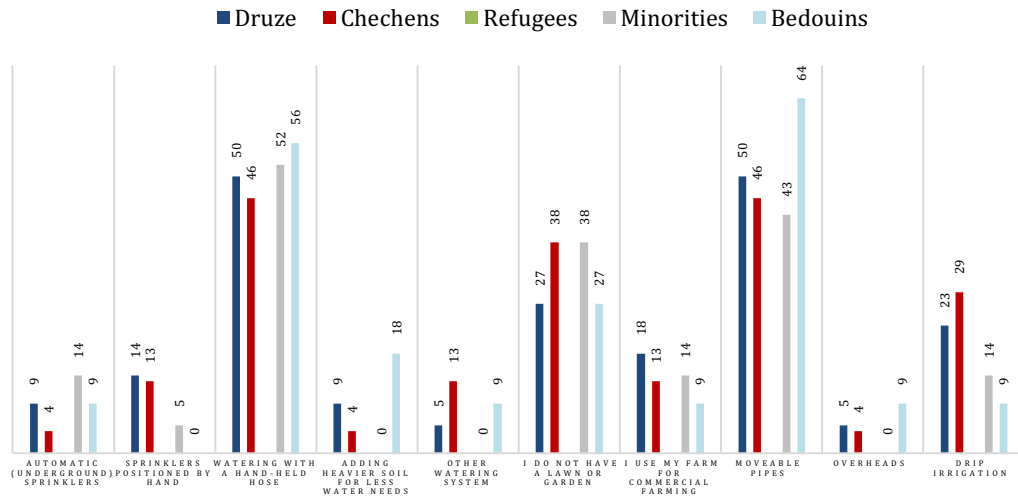


Figure 5.8 Type of watering system used (%)

WHAT IS THE PURPOSE OF CROP PRODUCTION (%)

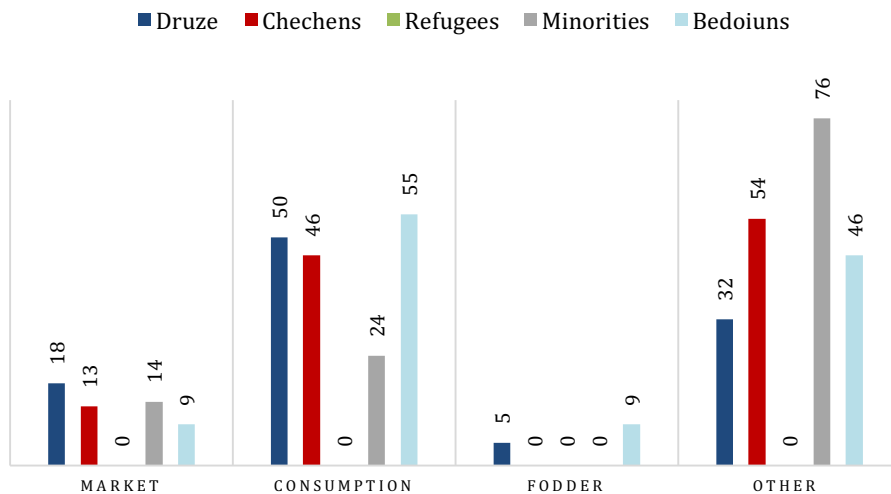


Figure 5.9 Production and condition of crop cultivated (%)

Table 5.4 Behavior towards water Conservation between five sub Cultural Groups (Percentages %) (n=97) [3]					
Behavior Statements	Druze	Chechens	Refugees	Minorities	Bedouins
	Yes %	Yes %	Yes %	Yes %	Yes %
Do you have water meters?	96	83	0	100	91
Do you pay for water?	96	88	0	100	82
Do you save water at home at all?	64	71	6	43	46
Do you make efforts to conserve water in your community?	41	36	53	18	9
*How do you store water					
I have rain water tanks	0	8	0	5	18
I store water from showers/sinks/bath for other uses	9	14	0	5	0
I don't know	14	0	35	23	0
Do you have any water-efficient technologies for example:					
Water –efficient Dish washer	41	13	0	19	27
Water –efficient Washing machine	77	46	0	67	82
Water –efficient Taps	46	47	0	29	36
Water –efficient Shower heads	9	8	0	10	0
I don't have any of the above technologies	14	38	0	24	18
*I make sure taps don't leak					
I use dishwashers when full only	36	13	0	14	27
I don't have a dishwasher	0	4	0	0	0
Water in your household get recycled	5	4	0	5	0
I don't use recycled water	82	88	0	91	100
I close taps when brushing your teeth	77	88	0	62	73
I water my garden once per week or less in summer	73	71	53	6	64
I use rain barrel	5	0	0	0	9
I grow native/ drought tolerant plants	14	17	0	5	0
I have low flow toilets	9	0	0	5	0
Hand wash clothes	5	0	82	10	0
Use washing machines for washing clothes	96	92	6	81	82
Wash clothes less often	9	8	18	14	18
Use bucket water to take bath	5	0	88	5	18
Use head shower for taking a bath	95	100	12	27	82
*Behavior statements taken from M. Gilbertson et al "does water context influence behavior and attitudes to water conservation" March 2011					

Feeling towards water conservation:

All seem to agree that that they worry about water shortage – Druze 96%, Chechens 88%, Refugees 100%, Minorities 86% and Bedouins 82%, (Figure 5.10) and the quality of

water is their primary concern (91% Druze, 86% Chechens, 77% Refugees, 76% Minorities and 64% Bedouins), as opposed to quantity and water price (Figure 5.11). Similarly, all social groups appear to agree on the fact that water prices are somewhat high except, for 59% refugees who consider the water prices to be in the normal average range (Figure 5.12)

Data also indicates that all sects – 82% Druze, 83% Chechens, 71% Refugees, 86% Minorities and 82% Bedouins, seem to have a neutral feeling about using recycled water and are fine using mainly for agricultural purposes, as seen in Figure 5.13. At the same time they exhibit concerns about quality of water, which is consistent with the study that was conducted in 2003 by Abu-Madi et al., which indicated that farmers in Jordan proved unwilling to pay more of reclaimed wastewater, primarily because of quality concerns and price [72], but the difference we see now is in the price; they agree that price for using recycled water is not high, and are now willing and are using recycled water, irrespective of the price issue for agricultural purposes. However, at the same time, quality of water concern is still there, although more because of general health.

Survey indicated that farmers from all sub cultural groups have no issue in using recycled water for agricultural purposes. About 18% were afraid to use recycled water, 18% expressed their concern of finding it difficult to use it, and 9% were concerned if using recycled water would bring the expenses down. Some farmers had multiple concerns, but interestingly very few only 10% thought it was against their religious beliefs.

The study conducted in 2003 indicated that 75% of the farmers were in agreement in using unrestricted reclaimed water for irrigation purposes [72], whereas our survey captured that 82% of farmers agreed in using recycled water for agricultural purposes (see figure 5.15).

Also, 47% of the Refugees seem to be hesitant in using recycled water. This is consistent with their knowledge of water shortage, that is lack of awareness about the water scarcity as well as lack of knowledge on the ways to restore water. Survey also indicated that they have concerns about quality of water and are afraid to use recycled water. For instance, survey indicated that 59% of them are concerned if using recycled water will bring the cost/expenses down and 71% expressed their feelings about difficulty in using recycled water. Also, 18% of Bedouins, 25% of Chechens and 27% of minorities alike express their feeling of using recycled water being difficult to use, and if anything, this will bring the expenses down (Figure 5.14). None of them seem to be satisfied with water agencies services (18% of Druze and Bedouins, 46% of Chechens, 24% of Minorities), except for refugees (69%) they seem to be satisfied as compared to other groups (Figure 5.16). It should be noted that these refugees are coming from war torn zones, and for them it is not an issue.

ARE YOU WORRIED ABOUT WATER(%)?

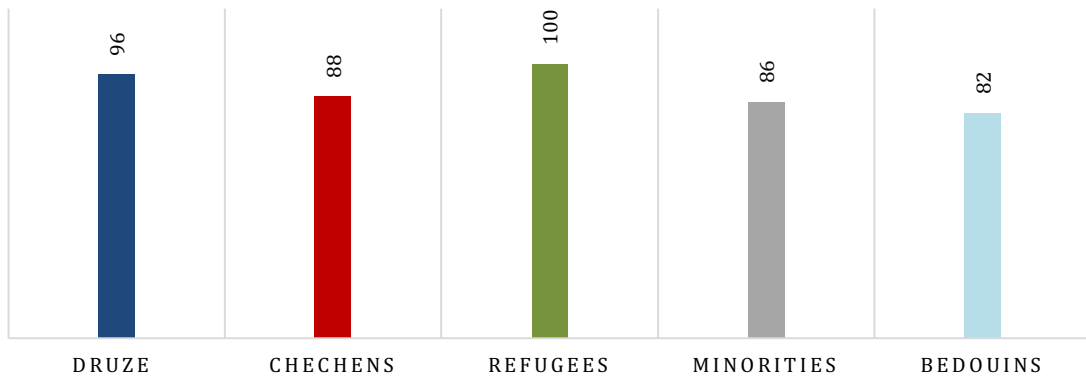


Figure 5.10 Worry about water shortage (%)

WHAT DO YOU VALUE THE MOST ABOUT WATER (%)?

■ Druze ■ Chechens ■ Refugees ■ Minorities ■ Bedouins



Figure 5.11 what is valued the most in water (%)

THOUGHTS ON PRICE OF WATER (%)?

■ Druze ■ Chechens ■ Refugees ■ Minorities ■ Bedouins

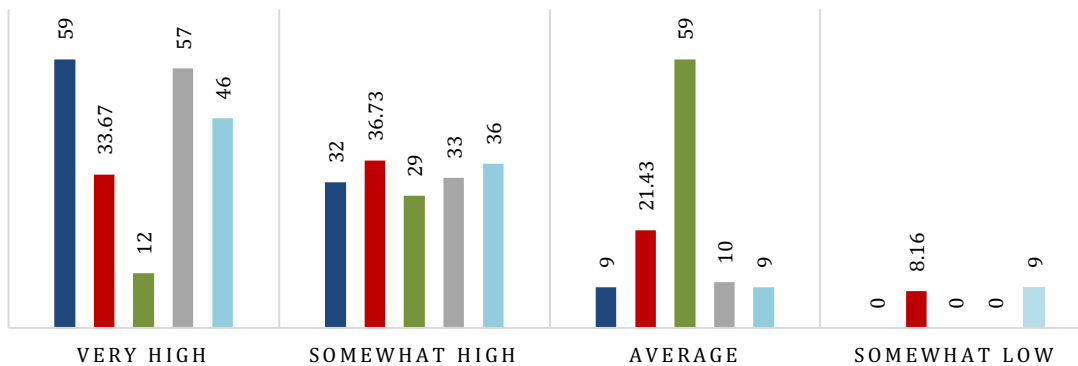


Figure 5.12 Thoughts on Price of water (%)

FEELINGS ABOUT RECYCLED WATER (%)

■ Druze ■ Chechens ■ Refugees ■ Minorities ■ Bedouins

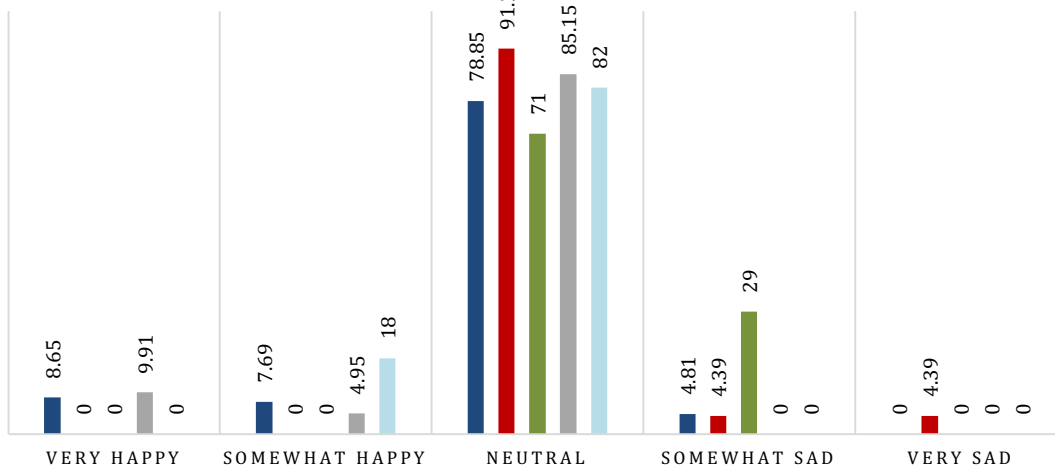


Figure 5.13 Feeling about using recycled water (%)

