Journal of Positive School Psychology http://journalppw.com
2022, Vol. 6, No. 6, 4895 – 4913

Jordanian and Syrian Refugee Knowledge of Hydropolitics in the Middle East

[1]Raed Al-Tabini, [2]Kerry Miller, [*3]Ismaiel Abuamoud, [4]Dr. Hussein M. Ibrahim

[1]Environment and Sustainability programs, Academic Director, SIT-Study Abroad, Jordan, Amman. raed.altabini@sit.edu
[2]Johnston Centre for Integrative Studies, University of Redlands, Redlands, California. kerry99miller@gmail.com
[3]associate Professor, School of Archaeology and Tourism, The University of Jordan, Amman, Jordan. Email: i.abuamoud@ju.edu.jo
[4]Assistant Professor, School of Archaeology and Tourism, the University of Jordan

Abstract

Jordan faces extreme water scarcity. Jordan is taking steps to ensure water security, including increasing citizen water scarcity awareness. This study sought to understand refugees and Jordanians' base water knowledge to enhance awareness and conservation efforts. A stratified random sample of 389 Jordanian citizens and refugees were surveyed to understand their water resource management and transboundary water partnership knowledge and perspectives. Questionnaires were utilized to gather responses which were then scored on a knowledge index and an optimism index, a measure of positive perspectives. Jordanians scored an average of 54% on the water knowledge index and 45% on the water optimism index. Refugees scored an average of 58% on the knowledge index and 51% on the optimism index. Respondents understood that conservation is important due to growing water scarcity but lacked specific knowledge about what scarcity would mean for water resources in Jordan and the Jordan river basin region.

Keywords: Water scarcity, Environmental awareness, Jordan river basin, Water resource management, Syrian refugees.

1. Introduction

As precipitation patterns change around the world, it is important that residents are aware of their region's water issues and water resource management approaches. This is particularly relevant for residents of Jordan, as their country lies in the heart of the Middle East and plays a stabilizing role in the region. Jordan's water security contributes to this stabilization, and thus is an important resource to understand and protect. Yet in 2019, Jordan was considered the fifth most water scarce country in the world (WRI, 2019). According to the Water Authority of Jordan (WAJ), Jordan's water supply was 125 m3/capita.year in 2018 (MWI, 2018), well below the 500m3/capita.year water scarcity threshold for semiarid countries estimated by Falkenmark et al. (1989). As a result, water demand exceeds sustainable supply, threatening future agricultural and drinking water resources. Region wide management changes would lessen water scarcity, but to understand and support alternative water management approaches, residents need to understand the current management approaches and history of their region's water. This research focused on resident's knowledge and perspectives surrounding water management as a vital human resource and water as a tool for transboundary cooperation.

2. BACKGROUND

2.1 Water Supply

Due to limited surface water, groundwater comprises 59% of Jordan's water supply. To reach this amount, groundwater is being pumped at an unsustainable rate. As a result, 10 of Jordan's 12 groundwater basins have an abstraction deficit (WAJ, 2017). In addition to decreasing groundwater recharge capabilities, over exploitation of groundwater resources can lead to saltwater intrusion, further limiting the water source (Al-Karablieh and Salman, 2016).

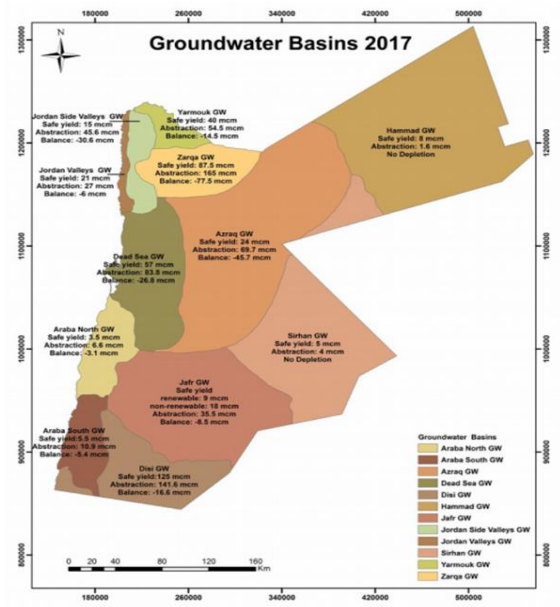

Figure 1. Groundwater basins in Jordan and their water balance (WAJ 2017).

The Disi Aquifer on the border between Saudi Arabia and Jordan is a nonrenewable aquifer that the capital of Jordan, Amman, currently relies on to augment its drinking water supply. In 2017, 141.58 MCM of water was extracted but the renewable extraction rate is 125 MCM, creating an abstraction deficit of 16.58 MCM of water (WAJ, 2017). Figure 1 provides a map of groundwater basins in Jordan, including the Disi Aquifer. The Disi aquifer is considered the last conventional water resource available but is expected to be depleted by the end of the century, necessitating a focus on securing alternative water supplies (Rajsekhar and Gorelick, 2017). General awareness of this impending depletion could increase support for alternative supply methods.

2.2 Supply limitations: Climate change and refugees

In addition to struggles with water resource management, climate change and recent population growth affect Jordan's freshwater availability. The changing climate is projected to increase temperatures by about 2.1℃ and decrease rainfall in the region by about 11.5% by 2060, leading to increased pressure on existing and alternative water resources (Black, 2009; Krichak et al., 2011; Smiatek et al., 2014). At the same time, an influx of refugees has increased water demand. The Jordanian government estimates there are approximately 1.4 million Syrian refugees in Jordan, including those who lived in Jordan prior to the 2011 conflict and those who fled to Jordan because of it (Hussein et al., 2020). The government's dominant discourse about this rapid population growth has been that while Jordan willingly welcomes refugees, it has strained Jordan's resources, including their water supply (Hussein et al., 2020). The WAJ identified that each Syrian refugee costs the water sector about 440 JD a year (WAJ, 2017). Despite this narrative, nearly 94% of Jordanians are sympathetic to refugees escaping conflict and persecution and 84% say the government's response towards refugees has been positive (NAMA, 2020). Therefore, Jordanian citizens understand the necessity of increased demand on their infrastructure, but knowledge of Jordan's alternative options in the face of increased demand with decreasing supply is also needed.

2.3 Transboundary water resources

Increased water supply is not likely to come from traditional surface and groundwater surfaces, partly because forty percent of Jordan's total water resources are shared with neighbouring countries. These countries also rely heavily on shared sources for their water supply (WAJ, 2017). Therefore, it is important for residents to know how the shared water is distributed and the constraints shared use places on expanding water supply. Jordan shares the Disi aquifer with Saudi Arabia and the Jordan river basin with Lebanon, Syria, Palestine, and Israel. The water bodies of the Jordan river basin can be seen in figure 2. As upstream countries,

Lebanon and Israel have control over the flow of the Jordan river and its tributaries originating in Lebanon, and Syria controls the Yarmouk River, a major tributary of the Jordan river originating in Syria. Syria and Israel thus have priority to divert and dam the Yarmouk and Jordan rivers, limiting water availability for Jordan. Under the 1994 Peace Treaty between Israel and Jordan, the waters of the Yarmouk and Jordan rivers are allocated between the countries, with specific stipulations for when Jordan will receive its allocated amount (Israel Jordan Peace Treaty Annex II 1994). Yet Jordan does not receive all the water allocated to them in the treaty (Talozi et al., 2019). Furthermore, diversion of the upper Jordan river has drastically decreased the flow of the river from lake Tiberius to the Dead Sea. For over half the year there is no inflow to the Dead Sea, causing the sea level to quickly decline. (Waslekar, 2011). The decreasing flow of the Jordan river limits its use as a water supply and necessitates delineating natural flow to protect the ecological health of the area. Jordan and Syria have also negotiated water allocations regarding the Yarmouk River (Agreement concerning the utilization of the Yarmuk waters, 1953). These agreements discuss the design of a dam intended for Jordanian use, which today is known as the Wehdah dam. Similar to the agreement with Israel, Jordan is entitled to fill this dam after Syria has filled its dams on the Yarmouk, which numbered 26 at the time of the 1987 agreement and have since increased to 32 dams (Zeitoun et al., 2019). The Wehdah dam has yet to be filled to capacity (Al-Zu'bi, 2021). Jordan's position as a lower riparian state places it a disadvantage for ensuring water security in the Jordan river Basin, especially when climate change threatens the supply of this entire basin (Smiatek et al., 2014).

Figure 1. The Jordan river basin (created using ESRI Light Gray Canvas Basemap 2011)

2.4 Alternative water resources

In the face of Jordan's limited capability to expand traditional supply, Jordanians must understand the alternative water sources available. Greater knowledge of the current water supply limitations will increase support for alternative sources. Wastewater reuse and desalination are considered the most promising options. The Jordanian government has been using treated wastewater for irrigation since the 1980's but wastewater is not included in their integrated water resource management approach (WAJ, 2017). In 2017 the WAJ identified that only 65% of houses were served by sewer systems. Most of the areas that are not served are rural, which is also predominantly where agriculture occurs, making it more difficult to implement wastewater reuse. Additionally, Jordan faces public scepticism and financial limitations to increased wastewater collection and treatment capacity (Breulmann et al., 2019). However more knowledge about wastewater reuse could change people's opinion on its cleanliness and value in a community. To improve acceptance, the Jordanian government, USAID, and Jordanian universities have all constructed demonstration gardens with direct water reuse (Khleifat and McEleroy, 2003; Lindsey, 2020). As more people recognize the environmental, social, and economic benefits of wastewater reuse, there may be broader support for small scale treatment plants (Al-Assaf et al., 2018).

Along with expanded wastewater reuse capacity, Jordan plans to desalinate water. Due to a limited coastline, Jordan has not developed desalination capabilities beyond limited brackish water desalination but is now looking to desalination of the Red Sea to meet increasing demand. Desalination of the Red Sea could be done as part of the Red Sea to Dead Sea Conveyance project with Israel and Palestine. This project proposes building a pipeline from the Red Sea (specifically the Gulf of Aqaba) that would bring desalinated water to Palestine, southern Jordan, southern Israel, and eventually the brine from desalination to the Dead Sea. In exchange for providing desalinated water to southern Israel, Israel would divert more water from Lake Tiberius to Jordan. A later phase of the project will include an additional desalination plant and transmission of desalinated water to Amman (Rabadi, 2016). Phases I and II of this project will bring the water demand exceedance in 2025 to 6% instead of the projected 26% (MWI 2016). However, significant progress has not been made due to the high cost of the project, environmental concerns, and tensions between the countries. Instead, Jordan is conducting feasibility studies for its own Red Sea project to desalinate water in Aqaba and pump it to Amman. This Red to Dead Canal Project will decrease the gap between supply and demand in Amman and Zarqa (Jordan's second most populous city) and reduce reliance on groundwater (Al-Omari et al., 2014). Despite the high cost, the Jordanian government views this project as necessary for adequate water supply. Therefore, understanding the necessity of a new water source may bring the public to further support such an ambitious goal.

As a conclusion, Jordan faces water scarcity because of increased demand combined with water resource mismanagement, climate change, population growth, and limited freshwater resources in the entire river basin. It is vital that Jordanians, both citizens and refugees, be aware of this dire water situation in their country and region. Beyond knowledge of scarcity, it is important for communities to know about their specific water resources, the water supply challenges facing their area, and proposed solutions. As a result, this research article strives to understand how much Jordanian citizens and refugees know about the region's water resources and their perspectives on Jordan's water present and future.

3. LITERATURE REVIEW

3.1 Past studies on water knowledge

Most of the existing literature focusing on water knowledge assesses the effectiveness of water scarcity and conservation knowledge campaigns. Research has been done on how effective water conservation campaigns have been on increasing water knowledge and promoting conservation behaviours. In Barcelona, a study looked at a water conservation campaign that occurred during drought conditions to understand its effectiveness after drought conditions had ended. The study found that the campaign did raise awareness about the drought and conservation behaviours, but more targeted information was needed (March et al., 2013). In Jordan, a survey was done to compare the knowledge of students who had participated in USAID's Jordan Water Conservation Education Project to those who had not, and it found that participation in the campaign increased knowledge about water conservation and performance of conservation behaviours (Middlestadt et al., 2001). Another study analysed the effect of USAID's Water Efficiency and Public Information for Action campaign (WEPIA) on water conservation awareness and behaviour in Jordan. It found that knowledge of water scarcity was not affected by the awareness campaign, nor did it contribute to more conservation practices. However, they found that the campaign increased citizens' awareness that they are responsible for water scarcity and conservation as a solution to scarcity (Zietlow et al., 2016). Thus, they found that sense of responsibility was a determinant for water conservation behaviour. The WEPIA campaign was also analysed in another study, which concluded that the Ministry of Water and Irrigation within the Jordanian government, which worked with USAID to implement this

program, incorporated national security concerns into its water awareness campaigns to persuade citizens that water conservation was a matter of national responsibility (Benedict and Hussein, 2019).