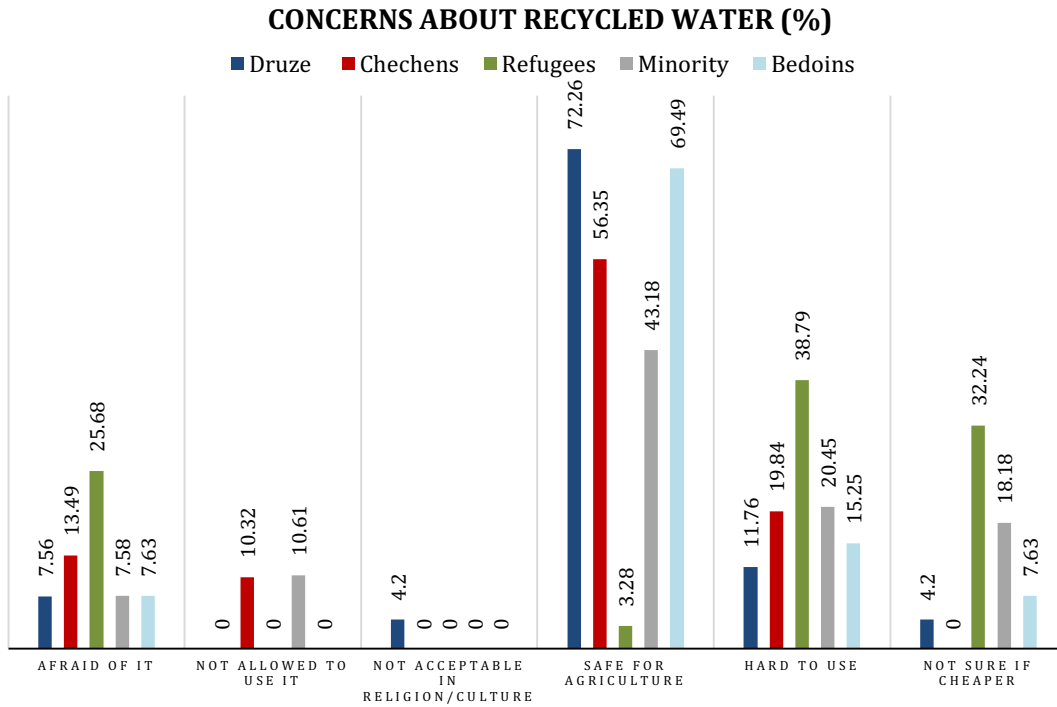


Figure 5.14 Concerns about using recycled water (%)

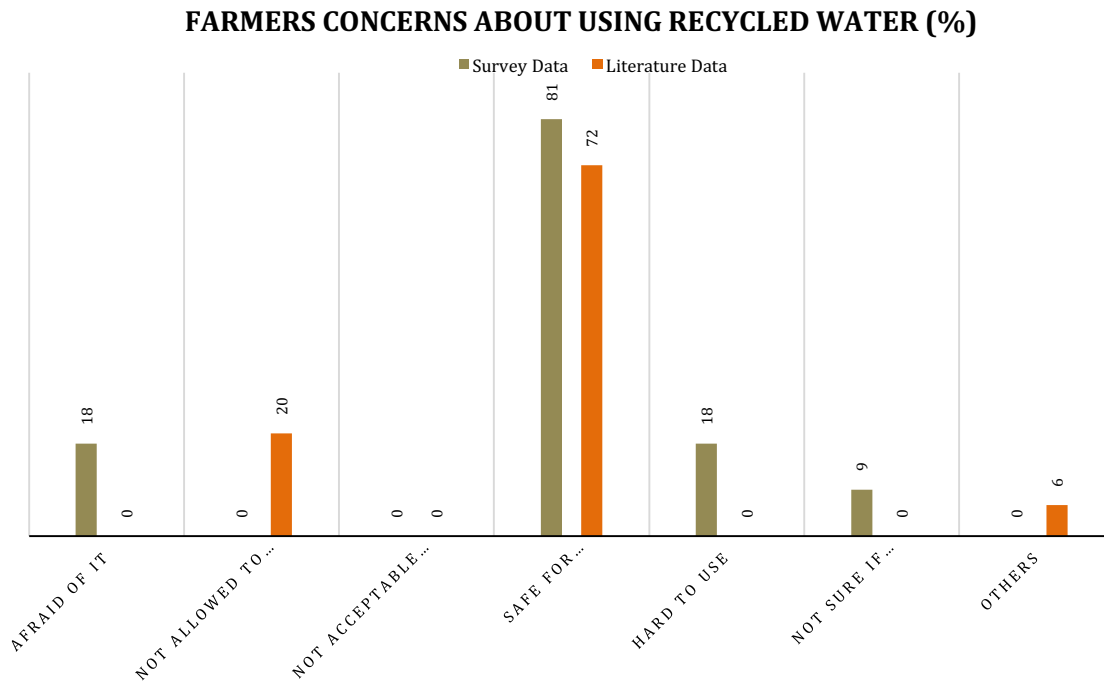


Figure 5.15 Farmers concerns about using recycled water (%)

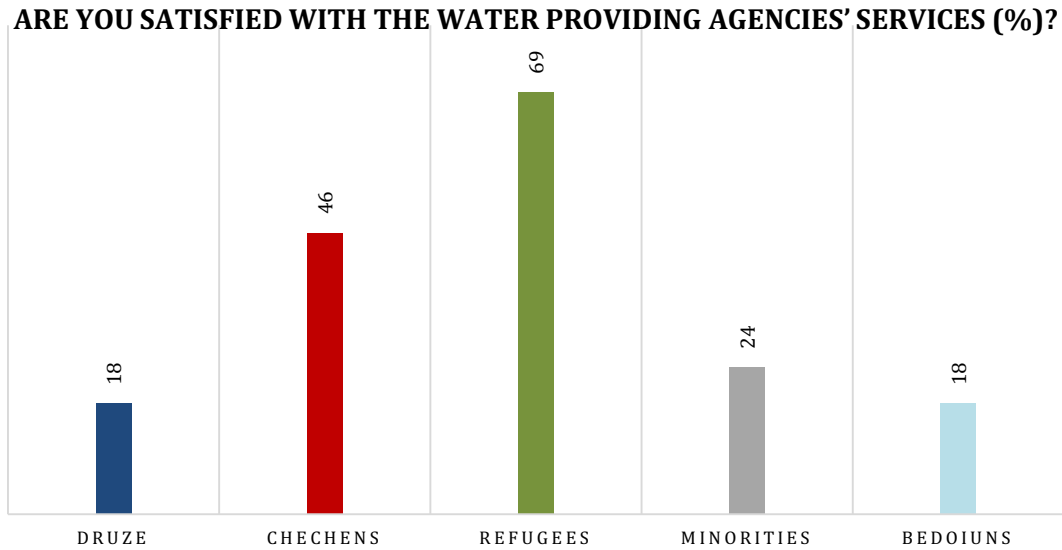


Figure 5.16 Feelings about being satisfied with the water agencies (%)

Water Conservation Regression Model

Model description:

There are four cultural domain models shown in the tabulated form (Table 5.5). Each cultural scale was created after combining the questions relevant to that specific cultural aspect.

The Cronbach Alpha (Reliability test) for each cultural component scale was as such; for Behavior: 0.80, Knowledge: 0.85, Attitude: 0.75, Feeling: 0.71. Thus, the reliability scale (Cronbach Alpha) values (all above 0.7) indicate that each scale of cultural domain is valid/reliable and the values show that they are measuring the same construct.

The questions selected in the mode to create scales for all cultural domains included; For knowledge scale, following question reliability gave the Cronbach's Alpha value to be 0.85.

- Aware of ways to conserve water
- Aware of Local Water Policies
- Aware of a Water Sector Group
- Knowledge about Water Control Organization

The Cronbach's Alpha value for Behavior scale is 0.80 and is based on the following questions;

- Pay for Water
- Do you save water at home?
- Make sure there are no leaks
- Close tap while brushing teeth

Similarly, Cronbach Alpha's value for Feeling scale is 0.71 and is based on the following questions;

- Positive Feeling about saving water
- If worried about water shortage

Whereas for Attitude scale the Cronbach Alpha's value is 0.75 based of the following statements from the survey were considered;

- Positive about water conservation
- Water conservation necessary for water shortage
- Water conservation not my responsibility
- Not concerned about water conservation
- Water conservation issues do not effect me
- I conserve water wherever I can
- Advocate water conservation in my family friends

- Only if water conservation does not inconvenience me
- Only if water conservation if does not have additional cost
- Only if water conservation does not take time
- Water conservation depends on Location
- Feel no pressure to conserve water
- Challenge to convince others to conserve water
- I could make more efforts to conserve water
- Water conservation is important
- Water conservation alone can solve water problems in our Country

The scales were used as dependent variables to create the models. The independent variables were the social demographics (Age, Gender, Income, Education levels) and the type of population living in Azraq (Druze, Chechen, Refugee, Bedouins and other Minorities). The overall evaluation of the models explained that the knowledge and behavior models are more significant than the attitude and feeling models. The values of R^2 (behavior model: 0.3 and Knowledge model: 0.4) and the F values (behavior model: 2.1 and Knowledge model: 3.4) are also higher compared to the attitude and feeling models towards conserving water.

Table 5.5 Descriptive Models of four cultural parameters towards conserving water

	Mode 1	Model 2	Model 3	Model 4
	Behavior	Knowledge	Attitude	Feeling
	positive Behavior towards conserving water	Awareness towards conserving water	Attitude towards conserving water	Feeling towards conserving water
Variables	Beta (SE)	Beta (SE)	Beta (SE)	Beta (SE)
Cultural Domains				
DruzeDrouze	0.24* (0.038)	0.307* (0.134)	-0.001 (0.06)	0.08 (0.10)
Chechenion	0.301*** (0.089)	-0.226 (0.059)	-0.03 (0.063)	0.007 (0.03)
Refugee	missing data	missing data	-0.05 (0.09)	0.35*(0.13)
Bedwin	-0.001(0.09)	-0.244 (0.064)*	0.02 (0.07)	-0.113 (0.03)
Social Attributes: (Control Variables)				
Age	-0.002 (0.003)	0.004 (0.004)	0.002 (0.002)	0.006*(0.003)
Gender (Male)	-0.021 (0.101)	0.091 (0.131)	0.04 (0.05)	0.02 (0.08)
Income Rich	0.101(0.10)	0.445** (0.137)	0.08 (0.07)	0.14 (0.10)
Income MiddleClass	0.019 (0.07)	0.251* (0.096)	0.03 (0.05)	0.13 (0.07)
Income Poor	0.215 (0.12)	0.082 (0.168)	0.02 (0.08)	-0.16 (0.12)
Education HighSchool Level	0.056 (0.08)	-0.188(0.132)	-0.007 (0.05)	-0.06 (0.08)
Education College Level	-0.06 (0.11)	0.043 (0.159)	-0.03 (0.07)	-0.008 (0.11)
Education some college Level	-0.21 (0.10)	0.171 (0.143)	-0.04 (0.07)	-0.01 (0.11)
R2	0.308	0.445	0.09	0.21
F	2.155	3.495	0.55	1.4
Model Sig	0.02*	0***	0.8	0.14
< 0.05=*				
< 0.01=**				
< 0.001=***				

Knowledge and Behavior models:

It is interesting to note that the Druze (*Beta* 0.24) and the Chechens (*Beta* 0.30) have significantly more positive behavior towards water conservation compared to the Bedouins (*Beta* -0.001). Data for refugees on the behavior is missing which is why it is difficult to comment on their behavior towards water conservation. In this model, the Chechens (*Beta* -0.2) and the Bedouins (*Beta* -0.2) show lack of knowledge as compared to Druze (*Beta* 0.03). On the contrary, the Bedouins seemed to have negative behavior (*Beta* -0.001) but positive attitude (*Beta* 0.02) towards water conservation and also showed significant lack of knowledge towards water conservation. When the social attributes are compared between the two models, it is interesting to note that individuals

with a higher income (*Beta* 0.1, 0.13) showed significantly more positive behavior, and have more knowledge compared to individuals with lower incomes (*Beta* 0.01, 0.2). On the other hand, between these models, age and gender do not have any significant difference, although it is interesting to note that even though few were surveyed, females tend to have more positive behavior towards water conservation than males (*Beta* -0.02).

Attitude and feeling models:

When comparing the attitude and feeling models, the refugees (*Beta* 0.35) show more positive feelings but non-significant, negative attitude (*Beta* -0.05) towards conserving water as compared to the other three groups. On the other hand, the Druze (*Beta* -0.001) and the Chechens (*Beta* -0.05) have negative non-significant attitudes but positive feelings (*Beta* 0.08, 0.007) about conserving water. The rest of the social attributes in the attitude and feeling model, which were used as a control, towards water conservation were shown to be insignificant, except for the age (*Beta* 0.006). The model indicates that the older the individuals are, the more likely they will have a more positive feeling towards water conservation. Surprisingly, the data indicates that the Refugees have a significant positive feeling about conserving water. The hypothesis here for this reasoning here could be that there is possibility the Refugees do want to conserve water, but they don't know how. There is a possibility that refugees may be more inclined if given the opportunity to learn and understand water conservation skills. Further studies would need to be conducted in order to evaluate this hypothesis. The next and final chapter of my thesis discusses the conclusions and implications of the results obtained from my model, including limitations and future work.

Chapter 6 : Conclusions and Implications

Water scarcity is unfortunately not just affecting the Azraq Oasis; it is a global problem. The purpose of this thesis was to analyze, evaluate and understand the potential cultural dimensions that are affecting water conservation. To what degree has the experience of water shortage in Azraq affected its five different social groups? How do these social groups orchestrate their attitude and behavior toward conserving water? What are their perceptions, opinions and how much information do they possess about the seriousness of this major problem and how this impacts the environment? The aspect of an affected region's culture is crucial in strategizing, improving, and promoting water conservation. In order to bring change, we need to understand the culture of the people and their work accordingly. The cultural aspect of water conservation is taken lightly and it does not get the attention it requires. Thus, the cultural aspect in this thesis would contribute to better understand and develop better strategies to conserve water.