Far less research has been done to assess a community's knowledge about water scarcity and conservation when not connected to a campaign. An Australian study looked at factors affecting water knowledge and water conservation actions and found that overall people had poor water knowledge, but relevant life experiences contributed to greater knowledge (Dean et al., 2016a). Another study looking at the same nationally representative survey of Australians found that demographic characteristics played a role in how knowledgeable and active Australians were regarding water related issues (Dean et al., 2016b). Researchers looking at stormwater knowledge in South Carolina found that only 28% could correctly define a watershed and fewer respondents in inland cities knew that stormwater was not treated before entering waterways, indicating that location factors into water knowledge (Giacalone et al., 2010). These studies emphasized that awareness campaigns are influenced by the different factors that affect public water knowledge.

3.2 Importance of community water knowledge

Community knowledge of a country or region's water issues is often not considered a priority. However, in arid and semiarid countries with a greater likelihood for drought, the importance of water knowledge is greater (Magiera et al., 2006). Increased water knowledge allows citizens to be more engaged in scarcity solutions, including sustainability and conservation (Jiménez et al., 2019). Water knowledge also increases approval of alternative water supplies (Dolnicar et al., 2011). Similarly, water knowledge increases support for new management methods and water policy. For instance, fostering 'water sensitive citizens', those that have cognitive, emotional, and behavioural engagement, allows for more sustainable water management practices (Dean et al., 2016). In addition, "concern," as a component of emotional engagement, was found to indicate support of water conservation policy (Salvaggio et al., 2014). Support for ocean and coastal conservation policy was also related to policy relevant knowledge, a type of cognitive engagement (Steel et al., 2006). In Florida, surface water knowledge was greater among those who engaged in the watershed, because the knowledge was more relevant to them (McDuff et al., 2008). Furthermore, water knowledge is important to making fact based decisions, as lack of knowledge about water sources can lead to decisions based on myths and misconceptions (Daugs and Israelson, 1984). Increasing water knowledge can aid a government or organization in a variety of management and policy endeavours once a community's baseline water knowledge is known.

3.3 Importance of community water perspectives

Water knowledge in a community is coupled with the community's perspectives on water issues, making it equally important to understand. Similar to water knowledge, water perspectives can be shifted by different experiences. In a study of how location affects water attitudes in two Australian areas, it was found that residents in the water scarce area had greater support for conservation behaviours (Gilbertson et al., 2011). Furthermore, a study done in multiple states in the United States concluded that interest in water issues, perceived importance of a water resource, and preferred learning methods affected conservation actions (Adams et al., 2013). This study demonstrated that gaining water knowledge depended on the attitudes of the individuals, so it is important for those making water awareness campaigns to know these attitudes. In this way, understanding the opinions of the community allows for better engagement initiatives to be created (Giacalone et al., 2010). Engaging with people about their perspectives and stories also leads to empowerment and a greater chance for community and government cooperation on inclusive water governance (Enqvist et al., 2020). Furthermore, understanding individual perspectives and prominent opinions can better inform water managers on potential water decisions and behaviours (Eck et al., 2019).

This research will go beyond accessing water scarcity awareness by focusing on water knowledge and perspectives related to water management and regional cooperation in the Middle East. It will also explore whether any demographic factors are associated with water related knowledge and perspectives.

4. METHODOLOGY

4.1 Participants and procedure

The data in this paper was collected through 389 surveys. The survey was designed to get a representative perspective of the Jordanian population and Syrian refugees on questions about water resource management, climate change, and regional water management relationships. the three main region in Jordan were surveyed, specifically, 162 questionnaires were collected from the North (Mafraq, Irbid, Jerash, Ajloun), 137 from the Middle (Zarqa, Amman, Salt, Madaba), and 90 from the South (Karak, Tafilah, Ma'an, Aqaba). The survey was designed to get responses from a representative sample of Jordanians over 18 years old in terms of location, profession, education level, refugee status, gender, and age.

Data for this research was gathered through a survey designed after a thorough literature review. Questions were formed around current and historic water resource management in Jordan and transboundary partnerships in the region to assess participants knowledge of those two areas and opinions on them.

The surveys were conducted through an in person self administered format by the lead author and college educated individuals in the water field. seven data collectors were trained by the lead author on the purpose of this research and all individuals administering the survey had previous experience. The survey questions were written in English and then translated into Arabic prior to the survey being conducted. Surveys were conducted through random sampling within the chosen cities, as potential participants were approached in public, given a brief introduction to the study, and asked if they wanted to participate. Surveys were either completed at the time of distribution or completed later and returned to a researcher.

In-person surveys were chosen to reach a greater sampling pool, including those without access to the technology to complete an online survey. This specifically allowed refugees to answer the questions, giving voice to a population often overlooked in surveys about the Jordanian population.

4.2 Measurement of water knowledge and perspectives

The survey consisted of 27 questions asking participants about their knowledge of and perspectives on water resource management and transboundary partnerships. An additional five demographic questions were asked about age, gender, region, education level and profession. Respondents were also asked if they identified as refugees, and if they did, they were instructed to answer a follow up question about which country they had lived in before. The main survey questions were divided into 14 questions asking about water knowledge and 11 questions asking about water perspectives besides three question about the demographic factors. The survey was designed so that knowledge and perspective questions were asked together within the categories of water resource management and transboundary partnerships. The format of the question depended on the nature of the topic and whether the goal of that question was to assess the respondent's water knowledge or seek their opinions. As a result, 14 questions utilized yes/no options, 3 were multiple choice, 3 used a check all that apply format, and 7 were free response answers. Many questions included a space for respondents to add additional comments if they wished to. The yes/no format included a "don't know" option.

For both water knowledge and water perspective participants answers were scored. The water knowledge questions asked participants facts about Jordan's and the regions water. Therefore, scores were based on the number of facts answered correctly. The "don't know" option was coded as incorrect. Free response answers from questions asking about knowledge were grouped into answers that were correct if given

a specific and appropriate answer Participants were asked to identify water infrastructure in their area and responses of "none" were coded as correct because there could be no projects in their area. For seven questions, "no" was the correct response to the question.

correct scores received one point and incorrect scores zero, however for three free response questions, there were partial and fully correct answers. Partially correct answers received one point and fully correct two points (See table 1). For the water perspectives score, participants were scored on their number of optimistic answers pertaining to the treatment and quantity of water, regional cooperation, peace treaty allocations, and the implementation of water reduction strategies. Since this score reflected a participant's beliefs, the coding of answers as correct and incorrect did not indicate a comment on these beliefs but rather serves as a way to better analyse the perspectives of the respondents. "Don't know" answers were also coded as incorrect. For both scores the answers from Jordanians and refugees were analysed separately in order to understand the differences in knowledge and perspectives.

Table 1: Average scores for water knowledge questions

Knowledge Questions	% Correct (N)	
	Jordanian	Refugee
Identify Jordan's water sources	28.3(89), 21.9(69) *	20.3(15),41.9(31)*
Identify your drinking water source	95.2 (300)	100 (74)
Identify your groundwater source	25.1 (79)	16.2 (12)
Water infrastructure in your region	49.8 (157)	59.5 (44)
Precip. changes - Droughts	14.6 (46)	41.9 (31)
Rainfall Increase	81.6 (257) **	94.6 (70) **
Rainfall Decrease	24.4 (77)	36.5 (27)
Shorter rainy season	25.4 (80)	27 (20)
Longer rainy season	93.3 (294) **	95.9 (71) **
Later rainy season	49.8 (157)	58.1 (43)
Earlier rainy season	95.6 (301) **	93.2 (69) **
Flooding	13.3 (42)	0 (0)
No change	94.3 (297) **	73 (54) **
Climate change decrease water	75.2 (237)	86.5 (64)
Jordan's Water Neighbors - Egypt	89.2 (281) **	100 (74) **
Saudi Arabia	35.9 (113)	16.2 (12)
Israel	72.1 (227)	70.3 (52)
Syria	32.7 (103)	73 (54)
West bank	40.3 (127)	41.9 (31)
Iraq	95.2 (300) **	93.2 (69) **
Gave a water cooperation example	27 (85)	48.6 (36)
Full allocation given in treaty	61.9 (195) **	36.5 (27) **
Knew 1994 water agreement	14.3 (45)	10.8 (8)
Knew Syrian dams	21 (66)	33.8 (25)
Concerned about Disi depletion	54 (170)	56.8 (42)
Named environ. issues in area	34.6(109),25.4(80)*	45.9 34), 12.2(9) *
Named climate change effects	79.4(250),14.6(46)*	94.6(70),2.7(2)*

*Denotes a question with a partially correct answer (left) and fully correct answer (right).

**Questions where the correct response is 'no'.

4.3 Statistical analysis

Jordanian and refugee water knowledge and perspectives responses were analysed through frequencies and comparisons of means. Frequency tables for all questions were created using the Statistical Package for the Social Sciences (SPSS) statistical analysis software. SPSS was used to assess percentages of respondents who had knowledge about a particular water topic and their opinions on water issues. Additionally, SPSS was used to conduct Three-way ANOVA tests to understand the relationships between the mean water knowledge scores of Jordanians and the demographic factors. This was also done to

understand their relationship with the mean score for water perspectives. However, profession was not included in the analysis due to the many professions represented. The remaining free response questions were qualitatively analysed to see trends in responses and unique perspectives. Additional comments were also qualitatively analysed.

5. RESULTS

5.1 Sample demographics

The study sample were collected from the three main regions in Jordan, 36.5% live in Northern Jordan, 35.2% in the Middle region, and 28.3% in Southern Jordan. all particepants were over 18 years old; and 44.5% of the sample wasfemale.. Refugees represents 18.8% of the sample. 86.4% of respondents were employed, and 71% had a university degree or higher. (See table 2).

Table 2: Respondent Demographics

Characteristics		% (n)
Age (years)	18-30	28.8 (112)
31-60		63.8 (248)
60+		7.5 (29)
Gender	Male	55.5 (216)
Female		44.5 (173)
Location	North	36.5 (142)
Middle		35.2 (137)
South		28.3 (110)
Refugee Status	Yes	18.8 (73)
Education Level	Primary	2.8 (11)
Secondary		26.2 (102)
University		57.3 (223)
Masters/Doctorate		13.6 (53)
Profession	Farmer	6.9 (27)
Public Sector		35 (136)
Housewife		4.9 (19)

Private Sector	21.9 (85)
Retired/Unemployed	20.1 (78)
Student	11.3 (44)

5.2 Water knowledge

about 52% of respondents within each group correctly answered questions pertaining to their drinking water source, water infrastructure, certain precipitation changes, the decrease in water availability, what countries Jordan does not share water with, aquifer depletion, and climate change effects, Figure 3.

Less than 50% of respondents within each group correctly answered questions pertaining to Jordan's water resources, local aquifers, certain precipitation changes, some of the countries Jordan shares water with, examples of water cooperation, water treaty specifics and dams on a shared water source, Figure 3.

5.3 Water knowledge scores

The mean water knowledge score for Jordanian participants was 54% (SD=.12, corresponds to a mean of 15.47 questions answered correctly). The minimum score was 28% (8 questions correct) and the maximum score was 87% (28 questions correct).

Three-way ANOVA demonstrated significant main effects for education ($F(1,303) = 8.463$, $p = .004$), location ($F(2,303) = 3.30$, $p = .038$) and age ($F(1,303) = 3.88$, $p = .05$) among Jordanian participants. Pairwise comparison revealed a statistically significant mean difference between education groups, as participants with an undergraduate or higher education had a statistically significant higher mean score (M =0.491, SD =.017) than those with a secondary or lower education (M =.546, SD =.008). A Tukey post hoc test demonstrated that mean scores were significantly higher for the Northern group (M =.525, SD =.018) than the Middle group (M= .487, SD =.016), $p = .005$. There was no significant difference between the Northern and Southern groups (M =.543, SD =.015), $p = .427$. Nor between the Middle and Southern groups ($p = .193$). Pairwise comparison of age resulted in a statistically significant mean difference, with older participants having a significantly greater mean water knowledge score (M =.54, SD = .011) than younger participants (M = .50, SD = .016). No two-way or three-way interactions were observed.

An independent subject T-test comparing the mean score based on gender for Jordanians found no significant difference in means between men (M =.535, SD =.123) and woman (M = .548, SD = .120), $t(313) = -.98$, $p = .328$. An alpha level of 0.05 was used for all tests.

The mean water knowledge score for refugee participants was 58% (SD = .10791, corresponds to a mean of 16.38 questions answered correctly). The minimum score was 25% (7 questions correct) and the maximum score was 80% (24 questions correct).

The mean knowledge scores differed between refugees and Jordanians based on demographics (See figure 3).