For my thesis, I selected and conducted a survey of the current residents in the Azraq Oasis. This included five sub-cultural groups: Druze, Chechens, Refugees, Minority and Bedouins. The survey aimed to capture four different cultural dimensions: their knowledge (cognitive dimension), attitude dimension, behavior (active dimension) and feeling (affective dimension) toward water conservation. My analysis created scales for each of the dimensions, which were used to run regression models, and generalized linear regression models to assess which factors are impactful.

Impact of “Knowledge” (Cognitive) dimension

The survey results indicated that the education level was very low. Almost all of the respondents were high school educated or less; very few had a college education. Does low income hinder obtaining a higher education (cost of education and transportation) or is it the lack of interest in education or is it that the harsh climatic conditions make it difficult to commute long distances? One of the reasons for villagers not being able to attend college or university level education is due to the fact that there are no universities/colleges in Azraq, limited transportation and costs restricts them from gaining higher education. A previous study on socio-economic assessment conducted in 2010 indicated that ratio between compulsory and secondary school education was high, between 29 – 32%, whereas the university level education was 10% and higher education was only 7%, while the illiteracy ratio was 22% [84] which is consistent with my survey results. For women, although the study did not quantify, it estimated that a few only completed elementary school, some completed secondary schools, a few were able obtain a higher education and obtained positions in the government, while the rest were homemakers [84]. It should be noted that women who responded to my surveys were mostly refugees.

Furthermore, the income ratio in a previous study conducted in 2010, it was found that the monthly income level of individuals in North Azraq ranged from 50 – 150 JDs (Jordanian Dinars) (\$70 - \$211) where as individuals in Middle Azraq earn somewhere between 151 – 400 JDs (\$212 - \$564) and in South Azraq, individuals earn over 400 JDs (\$546) [84]. My survey captured the income by asking the respondent how they view

themselves in the society. My survey results indicated that their income level is moderately low (ranging from poor to medium), but there is a general interest among people in finding ways to increase income. The question arises: Is the difference in level of income due to the type of job opportunities available in different residential concentrations? For example, in South Azraq where tourism is very much in demand and promoted, the earning is higher in comparison to North and Middle Azraq. Income is generally higher in jobs related to trade, tourism, livestock raising, government, agriculture, salt production, or other. However, the Azraq community at large still falls under a poor-medium range for income.

Survey respondents differed in terms of their awareness (knowledge) regarding water conservation. As such, rigorous efforts need to be made to increase awareness and knowledge regarding water conservation practices in the Azraq community. Campaigning through community members and live simulations are a few examples of how this could be achieved. In particular, there needs to be more effective water conservation awareness strategies specifically geared toward the refugees, who are still assimilating to their new 'home'. This may be achieved by developing a 'Volunteer Water Advisor' (VWA) program in Azraq, where a few tribal members from each community are trained and educated well about water conservation, and these individuals can then go back and train their own communities in their own style according to their own norms. The idea is to find ways to help these individual conserve water and live a better quality of life. Cooperative societies do exist in Azraq, and reforming these cooperative societies would help in bring a change.

Furthermore, other possible effective strategies may include making water conservation a part of the teaching curriculum at schools and implementing interactive teaching methods to promote water conserving attitudes and behaviors. Susan Middlestadt conducted a study in central Jordan regarding the impact of two different teaching mechanisms on conserving water and her results indicated that curriculums that adopted interactive teaching were more promising [27].

Similarly, Hungerford et al., in their model of “Responsible Environmental Behavior” clearly distinguished between having knowledge of ‘issues’ and having knowledge of ‘action skills’, or what specific actions to take on these issues [141]. The study reinforced the concept that collective and conscientious efforts be made by the society as whole (that includes -men, women and children) in order to improve the environment [141]. The idea is to use knowledge about conserving water to spread awareness in a way that could bring more positive behavioral change toward this issue. Focus should be on educating the community so the stress on water demand could be reduced.

One of the interesting findings from my survey is that the farmers, who had a better understanding and know-how of the water crisis, had better intentions toward conserving water and collectively indicated positive responses toward using recycled water for agricultural purposes; i.e. they showed a willingness to pay for recycled water and using it for agricultural purposes. Almost all the farmers responded that they use drip irrigation. Drip irrigation is highly effective in applying water directly to the soil, so the water losses due to runoff and evaporation are less compared to sprinklers, although sprinklers cover a

larger area [144]. For watering gardens outside their homes, approximately 50% or more of all social groups indicated they use handheld hose for watering lawns/gardens. Hand held hose is the most common irrigation technique, in which flow can be controlled, but at the same time the nozzle is important for efficient irrigation, otherwise it causes overflow, resulting in a water waste [144].

In the villages of Azraq, villagers received an uninterrupted supply of water for four out of seven days of the week [89]. They store water when it is available to them in order to get through the days where water is cut off [89]. Although, from the middle of the year of 2013 this problem has been resolved according to the Azraq Manager Hazem Khreisha where he states, “*everyone gets continuous supply of water 7 days a week since mid 2013 after especially after activating of the disi aquifer southern Jordan*”⁴³. However, the villagers of Azraq also have a green thumb. Culturally, they enjoy greenery and utilizing gardens to grow their own vegetables, fruits, and flowers. This also gives them a sense of being independent, as they do not have to rely on the market for their needs [89].

Unsurprisingly, the Water Authority of Jordan (WAJ) is against this tradition of gardening, as it uses even more, arguably unnecessary, water in a time of water shortage and is deemed as wasteful water-use practice. They argue that the water supplied to them is costly and should be used for domestic purposes only rather than being used for outdoor irrigation purposes, especially in the past their resource wasn't continuous [89].

⁴³ Mr. Hazem Khreisha (the manager of the Royal Society of Conservation for Nature -RSCN), text message to author, August 25, 2017.

Before the drying of the Azraq oasis, water was used more in abundance for irrigating gardens by the villagers in North Azraq, mainly by the Druze due to the non-fertile soil and basalt ground. Chechens, on the contrary, were able to enjoy beautiful lavish gardens growing pomegranates, herbs, palm trees etc. with less water usage, due to fertile land in the South [89]. However, due to the water shortages, these gardens are not found in abundance in either of these villages.

To further meet the water demand of the villagers in Azraq as well as in other parts of Jordan, the Hashemite Kingdom of Jordan signed a Peace Canal contract with Israel and Palestinian Authorities to transfer water from the Red Sea as a proposed solution. This project is expected to be completed in 2018 [155]. It is also called the Red-Sea-Dead-Sea canal and Blue Peace contract (Figure 6.1). The idea is to pump out saline water from the Red Sea and transfer it through canals or a piping system to the Dead Sea and a water line going to Amman. This is estimated to provide 850 MCM per year freshwater to Jordan [156,157].

However, with proper planning and guidance, this could encourage and create a market opportunity for the villagers of Azraq in establishing a shrimp industry. Brine disposal could potentially also be used commercially for industrial purposes, metal recovery, salt recovery through investing in proper technologies and given proper trainings to the villagers [158].

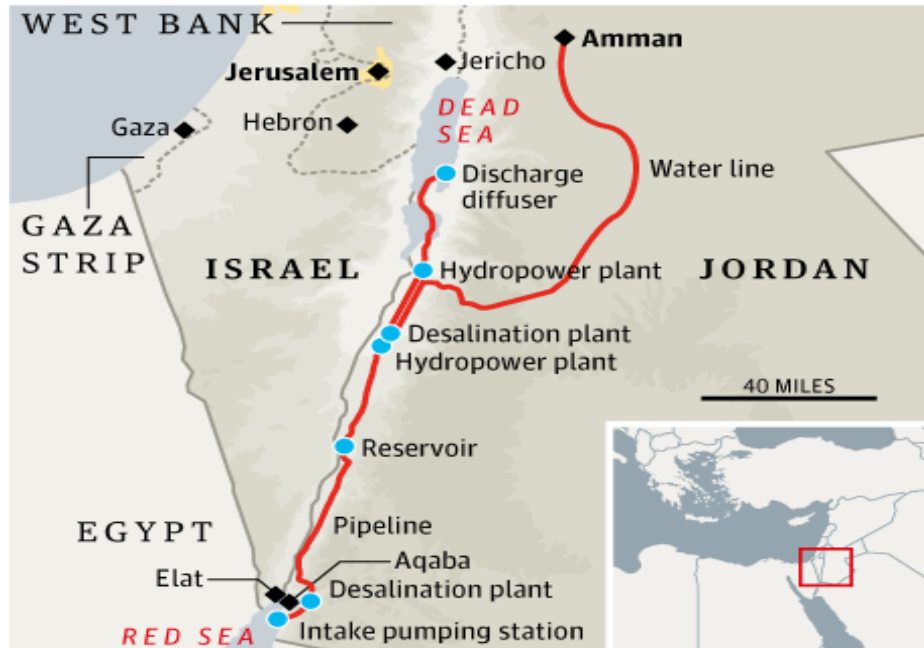


Figure 6.1 Red Sea- Dead Sea Canal [157,159]

Rethinking and redesigning policies to conserve water through water transfers is also an option to consider. This would be a great way to reallocate resources and minimize costs within Azraq. Transporting water from the North to South Azraq would enable the regions of Azraq with more demand for water to more easily cultivate fruits, vegetables and herbs in gardens there as more water is used in irrigating gardens in the North due to the difference in soil fertility level. Also, the government can provide incentives to the residents of North Azraq to buy land in the South to cultivate vegetable gardens. The other possible solution to maintain the gardens in the Azraq villages is to use gray water/reuse water. The question to ask is if nothing works, then would the residents of Azraq be willing to give up gardening completely? It is difficult to say because the culture of gardening is deeply ingrained in the Azraq villagers, and if they were forced to leave this practice, it could have debilitating effects. Gardening is a means for the Azraq

villagers' livelihood, and as such, it is not only used for leisure, but is also a means of obtaining non-staple food directly from their back yards throughout the year. Perhaps the government could develop a system of providing loans to these villagers to import water for daily use and promote household gray water reuse system for irrigating their gardens and take a portion of the profit, if they earn. Other possible water and garden preservation techniques include installing water-efficient irrigation systems/devices that are subsidized by the government, water harvesting (rainfall), promoting water smart gardens or control leaks. The policy implication here would be to provide the local residents of Azraq with an economic incentive that could prove to be effective in adopting the earlier mentioned potential water conserving solutions such as installing water-efficient devices. Gilbertson et al. indicated in a prior study that a rebate-scheme offered by the Australian Government helped two thirds of its community in installing water-efficient devices such as low-flow showerheads and dual-flush toilets [3]. Enforcing penalties for illegal water abstraction from the wells, installing meter-system, and promoting mandatory water saving procedures, could also help in conserving water.

Impact of "Attitude" dimension

The survey responses indicated that although all of the five sub cultural groups – Druze, Chechens, Refugees, Minority and Bedouins show positive behavior towards willingness to conserve water and indicate conserving water is important; refugees, however, despite agreeing that water conservation is needed, disagree that it is their responsibility to conserve water. Although, they indicate that they save water wherever they can. This is of interest because it may suggest that they do not have any water to spare to begin with,

so they are saving water on an individual level, without the greater community in mind, which would contribute to their sentiment that it is not their social responsibility. This attitude of refugees is understandable as they are coming from war torn zones, are displaced from their homes and cultural dimensions varies between geographical locations, but all five social groups have good intentions toward saving water. This response is geared more toward the psychological perspective of saving water among these immigrants.

These results are very much aligned with the results concluded by Gilbertson et al [3], Larson et al [140], Roseth [142], Dolnicar et al [143] and Bruvold [138] in which it was indicated water conservation is driven by the perception of the seriousness of the problem – in their case droughts in California and Australia. Sandra Postel describes the California Mono Lake story and regards it as an environmental victory [139]. In Los Angeles, residents had no choice but to switch their water consumption patterns to water conservation practices to meet their water needs. The California State Department Water Resources Control Board mandated LA to halt its diversion from Mono Lake tributaries until it restored its surface elevation [139], which is another example of how attitudes and behaviors to conserve water is derived circumstantially.

While it is promising that refugees in Azraq may already be conserving water, their attitude that it is not their responsibility is of concern. The implications of this are manifold. First, this could lead to a general resistance and negligence toward any other or new efforts to conserve water. Second, if the water scarcity problem continues or

becomes worse, the refugees might place even more responsibility and blame on the government. This might lead to a lot of discontent. Finally, the refugees may be in the best position to innovate to conserve water.

Refugees need to settle and feel at home and be given the opportunity to expand their living and help them become active community members by offering them resources so they help in conserving water. Delving into the psychological perspective of refugees regarding water conservation would provide more help. As Russel et al argues, knowing the psychology along with the environmental psychology together would be helpful in promoting residential water conservation behavior and inform evidence-based policy and practice [145].

Impact of “Behavior” (Active) dimension

In the behavior dimension, farmers from the Druze tribe indicated having greenhouses and using of bentonite soil as sealants, as opposed to others who indicated they used sprinklers instead.