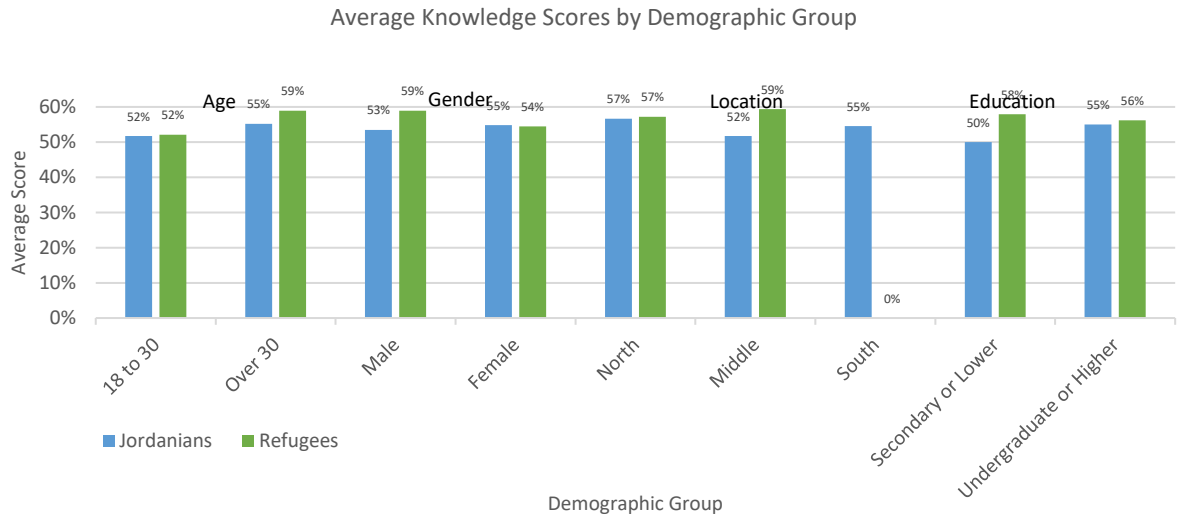

Figure 3 Average water knowledge scores by demographic group for refugees and Jordanians

5.4 Water perspectives

Respondents generally showed favourable views towards water conservation practices, supply alternatives, and regional cooperation. Refugees in particular saw shared water resources as a source of cooperation. Most respondents were supportive of a water conveyance solution.

Respondents, both refugees and Jordanians had mixed feelings about water resource management in Jordan, as they were split roughly equally between whether they had enough water for daily use or not (See table 3).

However, most respondents from both groups were not satisfied with water distribution and treatment in Jordan. They also did not know or did not believe that farmers were currently implementing conservation practices. A great majority of both groups believed that Israel is not giving Jordan the full amount of water allocated in their treaty.

Table 3: Average scores for "Correct" answers to perspective questions

Perspective Questions	% Correct (N)	
	Jordanian	Refugee
Enough for daily use	54.9 (173)	48.6 (36)
Satisfied with treatment	28.9 (91)	25.7 (19)
Your responsibility to conserve	95.2 (300)	87.8 (65)
Farmers should use treated wastewater	72.7 (229)	45.9 (34)
Farmers should grow low water crops	58.7 (185)	73 (54)
Farmers are conserving	21.6 (68)	17.6 (13)
Cooperation likely in region	53.7 (169)	54.1 (40)
Shared water leads to cooperation	18.4 (58)	45.9 (34)
Peace treaty allocation enough	2.5 (8)	10.8 (8)
Syrian dams beneficial	24.4 (77)	78.4 (58)
Support Red to Dead conveyance	59.7 (188)	64.9 (48)

5.5 Water optimism score

The mean optimism score for Jordanians was 45% (SD = .16, corresponding to a mean of 5.03 questions answered optimistically). Total optimistic answers for each participant ranged from 0 to 10, corresponding to a minimum score of 0% and a maximum score of 91%.

Three-way ANOVA demonstrated a main effect for education (F (1,303) = 4.31, p = .039). Pairwise comparisons revealed that the group with less education had a statistically significant higher mean (M =.483, SD =.023) than the group with a higher education (M = .429, SD = .001). There were no significant differences between age groups, p = .207, and location, p = .670. No three-way or two-way interactions were observed.

An independent sample T-test comparing the mean score based on gender for Jordanians found no significant difference in mean score between men (M =.441, SD =.163) and women (M =.452, SD =.158), t (313) = -.562, p = .575).

The mean optimism score for Refugees was 51% (SD = 2.17, corresponding to a mean of 5.53 questions answered optimistically). The minimum number of questions answered optimistically was 0 (0%) and the maximum number was 8 (73%).The mean optimism scores differed between refugees and Jordanians based on demographics (See figure 4).

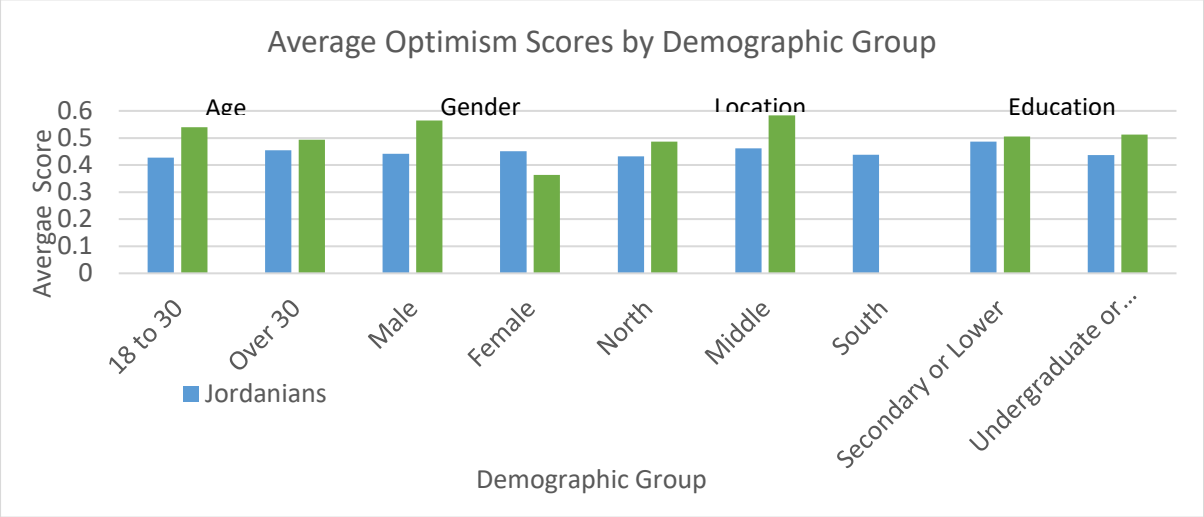

Figure 4 Average optimism scores by demographic group for Jordanians and refugees

5.6 Qualitative answers

One question asked respondents to identify what policies should be enacted to address water scarcity. Respondents answered within one of the categories outlined in figure 5. Interestingly, answers included a need for a more efficient water network for increased distribution, more conservation awareness campaigns, better allocation agreements with Israel and Syria, increased joint transboundary water projects, and the equitable distribution of water. The variety of answers indicates that Jordanians have a wide range of suggestions based on the water issues they know best. Combining this detailed list of community perspectives on policy solutions with increased water knowledge would increase support for these solutions throughout the community and allow community members to work together and advocate for the policies they need in their area.