Endorsing more greenhouses in Azraq would benefit the society and increase employment. Elite members who own private farms in Azraq could participate in providing incentives as well as training more farmers in using water efficiently would also be of benefit. Leading coaching sessions, seminars and workshops to train local farmers, like Bedouins, and non-farmers to not just learn how to operate greenhouses successfully, but also to educate them on using water efficiently, along with addressing

their concerns about using efficient irrigation technologies are some examples of effective strategies. The concept of growing vegetables in a greenhouse in Florida was initially taken from Israel to see if economically viable crops could be produced in high-proof-passive-ventilated structures [132]. Similarly, in the Wadi Hanifa Oasis in Riyadh, there are three large greenhouses located in privately owned farms by the late King Faisal's wife called AlMughatara farms (5 hectares). Crops and roses grown in these farms are used for organic markets and decorations/ cultural festivities purposes, respectively. Due to the high demand of roses, there are thirty-two varieties of roses that are grown in these houses. These roses require 250 m³ per day of water out of which 200 m³ per day is irrigated with the treated water⁴⁴.

In the survey, farmers indicated they cultivated mostly olive trees, alfalfa, palm trees, grapes, pomegranate, watermelons and vegetables, mostly for marketing and consumption purposes, but a few indicated cultivation for fodder purposes. The farmers' response to conserving water was that they grew drought tolerant crops or native crops. As mentioned earlier, there was an open-ended question regarding water prices or paying for water, to which farmers indicated in the survey that they paid for water somewhere between 400 to 2000 Jordanian Dinars every three months (\$564 - \$2820 USD). The area of land these farmers utilized for cultivation of crops ranged from 50 dunum (50,000m²) - 150 dunum (150,000m²).

A study conducted in 2014 indicated that drip irrigation used for irrigating olive trees saves up to 34% of total applied irrigation water and the fruit yield is increased by 19.2%

⁴⁴ In person interview with the farm manager in Riyadh.

in comparison to using surface irrigation systems by soil rings [128, 129]. An adult olive tree on average requires about 1 to 1.2 liters of water per square per meter of foliage per day and average water consumption is about 2000 – 2500 m³/ha./ year in arid climate regions [130]. Jordan exports about 300 to 400 tonnes of watermelons per day to the Gulf countries and one dunum of land produces about four to five tonnes of watermelons annually [131, 160]. It may be better to import watermelons in this particular context to help reduce water consumption. In my survey, the farmer cultivating watermelons is a Chechen from South Azraq who had 66 dunums of land indicating production of about 264 tonnes of watermelon annually. He used sprinklers and a drip irrigation system. Climate plays an integral part in crop production and the water required in crop production is expressed as volume of water needed for a unit area, or as depth in millimeters [133]. Water required for watermelon production is about 730 to 943mm in North Jordan Valley [133]. Similarly, net water requirement for grapes is 945mm and for other trees is about 1177mm [133]. For alfalfa, the water requirement is about 508 to 1168.4 mm/season (20 to 46 inches/season) depending on region's climate, elevation, latitude, growing season and other factors [134].

Impact of “Feelings” (Affective) Dimension

Survey findings indicated that all five sub cultural groups have similar feelings about water shortage; mainly they all worry about this problem and water quality seems to be their primary concern. Some farmers had multiple concerns, but interestingly very few, only 10%, thought it was against their religious beliefs. This shows greater awareness in the usage of recycled water, since the study conducted in 2003 indicated that 20% of the

farmers had concerns about using recycled water as it was against their religious belief [72]. Furthermore, everyone seems to be in agreement that water prices are high; albeit they agree that recycled water prices is not high. However, there is still a persistent widespread belief and concern toward the water quality of recycled water.

While it is promising that the population's attitude toward recycled water, in relation to their religious belief, has become positive, it remains concerning that their feelings toward the water quality of recycled water is not positive. This implies that there will still continue to be resistance toward the use of recycled water despite reasonable recycled water prices. It is imperative to integrate the use of recycled water as one of the main methods of water conservation.

Therefore, there needs to be a concerted effort toward correcting the feeling that recycled water is of low quality. This can be done at many levels but the primary stakeholder to push this effort should be the government. While reasonable recycled water prices is one step, the government, at the national and local level, needs to engage the population and reassure of them of its quality. If there continues to be concerns, then the next step would be to direct the use of seemingly 'bad' water to uses that the farmers and others feel comfortable toward (e.g. only for agricultural uses). Either way, this is an area of concern that has implications for furthering the problem of water scarcity and needs to be attended to.

Sub Cultural Groups

As a general conclusion, this thesis has found each group to have particular cultural dimensions more salient to them than others. This requires specific recommendations for each cultural subgroup outlined below.

Druze and Bedouins: Both the Druze and Bedouins are affected most by the '***Feeling (Affective) dimension***' as compared to the other cultural parameters. They worry most about the quality of water as oppose to quantity and feel water quality of recycled water is not positive. Besides this, they are least satisfied with the water providing agencies and are worried about water prices. As such a concerted effort should be made toward correcting the feeling that recycled water is of bad quality. Water agencies should approach the leaders of both the Druze and Bedouin communities, address their concerns, show them the water consumption and shortage statistics and involve them in their efforts to save water. A concerted effort should also be made to proactively engage them in the water pricing talks and negotiations; even if it is at a level of simply obtaining their input. The Druze, in particular, should be approached and engaged as my thesis reveals them to be amongst the most informed group regarding organizations that control water related matters and have a positive behavior towards water conservation.

Chechens: The Chechens are most affected by the '***Knowledge (Cognitive) dimension***'. Their level of awareness about water conservation is amongst the lowest. Only, 17% of the Chechens were aware about the different parties involved in the water sector in their area. In addition, their overall education level was found to be very low as well. Hence,

the Government needs to focus on the efforts to increase their level of awareness, their knowledge, promote water conservation and create incentives to build economy for these villagers.

Minorities: For the remaining minorities, the '*Behavior (Active) dimension*' affects them the most. They do not use drip irrigation as often as they should for crop production. Instead they use sprinklers and movable pipes. The government and other water related authorities, at the local level, should provide them with training sessions, incentives and workshops to help develop the greenhouses. Also, there should be efforts to endorse and encourage them for developing and using greenhouses.

Refugees: For Refugees, the '*Attitude dimension*' affects them the most. My thesis results indicated that there is a disparity between refugee's respondents agreeing to water conservation being needed and strongly indicating that it's *not their responsibility*. The reason for this attitude in refugees seems to stem from the psychological perspective of 'not belonging' and temporarily residing in Azraq. This could be due to their lack of connectedness with the land. In addition, living in refugee camps seems to further confirm their sense of residing in a 'temporary home' and further contributes to their sentiment that it is not their social responsibility. To top it off, these camps are made of metal, the wrong material selected for constructing these camps in such hot desert climate with little to no electricity available further aggravates the problem and makes it difficult for refugees to reside in these camps, which could also be one of the root causes of this attitude.

As such, this attitude of refugees is understandable as they are coming from war torn zones, are displaced from their homes and cultural dimensions varies between geographical locations, but they have good intentions toward saving water. This response is geared more toward the psychological perspective of saving water among refugees.

We need more data to answer questions such as ‘How much are these refugees culturally in sync with this problem and is the psychological perspective or consciousness helping or affecting their efforts in conserving water?’ or ‘How much of the discrepancies in the data are actually interpreted into the actual behavior?’ While it is promising that refugees in Azraq may already be conserving water, their attitude that it is not their responsibility needs to be focused. First of all, delving into the psychological perspective that Refugees feel settled in, feel at home and they be given sense of belonging to Azraq would be very helpful in this case. For this, they be given the opportunity to expand their living and help them become active community members by offering them resources, educate them so they help in conserving water. The other piece to really delve into would be to conduct studies to improve the thermal comfort and human wellbeing in these camps of Azraq for refugees.

Interestingly at the same time, though Refugees indicate it’s not their responsibility to conserve water but they are willing to save water wherever they can. Hypothetically here, it could be that there is a possibility that the Refugees do want to save water but they don’t know how as they lack skills in this area. This gives rise to a possible scenario that if they are given opportunity to learn and understand water conservation skills it could be

that they will be more inclined in conserving water for the benefit of the community, which they are part of. Also, the Refugees may be in the best position to innovate to conserve water. They are amongst the primary users and closest to the problem. Waiting for another entity to fix the problem might delay any solutions or prolong the situation at best. As such, building a sense of responsibility as well as ownership would be of benefit to all parties concerned. The refugees and the government could work together to develop this sense of responsibility as well as ownership.

Challenges faced in the Azraq Oasis

From the beginning, Azraq has been the victim of poor planning. Poor planning in water resources led to a severe water crisis, resulting in the drying of wells, while mismanagement led to the collapse of the salt industry. Also, even though the refugee camp construction project was orchestrated by well-known humanitarian agencies, lack of research and poor planning in this project led to the selection of the wrong material for its construction; that is, metal being used for the construction of these refugee camps while ignoring the hot desert climate of Azraq led to these camps to stand nearly desolate today in the arid soils of Azraq oasis.

Too many stakeholders being involved also appear to be at the root of the problem. The overlap of responsibility, lack of financial resources, lack of coordination or gap in the flow of information between local residents, water authorities and stakeholders, intrusion from outside sources, lack of awareness in treating water, harsh environmental conditions, water being intentionally or unintentionally taken as an infinite resource, and

the rising population leading to uncontrolled rise in water demand are just a few shortfalls and challenges that are seen in Azraq.

There is a lack of management, or proper flow of information from the local, to the national and to the international level that has exacerbated the situation of this oasis including the compounding effects of the environmental conditions as being one of the major contributing factors. While the overall goal is clear, there is failure in its planning and in its execution. The execution phase needs to be given attention and careful re-evaluation.

Once again, exploring options to revive trade and support the salt production industry even though it collapsed in the past may be effective strategies. One must learn from the lessons that lead to its failure, and how to avoid those mistakes from recurring. Similarly, encourage and promote further brine shrimp industry. The communication network between all stakeholders, starting from local, to national, to international level, should be strong, and everyone should be informed, able to fully participate, integrate and know the logistics to avoid errors. Perhaps implementing a real time database system with a login information should be provided to involved local, national and international leaders, where they would update the most current information, or be able to receive information of the current information, be able to correct information, or receive help. Mandatory rules should be applied on all personnel involved in any project to update the system as change occurs. This would be a way to avoid gaps in the flow of information.

Formulating a culture of water conservation in a system, with the help of tools that will help locals in implementation and give them the sense of security that their concerns and needs are being heard and met, their perceptions of disruptions, costs associated and infeasibility being addressed. Involving them in every step would be a key factor in generating an adjustment into a sustainable water resource management. The key to water conservation is to involve local community members to promote awareness and saving water. To promote cooperation among stakeholders and local society in the decision-making process requires encouraging locals to take lead roles in planning, implementing and strategize within their own communities [97,98].

One of the proposed solutions would be that the government of Jordan design and implement a policy for mandated training for water conservation practices for the general population in Azraq. It is seen again and again in places with water shortage that imposed policies from the government have worked, such as, in the case of California, where the urban California monthly water conservation increased about 19% after the state-mandated policy for water conservation was imposed for drought management [151]. I also suggest that there is a need for another comparative study of water conservation strategies between California and Jordan. It will help design and implement new policies to conserve water in this region. This will help in improving the camp design, which will help in developing sustainable, more functional and healthier communities.

Limitations

This dissertation, its conclusions and implications are limited to the Azraq Oasis only.

This dissertation cannot be used to generalize issues, implications and solutions for other affected regions internationally. Rather, it should be used as an exhaustive case study to provide insight and define areas of water shortage that may be applicable to other regions of interest – in particular understanding and incorporating a region’s culture to implement water conservation practices. Several studies in other regions would need to be conducted in order to draw conclusions of possible trends and/or differences.

Another limitation of this study is that the survey used in this dissertation is self-reported. While the self-reported data is best to understand and capture knowledge, feelings, and attitudes, participants may not be able to accurately describe the behaviors. Other metrics should be used, in addition to self-reported data, to better capture and understand behaviors; such as, measuring water use over time.

Future Work

In the future, similar studies from other oases should be conducted. It would be interesting to note and find similarities and differences amongst oases around the world; especially in regions that provide asylum to refugees. The model I developed in this study can be modified for each region accordingly.

Also, studies that compare cultural impact on water use in urban environments would also help develop and further the understanding in this field. While that may be more difficult and time-consuming, it would provide invaluable insight into the water crisis.

Finally, as the world moves toward greater technology, studies that provide strategies through the use of technology and its impact as a mediator on conserving water would also highlight and potentially provide long-term solutions to the water scarcity and a step towards cultural change. For instance, there is a pervasive use of a basic cell phone, even amongst the Bedouins. Studies could be aimed to sending simple SMS messages reminding or informing the region of the important of water use. SMS could even be used to disseminate new ways to conserve water. After a period of time, to collect data and note any differences before and after the use of SMS to increase awareness. How would the four dimensions of culture be impacted by the use of such technologies to help conserve water? Such studies would provide direct impact and benefit to the water crisis and as an insight towards cultural change in this region.

References

1. World Commission on Environment and Development. *Our Common Future*. Delhi: Oxford, Univ. Press, (1987).
2. Gleick, Peter H. "Water in Crisis: Paths to Sustainable Water Use." *Ecological Applications* 8, no. 3 (1998): 571- 579. doi:10.2307/2641249.
3. Gilbertson, M., Hurlimann, A., and Dolnicar, S. "Does Water Context Influence Behaviour and Attitudes to Water Conservation?" *Australasian Journal of Environmental Management* 18, no. 1 (2011): 47-60.
4. Silva, Tony, Diana Pape, Ronald Szoc, and Peter Mayer. *Water Conservation: Customer Behavior and Effective Communications*. (2010).
5. Bruvold, William H. "Residential Response to Urban Drought in Central California." *Water Resources Research. Res.* 15, no. 6 (1979): 1297-304.
doi:10.1029/wr015i006p01297.
6. @UCDavisWater. "Toilet to Tap": A Potential High Quality Water Source for California." California WaterBlog. 2016. Accessed September 05, 2016.
<https://californiawaterblog.com/2016/03/27/toilet-to-tap-a-potential-high-quality-water-source-for-california/>.
7. "Permanent Water Use Rules and Targets." Permanent Water Use Rules, Targets and Restrictions. Accessed September 05, 2016.
http://www.melbournwater.com.au/content/water_conservation/water_restrictions/water_restrictions.asp?bhcp=1.

8. Randolph, Bill, and Troy, Patrick. "Attitudes to Conservation and Water Consumption." *Environmental Science & Policy* 11, no. 5 (2008): 441-55.
doi:10.1016/j.envsci.2008.03.003.
9. Roseth, Naomi. "Community Views on Water Shortages and Conservation." *Journal of the Australian Water Association* 33, no. 8 (2006).
10. Kennedy, Merrit. "Lead-Laced Water In Flint: A Step-By-Step Look At The Makings Of A Crisis." NPR. April 20, 2016. Accessed September 05, 2016.
<http://www.npr.org/sections/thetwo-way/2016/04/20/465545378/lead-laced-water-in-flint-a-step-by-step-look-at-the-makings-of-a-crisis>.
11. Hanna-Attisha, Mona, Jenny Lachance, Richard Casey Sadler, and Allison Champney Schnepf. "Elevated Blood Lead Levels in Children Associated With the Flint Drinking Water Crisis: A Spatial Analysis of Risk and Public Health Response." *American Journal of Public Health* 106, no. 2 (2016): 283-90.
doi:10.2105/ajph.2015.303003.
12. Water Aid. 2015.
13. Abu-Taleb, Maher, F., and Murad, M. "Use of Focus Groups and Surveys to Evaluate Water Conservation Campaign." *J. Water Resources. Planning Management. Journal of Water Resources Planning and Management* 125, no. 2 (1999): 94-99.
doi:10.1061/(asce)0733-9496(1999)125:2(94).
14. Middlestadt, Susan, Mona Grieser, Orlando Hernández, Khulood Tubaishat, Julie Sanchack, Brian Southwell, and Reva Schwartz. "Turning Minds On and Faucets Off: Water Conservation Education in Jordanian Schools." *The Journal of Environmental Education* 32, no. 2 (2001): 37-45. doi:10.1080/009558960109599136

15. M. Abu Madi, O. Braadbaart, R. Al-Sa'ed, G. Alaerts. "Willingness of farmers to pay for reclaimed wastewater in Jordan and Tunisia." *Water Science & Technology Water Supply* 3, no. 4(2003): 115-122.
16. Cary, J. W. "Influencing Attitudes and Changing Consumers' Household Water Consumption Behaviour." *Water Science & Technology: Water Supply* 8, no. 3 (2008): 325. doi:10.2166/ws.2008.078.
17. "Water Scarcity and Humanitarian Action: Key Emerging Trends and Challenges." *OCHA Occasional Policy Briefing Series*. 2010.
https://docs.unocha.org/sites/dms/Documents/OCHA_OPB_Water_11Nov10_fnl.pdf.
18. "The Middle East and North Africa at Risk 2010." World Economic Forum. 2010.
www.weforum.org/docs/ME10/WEF_ME10_RiskReport.pdf
19. Batnich Adam. "[Sustainable Water for Abu Dhabi; Midterm briefing.](#)" 2010.
Al Qassimi, S., Batnick, A., Cao, T., Croushore, L., de Valladares Pacheco, T., Kano, J., Lee, A., Lee, Y., Mankin, J., Rodriguez, C., Rozwadowski, Y., and Wurden, K.
"Sustainable Water Management: Assessment and Recommendations for the Emirate of Abu Dhabi," *Columbia University School of International and Public Affairs*. (2010).
<https://www.mpaenvironment.ei.columbia.edu/files/2014/06/AbuDhabiFinalReport.pdf>
20. "World Water Forum5". Arab Countries Regional Report. 2009.
<http://portal.worldwaterforum5.org/wwf5/en-us/worldregions/MENA%20Arab%20region/Consultation%20Library/MENA-Arab%20Regional%20Report.pdf>

21. "Water Governance in the Arab Region: Managing scarcity and securing the future." United Nations Development Programme (UNDP). 2009.
22. "Arab Human Development Report 2009: Challenges to Human Security." United Nations Development Program (UNDP). 2009.
23. Darwish, M.A., N.M Al-Najem, and N.b Lior. "Towards Sustainable Seawater Desalting in the Gulf Region." *Desalination* 235 (2009): 58-87.
[http://www.seas.upenn.edu/~lior/lior_papers/Towards sustainable seawater desalting in the Gulf area-published.pdf](http://www.seas.upenn.edu/~lior/lior_papers/Towards_sustainable_seawater_desalting_in_the_Gulf_area-published.pdf).
24. "Abu Dhabi Water Resource Master Plan 2009," Environment Agency of Abu Dhabi. 2009.
25. "Dealing with Water Scarcity in MENA." World Bank report. 2008.
26. "Vital Water Graphics." United Nations Environment Programme (UNEP). 2008. <http://www.unep.org/dewa/vitalwater/index.html>
27. Jeffery, Paul, and Temple, Clive. "Sustainable Water Management: Some Technological and Social Dimensions of Water Recycling." Sustainable Developments International. 2008. <http://infohouse.p2ric.org/ref/22/21992.pdf>.
28. "Combating Salinity in Oman." International Center for Biosaline Agriculture. *Biosalinity News, Vol 10*, 2009.
<http://www.biosaline.org/sites/default/files/biosalinepdfenglish/Vol-10-1-Eng.pdf>.
29. "Making the Most of Scarcity: Accountability for Better Water Management results in the Middle East and North Africa," MENA Development Report, The World Bank. 2007.

30. "Coping with Water Scarcity. Challenge of the twenty-first century." UN Water, FAO. 2007.
31. "Earth trends, actual renewable resources: per capita." World Resources Institute. 2007.
32. Falkenmark, M., A. Berntell, A. Jägerskog, J. Lundqvist, M. Matz and H. Tropp. "*On the Verge of a New Water Scarcity: A Call for Good Governance and Human Ingenuity.*" SIWI Policy Brief. SIWI, 2007.
33. World Water Council. 2006.
34. In person from Masdar Institute of Science and Technology (MIST). 2006.
35. "Arab Culture Awareness: 58 Factsheets," Federation of American Scientists. 2006.
<http://www.fas.org/irp/agency/army/arabculture.pdf>
36. Abderrahman, Walid A. "Water Management in ArRiyadh." *International Journal of Water Resources Development* 22, no. 2 (2006): 277-89.
doi:10.1080/07900620600654785.
37. "Water Resources Sector Strategy: Strategic Directions for World Bank Engagement." The World Bank. Washington. D.C. USA. 2004.
38. "From Scarcity through Reform to Security: Draft Policy Paper on Water reforms in the Middle East and North Africa." World Bank. Presented at the Third World Water Forum, Kyoto, Japan. 2003.
39. Nabli, Mustapha Kamel. "Breaking the Barriers to Higher Economic Growth. Better Governance and Deeper Reforms in the Middle East and North Africa." *The International Bank for Reconstruction and Development / The World Bank*, 2007.

<https://openknowledge.worldbank.org/bitstream/handle/10986/6914/439690PUB0Bo x310only109780821374153.pdf?sequence=1>.

40. United Nations/ World Water Assessment Programme (UN/WWAP). “*Water for People, Water for life*”. The United Nations World Water Development Report; Executive summary 2003. United Nations Educational, Scientific and Cultural Organization (UNESCO). 2003.
<http://www.unesco.org/water/wwap/wwdr/index.shtml>
41. Engelman, R., and P. LeRoy. "Sustaining Water: Population and the Future of Renewable Water Supplies." *Population Action International*, 1993.
42. Abrams, Lee. “*Water Scarcity*”. African Water Page. 2003.
http://www.africanwater.org/drought_water_scarcity.htm
43. Waterbury, John. “*The Nile Basin: National Determinants of Collective Action.*” Yale University Press. 2002.
44. Hötzl, Heinz, Fathi Zereini, and Wolfgang Jaeschke. "Natural Scarcity of Water Resources in the Semi-Arid and Arid Middle East and Its Economical Implications." *Water in the Middle East and in North Africa*, edited by PD Dr. Habil. 2004.
45. Alsharhan, A. S, Rizk, Z.A., Nairn, A.E.M, Bakhit, D.W. and AlHajari, S.A . “Hydrogeology of an Arid Region: The Arabian Gulf and Adjoining Areas.” Amsterdam: Elsevier, 2001.
46. Roudi-Fahimi, Farzaneh, Liz Creel, and Roger-Mark De Souza. *Finding the Balance: Population and Water Scarcity in the Middle East and North Africa*. Report. 2002.
http://www.prb.org/pdf/FindingtheBalance_Eng.pdf

47. "Water in the Arabian Peninsula: Problems and Policies." Edited By: Kamil A. Mahdi: NHBS. 2001. <http://www.nhbs.com/title/152290/water-in-the-arabian-peninsula>.
48. Fortin, M., E. Slack, M. Loudon and H. Kitchen. "Financing Water Infrastructure." Report Commissioned for the Walkerton Inquiry, Toronto: Ontario Ministry of the Attorney General. 2001.
49. "Towards Water security: Framework of Action." Global Water Partnership (GWP). Stockholm. Sweden. 2000.
50. Amery, Hussein A., and Aaron T. Wolf. "Water, Geography, and Peace in the Middle East: An Introduction," *Water in the Middle East A Geography of Peace*. 2000.
51. Ohlsson, Leif, and Turton R., A. "The Turning of a Screw: Social Resource Scarcity as a Bottle-neck in Adaptation to Water Scarcity." SOAS Occasional Paper no. 19. London: University of London, School of Oriental and African Studies. 1999. <https://www.soas.ac.uk/water/publications/papers/file38362.pdf>.
52. "Evaluations of Present Water Resources in the Arab Region. Arab Center for the Study of Arid Zones and Dry Lands." ACSAD. Damascus. 1999.
53. Lovell, James E., Maj, USAF. "The Threat of the International Oil spills to Desalination Plants in the Middle East; A U.S. Security Threat." 1998.
54. Winpenny, J.T. 1997. *Managing Water Scarcity for Water Security*. A discussion paper prepared for the First FAO E-mail Conference on *Managing Water Scarcity*, 4 March to 9 April 1997.
55. Gleick, Peter H. "Water in Crisis: A Guide to the World's Fresh Water Resources." New York, Oxford, Oxford University Press. 1993

56. Martin, William Edwin. *“Saving Water in a Desert City.”* Washington, D.C.: Resources for the Future, 1984.
57. Waterbury, John. *“Hydropolitics of Nile River.”* Syracuse University Press. 1979.
58. DeCarbonnel, Eric. “Catastrophic Fall in 2009 Global Food Production.” Market Skeptics. 2009. <http://www.globalresearch.ca/index.php?context=va&aid=12252>
59. Mesnil, Alexandre, and Nour Habjoka. "The Azraq Dilemma: Past, Present and Future Groundwater Management." German-Jordanian Programme “Management of Water Resources”. GIZ (Gesellschaft für Internationale Zusammenarbeit). MWI (Ministry of Water and Irrigation, Jordan). Amman, Jordan. (2012): 6-12
<https://highlandwaterforum.files.wordpress.com/2012/08/2-1-azraq-dilemma.pdf>.
60. MWI (Ministry of Water and Irrigation, Jordan). “Water Budget for Year 2013.” Ministry of Water and Irrigation: Amman, Jordan. (2014): 14–17.
61. Al-Bakri, Jawad, Sari Shawash, Ali Ghanim, and Rania Abdelkhaleq. "Geospatial Techniques for Improved Water Management in Jordan." *Water* 8, no. 4 (2016): 132. doi:10.3390/w8040132.
62. Haddad, Fidaa. *“Azraq Oasis Restoration Project, Jordan; Rescuing the Azraq Oasis and Local Livelihoods.”* Technical paper. IUCN, International Union for Conservation of Nature, 2011.
63. Haddad, Fidaa. *“Case Study on the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) Role in Restoring Azraq Oasis. Report.”* United Nations Entity for Gender Equality and the Empowerment of Women. 2009.
64. Schacht, Karsten, Sven Gönster, Elisabeth Jüscke, Yona Chen, Jorge Tarchitzky, Jawad Al-Bakri, Emad Al-Karablieh, and Bernd Marschner. "Evaluation of Soil

- Sensitivity towards the Irrigation with Treated Wastewater in the Jordan River Region." *Water* 3, no. 4 (2011): 1092-111. doi:10.3390/w3041092.
65. "Global Drylands Initiative." IUCN. 2016. Accessed September 15, 2016.
<http://www.iucn.org/drylands>.
66. Wescoat Jr., J.L., and Laurence MacDonnell. "The Culture of Irrigation." In *A New Era for Irrigation*, 20-45. Washington D.C.: National Academy Press. 1996.
67. Yahya, Bakour. "Planning and Management of Water Resources in Syria." Damascus: League of Arab States. Arab Organization for Agricultural Development (AOAD), 1992.
68. Orlove, Ben, and Steven C. Caton. "Water Sustainability: Anthropological Approaches and Prospects." *Annu. Rev. Anthropol. Annual Review of Anthropology* 39, no. 1 (2010): 401-15. doi:10.1146/annurev.anthro.012809.105045.
69. Picon, Antoine. "Constructing Landscapes by Engineering Water." *Landscape Architecture in Mutation. Essays on urban landscape*, 99- 115. Gta Verlag, 2005.
70. Miller, Susan Gilson. "Watering the Garden of Tangier: Colonial Contestations in a Moroccan City." *The Journal of North African Studies* 5, no. 4 (2000): 25-50.
doi:10.1080/13629380008718410.
71. McIlwaine, Stephen, and Redwood, Mark "Greywater Use in the Middle East: Technical, Social, Economic and Policy Issues." Warwickshire, UK: Practical Action Pub. 2010.
72. Morris, Mary E. "Water and Conflict in the Middle East: Threats and Opportunities." *Studies in Conflict & Terrorism* 20, no. 1 (1997): 1-13.
doi:10.1080/10576109708436023.