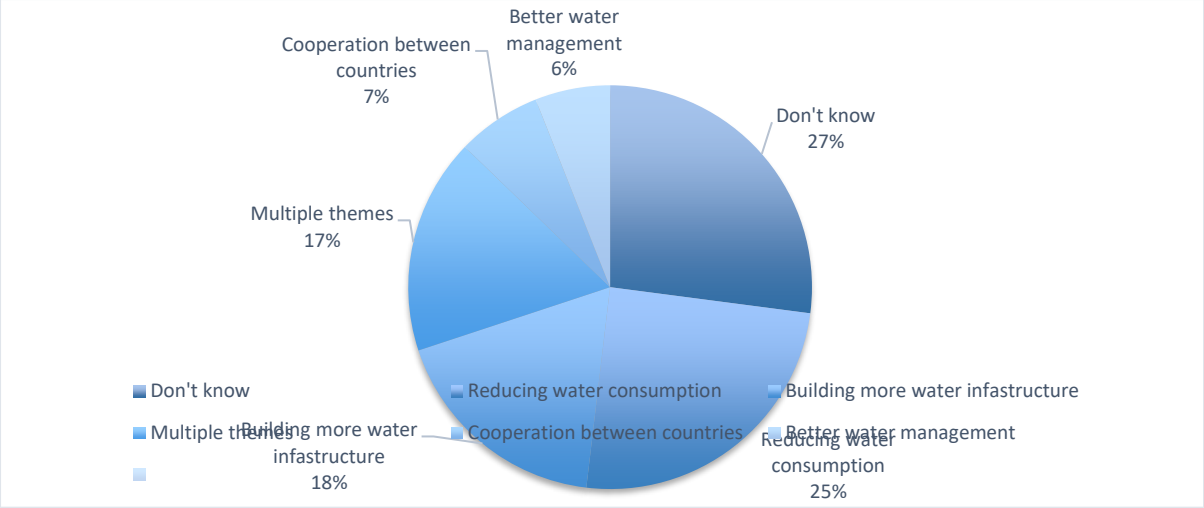

Figure 5 Policies to address water scarcity

6. DISCUSSION

This study uniquely examines knowledge of and perspectives on Jordan's water resource management and transboundary water interactions through the eyes of Jordanians and refugees throughout the country. The comparisons and insights gained from this study can be used to inform engagement initiatives, including government awareness campaigns, future policies, and nonprofit educational objectives.

6.1 Demographic influences on knowledge and perspectives

Overall knowledge scores demonstrated that a higher education level led to a higher knowledge index score. Knowledge campaigns and curriculum are often targeted at schools and universities, so more water knowledge is gained with more exposure to water conservation topics. People with a lower education level may have emotional and behavioural engagement with water sources but lack the formal education that leads to cognitive engagement. As a result, educational resources regarding water sources should be written and distributed in such a way that people with a secondary or lower education can gain insight from them. Pairing cognitive engagement with other forms would give individuals broader context for the water issues they are seeing at a local level.

A lower education level was also associated with a higher optimism score. This connects to the result regarding water knowledge and education level. Those with a higher education level can follow and read the news critically, allowing them to conceptualize the water issues based on the risk to their water resources, their career field, and the future of the region's water. Understanding the severity of water problems introduced at university or on the news leads to uncertainty and pessimism. People with a lower education level may not have been taught to analyse environmental or political issues, making them less fearful and more optimistic about the status of water resources.

Older age was associated with a higher mean knowledge score. This could be attributed to their greater knowledge of historic rainfall patterns and political tensions. Older Jordanians may have a memory of the climate in Jordan a couple decades ago and thus have a better idea of how it has changed recently, whereas younger Jordanians may not be able to fully appreciate how much the Jordan river has decreased or how much hotter it has gotten. They also would have a better understanding of older political events, like the signing of the 1994 Peace Treaty and what it entailed. While education level and age may be related, no interaction between these two demographic factors was found.

Analysis of region found that people in northern Jordan had greater water knowledge than participants in central Jordan. Northern Jordan

contains more agriculture than the population dense central Jordan and farmers need greater water knowledge to understand how their crops will be affected by water scarcity. They have a vested interest in conserving their water resources, which requires knowledge of them. Residents of central Jordan interact with water through storage tanks above their homes and thus are less connected to the country's water resources. In the south, historic Bedouin communities also did not have an abundance of water for irrigation and thus view water resources differently. Geography of the locations contributes to these lifestyles and transboundary water knowledge. Farming occurs within the Jordan Valley and along the Yarmouk River, making farmers aware of transboundary water actions affecting these waters. While people in central Jordan utilize transboundary waters for domestic use, it is again not as readily apparent what rivers or aquifers their water is coming from, so transboundary relationships are not as focused on. Transboundary water is not as prevalent in Southern Jordan and the water that is shared is groundwater, which has less visible changes, so there is also less of a focus on knowledge about its shared use, nor is there focus on the farther away transboundary water issues. Based on these results, it is important for water education initiatives to tailor information that will engage people based on their education level and location.

It is also interesting that gender did not influence scores. In this regard, water scarcity can be seen as in issue that effects all Jordanians and refugees, regardless of gender. Therefore, within the targeted age, education, and location demographics, both men and women should be included in knowledge initiatives. It is important to stress that while gender did not influence respondent's knowledge and attitudes about water resources, gender traditionally informs who is most affected by water scarcity. Water insecurity affects women and girls more than men, so steps must also be taken to ensure women have the water knowledge they need, are included in water management decisions, and that their status does not become more vulnerable with increasing water scarcity (Andrew et al., 2019).

6.2 Jordan's physical water resources

Many participants lacked knowledge of Jordan's water resources and the water management infrastructure to utilize these resources. For instance, the inability to name groundwater sources suggests a disconnect from this vital resource. With so many aquifers experiencing a deficit from unsustainable abstraction, it is important for residents to connect their diminishing groundwater source with their own water security. At a higher level, the inability of 75% of participants to name both groundwater and surface water as sources of Jordan's water indicates a need for increased watershed awareness. In total, only a third of participants mentioned groundwater as a source, yet groundwater makes up 59% of Jordan's water supply (WAJ, 2017). Over half of Jordanians and refugees did display concern over the depletion of the Disi aquifer, but with this being the last available traditional water source (Rajsekhar and Gorelick, 2017), the extremity of future water scarcity is not fully reaching everyone. The Jordanian government also needs to increase knowledge of water projects, like wastewater treatment plants or water pipelines, so people are aware of the steps Jordan is taking to manage water and whether adequate steps are being taken in their area. Of the respondents who answered the question about projects in their area, only 19% answered with a type of project. Many respondents identified no projects in their area, which could indicate a lack of infrastructure in certain areas, but also that the government needs to better inform consumers about their water infrastructure to increase citizen's cognitive engagement with Jordan's water resources.