73. De Haas, Hein. "Agricultural Transformations in the Meghreb and the Role of Multidisciplinary Research." *Water, Land, Agriculture and Policies in the Mediterranean*, edited by A. Kroll. Brussels: Institute for Prospective Technological Studies, JRC and European Commission. 2001.
74. De Haas, Hein. "North-African Migration Systems: Evolution, Transformation and Development Linkages." *Migration and Development: Perspective from the South, Geneva: International Organization for Mitigation*, edited by Stephen Castles and Raúl Delgado Wise, 143-74. Geneva: International Organization for Mitigation. 2008.
<http://www.heindehaas.com/Publications/Castles%20and%20Delgado%20Wise%20-%20ed%20-%202008.pdf>
75. Babakhouya, B.M.A. and A. Abaouz. "Integrated management of water resources in the Tafilalet: a necessity for the preservation of Oasis South- Eastern Moroccan." *Proceedings of International Symposium on: Sustainable Development of the oasis system, Theme 2: Natural Resources of Outer Space Oasis-Dweller: (Water, soil, plant and animal biodiversity)* edited by B. Boulanouar and C. kradi. Erfoud-Moroc: National Institute of Agronomic Research, Ministry of Agriculture, Rural Development and Sea Fisheries. (2005).
76. Arab Forum for Environment and Development (AFED) Report "Water: Sustainable Management of the Scarce Resource." 2010.
<http://www.afedonline.org/report2010/pdf/en/introeng.pdf>.
77. World Bank Report. "Making the most of Scarcity – Accountability for better water management results in the Middle East and North Africa, MENA Development Report". Washington DC. 2007.

78. http://iucn.org/about/union/secretariat/offices/iucnmed/iucn_med_programme/terrestrial_ecosystems_livelihoods/drylands/oasis/
79. Comolet, Emmanuel. "Jordan: The Geopolitical Service Provider." Brookings Institute. Accessed September 15, 2016. <https://www.brookings.edu/research/jordan-the-geopolitical-service-provider/>.
80. Kloub, Naser, Mohammed Matouq, Monzer Krishan, Saeid Eslamian, and Monther Abdelhadi. "Multitemporal Monitoring of Water Resources Degradation at Al-Azraq Oasis, Jordan, Using Remote Sensing and GIS Techniques." *International Journal of Global Warming IJGW* 2, no. 1 (2010): 1. doi:10.1504/ijgw.2010.032192.
81. Alraggad, Marwan, and Jasem, Hind. "Managed Aquifer Recharge (MAR) through Surface Infiltration in the Azraq Basin / Jordan." *JWARP Journal of Water Resource and Protection* 02, no. 12 (2010): 1057-070. doi:10.4236/jwarp.2010.212125.
82. Margane, A.Al-Qadi, M. and Al-Kurdi, O. "Updating the Groundwater Contour Map of the A7/B2 Aquifer in North Jordan." Technical Cooperation Project 'Syrian Refugee Response', Technical Report No. 1. Amman, Jordan: Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) and Ministry of Water and Irrigation, Jordan (MWI). (2015).
83. Nelson, Bryan. "Azraq: Desert Oasis." Athens: Ohio University Press, 1974.
84. IUCN (International Union for the Conservation of Nature). "Azraq Oasis Restoration Project. Socio-Economic Assessment of the Pilot Sites." Jordan: Arab Women Organization. 2010.
https://cmsdata.iucn.org/downloads/new_azraq_socio_economic_assessment.pdf
85. Ham, Anthony and Greenway, Paul. "Jordan." *Lonely Planet Publications*. 2003.

86. <http://wildjordan.com/eco-tourism-section/azraq-wetland-reserve>
87. Nelson, J.b. "Return to Azraq." *Oryx ORX* 19, no. 01 (1985): 22-26.
doi:10.1017/s0030605300019505.
88. Damick, Alison and Lash, Ahmad. "The Past Performative: Thinking Through the Azraq Community Project." *Asor Blog*. <http://asorblog.org/2013/12/12/the-past-performative-thinking-through-the-azraq-community-archaeology-project/>
89. Janssens, Sylvie, and Thill, Zack. "Water in Azraq (Jordan): A Fluid Link between State and Society?" *Journal of Anthropologies*. No. 1 (2013): 317-338.
<https://www.cairn.info/revue-journal-des-anthropologues-2013-1-page-317.htm>.
90. "Azraq Camp for Syrian Refugees, One Year Later," ACTED. 2015.
<http://www.acted.org/en/azraq-camp-syrian-refugees-one-year-later>.
91. Reznick, Alisa. "Jordan's Azraq Syrian Refugee Camp Stands Largely Empty." Al Jazeera English. 2015. Accessed April 9, 2016.
<http://www.aljazeera.com/indepth/inpictures/2015/05/jordan-azraq-syrian-refugee-camp-stands-largely-empty-150526084850543.html>.
92. "Quick Facts: What You Need to Know about the Syria Crisis." Mercy Corps. June 16, 2016. Accessed July 10, 2016. <https://www.mercycorps.org/articles/iraq-jordan-lebanon-syria-turkey/quick-facts-what-you-need-know-about-syria-crisis>.
93. UNHCR. "UNHCR: Total number of Syrian refugees exceeds four million for first time," UNHCR. 2015. <http://www.unhcr.org/en-us/news/press/2015/7/559d67d46/unhcr-total-number-syrian-refugees-exceeds-four-million-first-time.html>
94. Ellingson, Joe and Abadesco, Enrico. "The Disi-Amman Water Conveyance Project."

<http://courses.washington.edu/cejordan/Disipresentation.pdf>

95. "Ar." <http://waterjo.mwi.gov.jo/Ar/Pages/Home.aspx>.
96. Lahn, G., Grafham, O., and E. Sparr, Adel. "Refugees and Energy Resilience in Jordan." *Moving Energy Initiative*, Research Paper. Amman. 2016.
97. Zeitoun, Mark, Allan, T., Al Aulaqi, N., Jabarin, A., and Laamarani, H. "Water Demand Management in Yemen and Jordan: Addressing Power and Interests." *The Geographical Journal* 178, no. 1 (2011): 54-66. doi:10.1111/j.1475-4959.2011.00420.x.
98. UNHCR. "Refugee operations and environmental management. A handbook of selected lessons from the field." UNHCR. 2002.
<http://www.unhcr.org/406c38bd4.html>
99. "Druze History." <http://www.druzeheritage.org/>
100. "A Brief History of the Great Syrian Revolt (1925-1927)." International History Blog.
<http://intlhistory.blogspot.com/2012/10/a-brief-history-of-great-syrian-revolt.html>.
101. Shannak, Lina. "Jordan: A Refuge through the Ages." Alaraby. 2015.
<https://www.alaraby.co.uk/english/features/2015/3/18/jordan-a-refuge-through-the-ages>.
102. <http://www.worldandischool.com/public/1993/March/school-resource10796.asp>
103. Janssens, Sylvie. "Azraq's Waters: A Political Ecology of Water Allocation in Azraq, Jordan." M.A diss., University of Kent, Canterbury, UK. 2010 -2011.
104. "Chechens - Minority Rights Group." Minority Rights Group. Accessed September 16, 2016. <http://minorityrights.org/minorities/chechens/>.

105. Hemsley, J. H. and George, M. "Azraq Desert National Park, Jordan, Draft Management Plan". *International Biological Programme, Conservation of Terrestrial Communities*, London, England. 1996.
106. Oestigaard, T. "Water, Culture and Identity: Comparing Past and Present Traditions in the Nile Basin Region." *Water, Culture and Identity: Comparing Past and Present Traditions in the Nile Basin Region*, edited by T. Oestigaard. Bergen: University of Bergen. 2009.
107. "Jordan Desert and Bedouin Culture" Terhaal Adventures
<http://www.terhaal.com/jordan-desert-bedouin-culture>.
108. Casanova A, Arrighi De. "Modernizing Irrigated Agriculture in the Near East Experience Feedback on the Achievements of the French Mission for Water and Agriculture (MREA) (1993-2007)." Food and Agriculture Organization (FAO). Rome, IPTRID No.7. 2009. <http://www.fao.org/docrep/011/i0649e/i0649e00.htm>.
109. Bajjali, W. and Al-Hadidi, K. "Hydrochemical Evaluation of Groundwater in Azraq Basin, Jordan Using Environmental Isotopes and GIS Techniques." Paper presented at the 25th Annual ESRI International User Conference, San Diego, CA, USA. 2005.
110. Lancaster, William, and Fidelity Lancaster. "People, Land, and Water in the Arab Middle East: Environments and Landscapes in the Bilâd Ash-Shâm." Amsterdam: *Harwood Academic Publishers*, 1999.
111. "Jordan Arabic Cuisine." Jordan Tours. <http://www.petranightstours.com/jordan-arabic-cuisine/?ID=173>.

112. Dottridge, Jane, and Nizar Abu Jaber. "Groundwater Resources and Quality in Northeastern Jordan: Safe Yield and Sustainability." *Applied Geography* 19, no. 4 (1999): 313-23. doi:10.1016/s0143-6228(99)00012-0.
113. Al Mes'han, Odeh. "Azraq Oasis Restoration Project. Development of a Decision Support System (DSS) for Azraq Oasis." Final Technical Report. Submitted to the International Union for Conservation of Nature (IUCN), National Center for Research and Development/ Badia Research Program(BRP). 2011.
114. Al Mes'han, Odeh. "Development of a Decision Support System for Azraq Oasis: Final Technical Report" Azraq Restoration Project, Submitted to International Union for Conservation of Nature. 2011.
- https://cmsdata.iucn.org/downloads/azraq_oasis_restoration_project__final_technical_report_2011.pdf
115. "World Wetlands Day 2011" Ramsar 2011.
- http://www.ramsar.org/sites/default/files/wwd2011_sprep_wetlands_flyer.pdf
116. Juhari, Nadia and Buchanan, Maya. "The Azraq Oasis". Paper for the 1st International Congress on Oasis & Sustainable Tourism. West/Central Asia & North Africa (WESCANA), World Conservation Union. 2010.
117. RSCN. "Azraq Wetand Reserve document." RSCN. 2011.
118. Athamneh, H., Portegies, R. and Latif, M. "*Jordan Country Report.*" *Status of National Agricultural Information System in Jordan.* 2008.
119. "What Do You Really Know About Water?" Watershed Agricultural Council.
- <http://www.nycwatershed.org/pdfs/WaterTriviaQuestions.pdf>
120. Van Aken, M., Courcier, R., Venot, J.-P., Molle, F. "Historical Trajectory of a River

- Basin in the Middle East: The Lower Jordan River Basin (in Jordan)". International Water Management Institute (IWMI) & French Regional Mission for Water and Agriculture (MREA):Amman. 2007.
121. "East of Amman: The Desert Castle Loop." King Hussein.
<http://www.kinghussein.gov.jo/tourism5.html>.
122. "Qasr Al-Azraq" Lonely Planet. <http://www.lonelyplanet.com/jordan/azraq-around/sights/castles-palaces-mansions/qasr-al-azraq>.
123. Stanton, Bethan. "Fruit Vendors and High-end Designers Share the Floor at Jordan's First Design Week." Quartz. 2016. <http://qz.com/775571/jordan-launches-its-first-design-week-in-amman/>.
124. Laureano P., Ouessar M., Moyano E., Dudeen B., Gad A., Martínez, J., Rodríguez R. "Conceptual frame on water culture and its use to raise public awareness on sustainable water management in the Mediterranean basin." *Water culture and water conflict in the Mediterranean area*, edited by El Moujabber M, Shatanawi M, TrisorioLiuzzi G, Ouessar M., Laureano P., and Rodríguez R. Bari: CIHEAM. (2008).
125. Davidson, D. J., and W. R. Freudenburg. "Gender and Environmental Risk Concerns: A Review and Analysis of Available Research." *Environment and Behavior* 28, no. 3 (1996): 302-39. doi:10.1177/0013916596283003.
126. Babbie, Earl R. *The Basics of Social Research*. Belmont, CA: Wadsworth Pub., 2010.
127. Zelezny, Lynnette C., Poh-Pheng Chua, and Christina Aldrich. "New Ways of Thinking about Environmentalism: Elaborating on Gender Differences in

- Environmentalism." *Journal of Social Issues J Social Isssues* 56, no. 3 (2000): 443-57. doi:10.1111/0022-4537.00177.
128. El-Naqa, Ali. "Study of Salt Water Intrusion in the Upper Aquifer in Azraq Basin." Report. IUCN, International Union for Conservation of Nature, 2010. 1-92.
129. Hijazi, A., M. Doghoze, N. Jouni, V. Nangia, M. Karrou, and T. Oweis. "Water Requirement and Water-use Efficiency for Olive Trees under Different Irrigation Systems." The International Conference on Water Resources in the Mediterranean Basin, Oct 10-12, 2014. Marrakech, Morocco
[http://www.icarda.org/sites/default/files/Hijazi-et-al-\(2014\).pdf](http://www.icarda.org/sites/default/files/Hijazi-et-al-(2014).pdf).
130. "Open Field Olives." Irritec. <http://www.irritec.com/en/solutions/open-field/olive/>.
131. Namrouqa, Hana. "Jordan Exports 300 Tonnes of Watermelon per Day to Gulf States" Jordan Times. 2015. <http://www.jordantimes.com/news/local/jordan-exports-300-tonnes-watermelon-day-gulf-states>'.
132. Cantliffe, Daniel J. "Protected Agriculture – A Regional Solution for Water Scarcity and Production of High-Value Crops in the Jordan Valley." *University of Florida, Horticultural Sciences Department*
<http://www.hos.ufl.edu/protectedag/pdf/jordanvalley.pdf>.
133. Hagan, Ross and Taha, Suzan. "Jordan's Irrigation Policy Report - in Support of Jordan's Irrigation Water Policy Formulation." Academia.
http://www.academia.edu/16547428/Jordans_Irrigation_Policy_Report_-_in_Support_of_Jordans_Irrigation_Water_Policy_Formulation_Full_document_.
134. Shewmaker, Glenn E., Richard G Allen, and W. Howard Neibling. "Alfalfa Irrigation and Drought." University of Idaho Extension. 2013.

[http://www.extension.uidaho.edu/forage/Fact Sheets/Alfalfa Irrigation Facts 2013 Final\[1\].pdf](http://www.extension.uidaho.edu/forage/Fact%20Sheets/Alfalfa%20Irrigation%20Facts%202013%20Final[1].pdf).

135. Meshram, D.T., Mittal, H.K., Purohit., R.C., Gorantiwar, S.D., " Water Requirement of Pomegranate (*Punica Granatum L.*) For Solapur District of Maharashtra State." *ISHS Acta Horticulturae*. http://www.actahort.org/books/890/890_43.htm.
136. Dwyer, Dialynn. "More than Half of Massachusetts now Experiencing an Extreme Drought." *Boston.com*. 2016. <https://www.boston.com/weather/local-news/2016/09/15/more-than-half-of-massachusetts-now-experiencing-an-extreme-drought>.
137. "2016 Mandatory Water Restrictions." Amherst Massachusetts Government. 2016. <https://www.amherstma.gov/2262/2016-Mandatory-Water-Restrictions>
138. Bruvold, William H. "Residential Response to Urban Drought in Central California." *Water Resources Research Water Resour. Res.* 15, no. 6 (1979): 1297-304. doi:10.1029/wr015i006p01297.
139. Postel, Sandra. "Honest Hope." *National Geographic*. <http://environment.nationalgeographic.com/environment/freshwater/honest-hope>.
140. Larson, Kelli, Amber Wutich, Dave White, Tisha A. Muñoz-Erickson, and Sharon L. Harlan. "Multifaceted Perspectives on Water Risks and Policies: A Cultural Domains Approach in a Southwestern City." *Human Ecology Review*. 2011. <http://www.humanecologyreview.org/pastissues/her181/larson.pdf>.
141. Hungerford, H., and T L Volk. "Changing Learner Behavior through Environmental Education." *The Journal of Environmental Education* 2, no.3 (1990): 8-21

142. Roseth, N. "Community Views on Water Shortages and Conservation." *The Cooperative Research Centre for Water Quality and Treatment*. Research Report 28. 2006.
143. Dolnicar, Sara, and A. Hurlimann. "Australians' Water Conservation Behaviors and Attitudes." *Australian Journal of Water Resources* 14, no 1(2010): 43-53.
144. "Efficient Irrigation - Water Use It Wisely." Water Use It Wisely.
<http://wateruseitwisely.com/100-ways-to- conserve/landscape-care/principles-of-xeriscape-design/efficient-irrigation/>.
145. Russell, Sally, and Fielding, Kelly. "Water Demand Management Research: A Psychological Perspective." *Water Resour. Res.* 46 (2010).
DOI:10.1029/2009WR008408.
<https://experts.griffith.edu.au/publication/n48fbbd72bdd1a75620286fb5b22b0fe0>.
146. "Water and Children." Water and Children – Water4. <http://www.water4.org/what-we-do/our-crisis/water-and-children/>.
147. "Environmental Performance Index – Development 2016 Report." Water and Sanitation | Environmental Performance Index - Development.
<http://epi.yale.edu/chapter/water-and-sanitation>.
148. Jiang, Yong. "China's water scarcity." *Journal of Environmental Management* 90, no. 11 (August 2009): 3185-196.
149. "The Integrated Environmental Management of the Zarqa River in Jordan." *Jordan Times (Amman, Jordan)*, May 5, 2009. Medwet.. <http://medwet.org/2009/05/the-integrated-environmental-management-of-the-zarqa-river-in-jordan/>.

150. Zelezny, Lynnette C., Poh-Pheng Chua, and Christina Aldrich. "Gender perspective serves as an indicator different attitudes and behaviors between men and women." *Journal of Social Issues*, 2000th ser., 56, no. 3 (2000): 443-57.
151. "State Water Board Continues Water Conservation Regulations, Prohibitions Against Wasting Water." California Drought Portal. January 4, 2017. <http://drought.ca.gov/>.
152. Water Authority of Jordan - Web Presence. <http://www.waj.gov.jo/sites/en-us/default.aspx#>.
153. "Qasr al-Kharana." Archnet. <https://archnet.org/sites/3544>.
154. Hoekstra, Arjen Y. "Appreciation of water: four perspectives." *Water Policy* 1 (September 21, 1999): 605-622.
<https://www.utwente.nl/en/et/wem/staff/hoekstra/hoekstra1998.pdf>.
155. "Green Light for Red-Dead Sea Pipeline Project in 2018." Israël Science Info. February 06, 2017. <http://www.israelscienceinfo.com/en/environnement/canal-mer-morte-mer-rouge-les-travaux-vont-demarrer-en-2018/>.
156. "Read "Water for the Future: The West Bank and Gaza Strip, Israel, and Jordan" at NAP.edu." National Academies Press: OpenBook.
<https://www.nap.edu/read/6031/chapter/7#157>.
157. Farishta, Aleena. "The impact of syrian refugees on jordan's water resources and water management planning" May 2014.
https://www.bing.com/cr?IG=63B5A57E3A244981991A333A6FE7E8BA&CID=0073926F991F6CDC0356981D988F6D76&rd=1&h=Q5tjUTKG0CjW-hWNMxn_KTb3g2dFxA3Ib6rI95UbjTk&v=1&r=https%3a%2f%2facademiccommo

[ns.columbia.edu%2fdownload%2ffedora_content%2fdownload%2fac%3a175301%2fCONTENT%2fFarishtaAleena_GSAPPUP_2014_Thesis.pdf&p=DevEx,5033.1](https://www.columbia.edu/~download%2ffedora_content%2fdownload%2fac%3a175301%2fCONTENT%2fFarishtaAleena_GSAPPUP_2014_Thesis.pdf&p=DevEx,5033.1).

158. Morillo, José, José Usero, Daniel Rosado, Hicham El Bakouri, Abel Riaza, and Francisco-Javier Bernaola. "Comparative study of brine management technologies for desalination plants." *Desalination* 336 (2014): 32-49. doi:10.1016/j.desal.2013.12.038.
159. "Blue Peace: Red Sea-Dead Sea Pipeline Plan Signed." Conflicts by Ari Rusila. December 10, 2013. <https://arirusila.wordpress.com/2013/12/10/blue-peace-red-sea-dead-sea-pipeline-plan-signed/>.
160. Akram, M. "Jordan exports summer fruit 400 tons of watermelon daily." Customs Today Newspaper. <http://www.customstoday.com.pk/jordan-exports-summer-fruit-400-tons-of-watermelon-daily/>.
161. "Transboundary Waters." UN-Water. <http://www.unwater.org/water-facts/transboundary-waters/>.
162. Lssozi. "Values and Participation: the role of culture in nature preservation and environmental education among the Baganda." *The Journal of Sustainability Education*, March 19, 2012.
163. Thompson, Michael, Richard Ellis, and Aron Wildavsky. *Cultural theory*. Boulder, CO: Westview Press, 1990.
164. Jaeger, W. K., A. J. Plantinga, H. Chang, K. Dello, G. Grant, D. Hulse, J. J. McDonnell, S. Lancaster, H. Moradkhani, A. T. Morzillo, P. Mote, A. Nolin, M. Santelmann, and J. Wu. "Toward a formal definition of water scarcity in natural-human systems." *Water Resources Research*. July 08, 2013. <http://onlinelibrary.wiley.com/doi/10.1002/wrcr.20249/abstract>.

165. Sophocleous, Marios. "Managing Water Resources Systems: Why "safe Yield" Is Not Sustainable". *Ground Water* 35, no. 4 (1997): 561. 10.1111/j.1745-6584.1997.tb00116.x
166. Supski, Sian, and Jo Lindsay. " Australian Domestic Water Use Cultures: A Literature Review. " CRC for Water sensitive cities.
https://watersensitivecities.org.au/wp-content/uploads/2016/05/TMR_A2-1_AustralianDomesticWaterUseCulturesReport.pdf
167. Rogers, Peter P., Manuel Ramon, Llamas, and Luis Martinez-Cortina. *Water crisis: myth or reality?* London: Taylor & Francis, 2006.
168. "Appendix 3: Keynote Paper - Management Of Water Scarcity: National Water Policy Reform In Relation To Regional Development Cooperation." Proceedings of the second expert consultation on national water policy reform in the Near East. Accessed September 14, 2017.
<http://www.fao.org/docrep/006/ad456e/ad456e0a.htm>.

Appendix

Appendix A

Survey

Section 1

Part A

Knowledge towards water conservation

- Do you think you have enough water to use in daily basis?
 - Yes
 - No
 - I don't know
- Do you think water shortage has any effect on you or individuals in your household?
 - Yes
 - No
 - I don't know
- Can this water shortage be resolved in your area?
 - Yes
 - No
 - I don't know
- Do you believe that water conservation in your area is
 - Very important issue
 - Important issue
 - Not a very important issue
 - Not important at all
 - Not sure
- Why do you think it would be a good idea to save water?

- Are you aware of any ways in which water is conserved in your area?
 - Yes
 - No
- Have you ever tried to reduce the amount of water you use on the basis of any water saving programs?
 - Yes
 - No

- Which approaches to water conservation do you think are most appropriate for your area at this time (select all that apply)
 - Voluntary restrictions as recommended by the government

- Mandatory watering restrictions as sometimes imposed by the government during the summer months
- No watering restrictions
- Financial assistance to encourage people to purchase more water efficient technology
- Higher rates for water bills based on how much an individual or business is using
- Other strategies
- Where do you get your water from?
 - Taps
 - Wells
 - Water Tanks
 - List any other source
- Are farmers trained or given technical training before handling new irrigation technologies?
 - Yes
 - No
 - I don't know
- Are farmers
 - Local
 - Expats
 - I don't know
- Are you aware of your local water management polices/ schemes?
 - Yes
 - No
- Do you have knowledge about the organizations that control the water related matters?
 - Yes
 - No
- Are you aware of the group of players involved in the water sector of your area (irrigation communities, hydrographic confederation etc)?
 - Yes
 - No

Part B

Attitude towards water conservation

- Do you have positive feeling about saving water?
 - Yes
 - No
- Please circle all that apply: *
 - I am positive about water conservation
 - Water conservation is necessary because of water shortage

- Water conservation isn't my responsibility
- I am not concerned at all about water conservation
- More attention is needed for water conservation
- I advocate water conservation among my family and friends
- Water shortage issues don't effect me
- I conserve water wherever I can
- I feel no pressure to conserve water at the moment
- I only conserve water if water conservation does not inconvenience me
- I only conserve water if water conservation does not cause additional expenses for me
- I only conserve water if water conservation does not take more time
- The need for water conservation depends on location
- It is a challenge to convince others to conserve water
- I could make more effort to conserve water
- Water conservation is important
- Water conservation ALONE can save water problems of my country

Part C

Behavior towards water conservation

- Do you have water meters?
 - Yes
 - No
- Do you pay for water?
 - Yes
 - No
 - I don't know
- How much do you pay for water?