6.3 Jordan's water present and water future

Jordanians and refugees understood the effects that climate change will have on the region. It was widely acknowledged that there will be a decrease in water availability (over 75% for both groups), an increase in temperature (over 60% for both groups), and a later rainy season (over 49% for both groups). Participants were asked to

list current environmental issues in their area and most respondents were able to provide an issue, including increased temperatures related to global warming, drought, pollution, urbanization, resource mismanagement, and Jordan's water shortage. Far fewer responses included more than one issue. Participants were also asked to choose which effects of climate change they were worried about occurring in the entire region. Most respondents who answered this question were able to identify at least one effect in their area, but very few could name more than two effects. Respondents had a basic understanding of the issues currently affecting them and what issues will arise in the future, but it is necessary for residents to have a greater understanding of the many ways climate change is and will affect individual health and water security.

In addition to acknowledging climate change's effects on the region, some participants also realized how climate change has been affecting and will affect their water sources. While less than half of respondents were worried about drought and about having less groundwater, more people saw issues with their water supply. Only half of respondents believed there was enough water for daily use. Less refugees than Jordanians believed they had enough water for daily use due to frequent water cuts. Jordan is reported to have an urban-rural divide in drinking water and sanitation coverage, causing rural areas to have less access to water for drinking and daily use (Zawahri et al., 2011). Additionally, less than a third of respondents in each group were satisfied with water treatment. This response could be attributed to Jordan's water quality index score, the lowest in the Middle East and North Africa (MENA) region due to intermittent water supply (Zawahri et al., 2011). Even though some participants noticed issues with their water resources, there could be greater awareness of how the quantity and quality of people's own water will shift due to climate change.

Along with a broad understanding of climate change, people understood the need for conservation. The great majority of respondents believed it was their responsibility to conserve water, with some people commenting it was a national responsibility to do so. Most respondents were in favour of farmers using treated wastewater and crops that use little water. These positive responses to reducing agricultural water demand, specifically for use of treated wastewater, signifies that most of the Jordanian population has recognized the benefits of water reuse and changed their attitude about concerns over odour and decreased property values (Breulmann et al., 2019). The Jordanian government, USAID, and Jordanian universities have all constructed demonstration gardens with direct water reuse to aid in increasing sociocultural acceptance (Khleifat and McEleroy, 2003; Lindsey, 2020). Despite their support for this alternative resource, less than a third of Jordanians and refugees believed that farmers were implementing these policies, with 42% from both groups saying they did not know whether farmers were conserving water. This result could signal to water agencies that they need to focus on informing the public about current water conservation practices. If the government implements policies that citizens support and communicates the status of projects, individuals might be more satisfied with the government's water management practices. Campaigns could bridge the disconnect between broad understandings of conservation efforts and climate change with the realities of current and future water management.

6.4 Preconceived notions of transboundary water partnerships

Respondents displayed limited knowledge regarding the countries Jordan shares its water resources with. Of the six options given, four were correct: Israel, Saudi Arabia, Palestine (West Bank), and Syria. Yet the only country that over 50% of both groups could identify was Israel. Less refugees than Jordanians knew that Saudi Arabia shared water resources with Jordan but over 70% of refugees knew that Syria shared water resources. Most refugee participants were Syrian (78%) which accounts for their knowledge of the shared Yarmouk River. Jordanians scored higher than refugees regarding Saudi Arabia perhaps because there are fewer refugees near the Saudi border. The low scores for Saudi Arabia across all

participants could also be due to the nature of the shared water resource, the Disi aquifer. As an underground source it is not as easily noticed as a river delineating a country border. Respondents' limited knowledge of shared regional water sources can lead to less regional thinking, as Jordanians will not realize that their water usage affects another country and in turn is affected by other countries.

Responses regarding the nature of transboundary water relationships differed between refugees and Jordanians. About half of respondents from both groups were optimistic that Jordan would be able to cooperate with its water neighbours. However, far more refugees saw water as a source for cooperation and were able to give an example of cooperation over a shared water source. A greater number of refugees also indicated that the dams on the Yarmouk River were beneficial, despite only about a third saying they knew about them. As mentioned above, most of the refugee respondents were Syrian which could contribute to their support of Syrian water infrastructure. Their understanding of both Jordan's and Syria's water needs may contribute to their optimism about cooperation, as they understand that the region's water resources are finite and must be managed responsibly within each country and together.

Limited knowledge of the shared water basin also led to limited knowledge of agreements between countries in the shared basin. However, a lack of knowledge did not prevent respondents from sharing perspectives on regional water issues. When asked about stipulations in the 1994 Peace Treaty between Israel and Jordan, both Jordanians and refugees were unaware of the agreement details, yet overwhelmingly believed that the treaty did not allocate enough water to Jordan and that Israel was not giving Jordan the full amount of water stipulated. Without knowing the facts of the water agreement respondents based these decisions off political and hydrologic conflicts between countries, which can lead to continued tension and misunderstandings. Answers regarding the Syrian dams also displayed this same disconnect, as just 21% of Jordanians indicated they knew Syria had dams along the Yarmouk, but when asked if the dams were beneficial to the region, 76% of Jordanians believed they were not. As a result, it is not surprising that less than 20% of Jordanians believed cooperation was more likely to occur in the region than conflict. Positivity about Jordan and its water neighbours working together in the face of climate change was barely above 50%. These responses exemplify the need for water education to ensure that people make informed decisions based on facts rather than decisions based on stereotypes and dominant narratives (Hussein et al., 2020). Having opinions based on the realities of water issues will allow for greater dialogue and understanding of the regional water situation. Thus, increasing knowledge of transboundary water resources would lead to a better understanding that regional cooperation is necessary to protect each country's water resources.

7. CONCLUSION

This cross-sectional research analysed the knowledge and perspectives of Jordanian citizens and refugees concerning water resource management and transboundary water partnerships, as well as the demographic factors that affected their responses. Jordanians and refugees scored an average of 54% and 58%, respectively, on the water knowledge index, which indicates a need for more water education initiatives. Education should particularly be focused on Jordan's water sources, less publicised changes in the region's climate, and transboundary water cooperation. Additionally, Jordanians and refugees lacked optimism about the region's water resources based on average optimism index scores of 45% and 51%. Participants were not satisfied with water treatment, did not believe that farmers were conserving water, and lacked optimism regarding transboundary cooperation and the current agreements.