- Do you save water at home at all?
 - Yes
 - No
- Do you make efforts to conserve water in your community?
 - Yes
 - No
- How do you store water
 - I have rain water tanks
 - I store water from showers/sinks/bath for other uses
 - I don't store water at all
 - I don't know
- Do you have any water-efficient technologies for example: (please circle all the ones you use)
 - Water –efficient Dish washer

- Water –efficient Washing machine
 - Water –efficient Taps
 - Water –efficient Shower heads
 - I don't have any of the above technologies
- Do you make sure taps don't leak?
 - Yes
 - No
 - Not sure
- Do you use dishwashers when full only?
 - Yes
 - No
 - I don't have a dishwasher
- Does the water used in your household get recycled?
 - Yes
 - No
 - I don't know
- Do you use recycled water for
 - Farming
 - Car washing
 - Washing pavement
 - Any other use
 - I don't know
 - I don't use recycled water
- Do you close taps when brushing your teeth?
 - Yes
 - No
- I conserve water in the following way (select all that apply)
 - I have a rain shut-off valve on my irrigation system
 - I water my garden once per week or less in summer
 - I use rain barrel
 - I grow native/ drought tolerant plants
 - I have low flow toilets
 - Other
- Do you (select one)
 - Hand wash clothes
 - Use washing machines for washing clothes
 - Wash clothes less often
- Do you (select one)
 - Use bucket water to take bath
 - Use head shower for taking a bath
- What type of watering system do you use to water your lawn/ garden? (select all that apply)
 - Automatic (underground) sprinklers

- Sprinklers positioned by hand
- Watering with a hand-held hose
- Adding heavier soil to your lawn so that it needs less water
- Other watering system
- I do not have a lawn or garden
- Do you practice any form of water conserving technique in farming, if yes please describe it?

- Do you use your land for commercial farming? *
 - Yes
 - No
 - I do not own any land
- (If yes) what crops do you cultivate?

- Do you water any of the three items: Flower beds, Vegetable gardens, Trees and Shrubs
 - YES
 - NO
- What type of watering system do you use when you water your flower beds, vegetable gardens or trees and shrubs?
 - Automatic (underground) sprinklers flowers/vegetables/trees
 - Hand watering (sprinklers positioned manually) flowers/vegetables/trees
 - Hand watering (with a hand-held hose) flowers/vegetables/trees
 - Other watering system flowers/vegetables/trees
- Approximately how much area of land do you have to grow crops (farming)?

- What type of irrigation system do you use?
 - Moveable pipes
 - Overheads
 - Drip irrigation
 - Other
- What is the purpose of crop production? **
 - Market
 - Consumption
 - Fodder
 - Other
- What is the condition of the crop that is cultivated? ***
 - Good quality
 - Poor Quality
 - Other

Part D

Feelings towards water conservation

- Do you worry about water shortage in your area?
 - Yes
 - No
- What do you value the most in water?
 - Quality
 - Quantity
 - Price
 - Availability without restrictions
- How do you feel about price of water in your area?
 - Very high
 - Somewhat high
 - Not high or low
 - Somewhat low
 - Very low
- How do you feel about using recycled water?
 - Very happy
 - Somewhat happy
 - Neutral
 - Somewhat sad
 - Very sad
- What concerns you about recycled water (select all that apply)
 - I am afraid of using recycled water
 - I am not allowed to use it
 - It is not acceptable in my religion and cultural norms
 - It is only safe to use it for agriculture
 - It is difficult to use recycled water
 - I don't know if it will bring my expenses down
- Are you satisfied with the water providing agencies' services?
 - Yes
 - No

Section 2

Demographic Characteristics

- Are you a Male or Female?
 - Male
 - Female
 - Do not wish to disclose
- What is your age?

- Do you consider yourself

- Rich
 - Middle Class
 - Low middle class
 - Poor
- How many individuals live in your household?

- What is the highest level of education you have completed?
 - Less than high school
 - Some College
 - College
 - University level

Thank you for participating in the survey.

(The questions were adapted from the following sources M. Gilbertson et al “does water context influence behavior and attitudes to water conservation” March 2011[3] and

<https://people.ok.ubc.ca/jowagner/OSEH/The%20Water%20Conservation%20Survey.pdf>)

Appendix B

Survey in Arabic (Courtesy: Mr. Hazem Khreisha, the Azraq Manager of the Royal Society of Conservation for Nature (RSCN)): Though Arabic Survey was available but English Survey was used as the contents were translated by the staff getting the survey filled out.

استمارة

القسم الاول

الجزء الاول

المعرفة تجاه الحفاظ على المياه

- هل تعتقد ان لديك كمية المياه الكافية للاستخدام اليومي ؟

* نعم

* لا

* لا اعلم

- هل تعتقد ان نقص المياه لديه تأثير على افراد اسرتك ؟

* نعم

* لا

* لا اعلم

- هل يمكن حل مشكلة قلة المياه في منطقتك ؟

* نعم

* لا

* لا اعلم

- هل تعتقد ان الحفاظ على المياه في منطقتك هي :

* مهم جدا

* مهم

* ليس مهما

* غير متأكد

- لماذا برأيك الحفاظ على المياه فكرة جيدة ؟

- هل انت على علم ودراية بالطرق التي يتم بها الحفاظ على المياه في منطقتك ؟

* نعم

* لا

- هل حاولت ان تقوم بتقليل استخدامات المياه ضمن اي خطة للحفاظ على المياه ؟

* نعم

* لا

- اي من طرق الحفاظ على المياه تعتقد بانها الانسب لمنطقتك في هذا الوقت (اختر ما يتم تطبيقه)

* قيود طوعية موصى بها من قبل الحكومة

* قيود السقي التفويضية التي غالبا تفرض من قبل الحكومة خلال اشهر الصيف

* بدون اي قيود مائية

* مساعدة مالية لتشجيع الناس لشراء ادوات مياه تكنولوجية فعالة

* اسعار عالية على فواتير المياه اعتمادا على كمية استخدام الافراد والمهن

* استراتيجيات اخرى

- من اين تحصل على المياه ؟

* الحنفية

* ابار

* صهاريج المياه

* قم بطرح اي مصادر اخرى

- هل المزارعين مدربين او حصلو على تدريب فني قبل استخدام تكنولوجيا جديدة في الري ؟

* نعم

* لا

* لا اعلم

- هل المزارعين :

* محليين

* مغتربين

* لا اعلم

- هل انت على وعي بسياسات وانظمة المياه المحلية في منطقتك؟

* نعم

* لا

- هل لديك المعرفة بالمنظمات التي تسيطر على شؤون المياه ؟

* نعم

* لا

- هل انت على وعي بالمجموعات العاملة في قطاع المياه في منطقتك (مجتمعات الري، اتحادات المصحة المائية الخ)

* نعم

* لا

الجزء الثاني

المواقف تجاه الحفاظ على المياه

- هل لديك شعور ايجابي تجاه الحفاظ على المياه؟

* نعم

* لا

- لطفا اختر ما ينطبق

* انا ايجابي بالحفاظ على المياه

* الحفاظ على المياه ضروري بسبب نقص المياه

* الحفاظ على المياه ليست مسؤوليتي

* انا غير مهتم اطلاقا بالحفاظ على المياه

* مزيد من الاهتمام بالحفاظ على المياه

* انا اوريد وادعم موضوع الحفاظ على المياه بين عائلتي واصدقائي

* موضوع نقص المياه لا يؤثر على

* اقوم بالحفاظ على المياه اينما كنت

* لا اشعر باية ضغوط للحفاظ على المياه في الوقت الراهن

* انا اقوم فقط بالحفاظ على المياه اذا لم يضاقني ذلك

* انا اقوم بالحفاظ على المياه حينما لا يسبب اي مساحات اضافية

* انا اقوم بالحفاظ على المياه حينما لا يأخذ وقت اكبر مني

* الحفاظ على المياه تعتمد على الموقع

* انه تحد ان تتفع الاخرين بالحفاظ على المياه

* قد اقوم بتقديم مجهود للحفاظ على المياه

* الحفاظ على المياه مهم

* الحفاظ على المياه لوحده قد يحل مشاكل المياه في بلدي

الجزء الثالث

التصرف تجاه الحفاظ على المياه

- هل لديك عداد مياه ؟

* نعم

* لا

- هل تدفع للمياه ؟

* نعم

* لا

- كم تقوم بالدفع للمياه ؟

- هل تقوم بالحفاظ على المياه في منزلك ؟

* نعم

* لا

- هل تقوم بآية جهود للحفاظ على المياه في مجتمعك ؟

* نعم

* لا

- كيف تقوم بتخزين المياه

* لدي خزانات مياه الامطار

* اقوم بتخزين المياه من مياه دش الاستحمام /المغاسل/الاستحمام لاغراض اخرى

* لا اقوم بتخزين المياه اطلاقا

* لا اعلم

- هل لديك اي من تكنولوجيا كفاءة المياه على سبيل المثال:(ارجو وضع دائرة حول ما تستخدم)

* غسالة صحون

- * غسالة ملابس
- * حنفيات
- * دش الاستحمام
- * ليس لدي اي من التكنولوجيا المذكورة
- هل تقوم بالتأكد من ان الحنفية لا تسرب مياه
- * نعم
- * لا
- * غير متأكد
- هل تستخدم غسالة الصحون عندما تكون ممتلئة تماما؟
- * نعم
- * لا
- * لا املك غسالة صحون
- هل المياه المستخدمة في منزلك معاد تدويرها ؟
- * نعم
- * لا
- * لا اعلم
- هل تقوم باستخدام المياه المعاد تدويرها في :
- * الزراعة
- * غسيل السيارات
- * غسيل ارضية الشوارع
- * اي استخدام اخر
- * لا اعلم
- * لا اقوم باستخدام المياه المعاد تدويرها
- هل تقوم باغلاق الحنفية عند الانتهاء من تنظيف اسنانك؟
- * نعم
- * لا

- اقوم بالحفاظ على المياه بالطرق التالية: (اختر ما ينطبق)

- * لدي صمام اغلاق المطر على نظام الري الخاص بي
- * اقوم بسقاية حديقتي مرة بالاسبوع او اقل بالصيف
- * لدي برمبل المطر
- * اقوم بزراعة النباتات الاصلية التي تتحمل الجفاف
- * لدي مياه اقل تدفقا
- * شئى اخر

- هل تستخدم (اختر واحدا):

- * غسيل الملابس يدويا
- * استخدام غسالة الملابس الالية
- * غسل الملابس اقل

- هل تستخدم (اختر واحدا)

- * استخد دلو المياه للاستحمام
- * استخدام دش الاستحمام

- ما هو نوع نظام السقاية الذي تستخدمه لسقاية حديقتك/ارضك؟ (اختر ما ينطبق)

- * رشاشات مياه تلقائية (تحت الارض)
- * رشاشات يتم تثبيتها يدويا
- * السقاية باستخدام خرطوم مباشرة
- * اضافة تربة ثقيلة الى حديقتك لا تحتاج مياه كثيرة
- * انظمة سقاية اخرى
- * لا املك حديقة او ارض

- هل تقوم باستخدام اي نموذج من تقنيات الحفاظ على المياه في الزراعة؟ (اذا كانت الاجابة نعم فقم بالوصف)

- هل تقوم باستخدام ارضك لاغراض الزراعة التجارية؟

* نعم

* لا

* لا املك ارض

- (إذا نعم) ما هي المحاصيل التي تقوم بفلاحتها؟

- هل تقوم بسقاية اي من الثلاثة التالية : الورود , حدائق الخضراوات , الاشجار والشجيرات؟

* نعم

* لا

- ما هو نوع نظام السقاية التي تقوم باستخدامها لسقاية الورود , حدائق الخضراوات , الاشجار والشجيرات؟

* رشاشات مياه تلقائية (تحت الارض)

* رشاشات يتم تثبيتها يدويا

* السقاية باستخدام خرطوم مباشرة

* انظمة سقاية اخرى

- تقريبا ما هي مساحة ارضك التي تقوم بزراعتها ؟

- ما هو نظام الري الذي تتبعه ؟

* انابيب متحركة

* رشاشات

* الري بالتنقيط

* اخرى

- ما هو الغاية من انتاج المحصول ؟

* تسويق

* استهلاك

* اعلاف

* اخرى

- ما هو حالة المحصول الذي تقوم بفلاحته ؟

* جودة عالية

* جودة ضعيفة

* اخرى

الجزء الرابع

الشعور تجاه الحفاظ على المياه

- هل لديك قلق تجاه نقص المياه في منطقتك ؟

* نعم

* لا

- ما هو أكثر شئين أكثر قيمة في المياه ؟

* الجودة

* الكمية

* السعر

* توفرها بدون قيود

- ما هو شعورك تجاه اسعار المياه في منطقتك؟

* عالية جدا

* عالية

* ليست عالية اة منخفضة

* منخفضة

* منخفضة جدا

- ما هو شعورك تجاه استخدام المياه المعاد تدويرها ؟

* سعيد جدا

* سعيد

* محايد

* حزين

* حزين جدا

- ما هو أكثر ما يهيك في استخدام المياه المعاد تدويرها ؟

* خائف من استخدام المياه المعاد تدويرها

* غير مسموح استخدامها

* غير مسموح في ديننا او ثقافتنا

* فقط امن استخدامه بالزراعة فقط

* من الصعب استخدامها

* لا اعلم اذا ما سوف تنهك ميزانتي

- هل انت مقتنع بالجهات المزود لخدمات المياه في منطقتك؟

* نعم

* لا

القسم الثاني

الخصائص الديموغرافية

- هل انت ذكر ام انثى؟

* ذكر

* انثى

* لا ارغب بالافصاح

- كم عمرك؟

- هل تعتبر نفسك :

* غني

* طبقة متوسطة

* طبقة متوسطة دنيا

* فقير

- كم عدد الافراد الذين يعيشون في منزلك؟

- ما هو اعلى تحصيل علمي لك؟

* اقل من ثانوية عامة

* ما يعادل كلية

* كلية

* جامعي

شكرا لمشاركاتكم في تعبئة الاستمارة