There were also differences in knowledge and optimism between Jordanians and refugees, as refugees had higher average scores. Refugees displayed greater knowledge of changes in water supply, regional water cooperation, and

transboundary topics that include Syria. However, refugees displayed less knowledge of Jordan's water sources and transboundary conflict between Israel and Jordan. The focused nature of their knowledge represents the unique status they have in Jordan regarding water. Refugees can be considered hydraulic citizens because they utilize Jordan's water supply and infrastructure but are not fully citizens (Anand, 2011). They may not feel the same national responsibility to conserve as Jordanian citizens, but they rely on the same water as citizens. Initiatives that frame refugees as hydraulic citizens may increase refugee knowledge of Jordan's resources and engagement in conservation efforts. At the same time, refugees should be included in water management and policy decisions, because these will affect them too.

Furthermore, the greater belief in cooperation among refugees is an important result for regional peace considerations. Jordan's generosity towards refugees points to regional cooperation, and perhaps when refugees return home, they will translate their optimism into action by continuing this cooperative effort in transboundary issues. Continued interaction with the refugees living in Jordan may also shift Jordanian's opinion on the potential for regional water cooperation.

In addition to shifting education initiatives to meet the lived experiences of refugees and Jordanians, different demographic factors within these groups should also be considered. Particularly a respondent's age, education level, and location and their influences on water knowledge and optimism scores. Respondents of different age groups have different memories to base water knowledge and opinions on. Furthermore, respondents with higher education levels engage with educational material differently than those with lower education levels. The regional variation in responses demonstrates the locality of water issues and a need to focus on both national and regional water education. Citizens and refugees need further education on water issues in their immediate areas, so they are aware of changes in the quality and quantity of the water they rely on. At the same time, it is important to understand the broader relationship between countries relying on a shared river or groundwater basin.

Educational campaigns by the Jordanian government, nonprofits, or other organizations need to recognize the knowledge gaps that exist in all demographic factors, since it is necessary to promote knowledge for all Jordanians and refugees regardless of their identities. Overall, this research demonstrates the importance of identifying the basis of people's water knowledge and their prominent beliefs about key water issues, as these can inform the development of water policies and community awareness and engagement campaigns.

Acknowledgements

The authors thank Jehad Jazi, Nouf Al-Shoumali, Yaqin Al-Tabini, Baraa Libzo, Nowar Bishmaph, Riham Niamat, and Rania Harfoushi, for conducting the surveys and inputting data. They are also grateful to Amy McGill for editing this article. Finally, the authors thank the Jordanian citizens and refugees who took the time to share their knowledge and opinions.

References

[1] Adams, D.C.; Allen, D.; Borisova, T.; Boellstorff, D.E.; Michael D. Smolen, and Robert L. Mahler. 2013. The influence of water attitudes, perceptions, and learning preferences on water-conserving actions. Natural Sciences Education 42: 114-122, https://doi.org/10.4195/nse.2012.0027

[2] Al-Assaf, R.; Almanaseer, N.; Hindiyeh, M. and Chiogna, G. 2018. Impact of wastewater treatment and reuse on the environment and public health; case study from Jordan. Proceedings of the European Geosciences Union General Assembly 2018. pp. 19796. Vienna, Austria, 4-13 April, 2018, https://www.researchgate.net/publication/323308656_Impact_of_wastewater_treatment_and_reuse_on_the_environment_and_public_health_case_study_from_Jordan (accessed 2 August 2021)

[3] Al-Karablieh, E. and Salman, A. 2016. Water resources use and management in Jordan - A focus on groundwater. Project Report No. 11. Colombo, Sri Lanka: International Water Management Institute, https://gw-mena.iwmi.org/wp-content/uploads/sites/3/2017/04/Rep.11-Water-resources-use-and-management-in-Jordan-a-focus-on-groundwater.pdf (accessed 2 August 2021)

[4] Al-Omari, A.; Salman, A. and Karablieh, E. 2014. The Red Dead Canal project: an adaptation option to climate change in Jordan. Desalination and Water Treatment 52(13-15): 2833-2840, DOI: 10.1080/19443994.2013.819168

[5] Al-Zu'bi, M. 2021. 'Water, Energy and Food: The problematic aspects of the transition from "Silo Approach" to "Nexus Approach" in the Arab Region (Jordan Case).' Presented at SIT Orientation Week, Amman, Jordan, 26 January 2021.

[6] Anand, N. 2011. PRESSURE: The PoliTechnics of Water Supply in Mumbai. Cultural Anthropology. 26(4): 542-564. https://doi.org/10.1111/j.1548-1360.2011.01111.x

[7] Andrew, E.; Borges, C. and Palmioli, L. 2019. The gendered impacts of climate change: The Jordan river basin region and water scarcity. Project Report. Vienna, Austria: The Organization for Security and Co-operation in Europe, Regional Academy on the United Nations. http://www.ra-un.org/uploads/4/7/5/4/47544571/13_osce_the_gendered_impacts_of_climate_change.pdf (accessed 2 August 2021)

[8] Benedict, S. and Hussein, H. 2019. An analysis of water awareness campaign messaging in the case of Jordan: Water Conservation for State Security. Water 11(6): 1156, http://dx.doi.org/10.3390/w11061156

[9] Berk, R.A.; Schulman, D.; McKeever, M. and Freeman, H.E. 1993. Measuring the impact of water conservation campaigns in California. Climatic Change 24 (3): 233-248. DOI: 10.1007/BF01091831

[10] Black, E. 2009. The impact of climate change on daily precipitation statistics in Jordan and Israel. Atmospheric Science Letters 10 (3): 192-200, https://doi.org/10.1002/asl.233.

[11] Breulmann, M.; Müller, R.; Al-Subeh, A. Subah, A. and van Afferden, M. 2019. Reuse of treated wastewater and biosolids in Jordan – Nationwide Evaluation. Project Report. Amman, Jordan. Leipzig, Germany: Helmholtz Centre for Environmental Research – UFZ with support from the Jordanian Ministry of Water and Irrigation, https://www.researchgate.net/publication/339612734_Reuse_of_Treated_Wastewater_and_Biosolids_in_Jordan_-_Nationwide_Evaluation (accessed 2 August 2021)

[12] Daugs, D.R. and Israelsen, C.E. 1984. A philosophy and framework for water education. Water International 9(2): 84-89, DOI: 10.1080/02508068408686067

[13] Dean, A.J.; Fielding, K.S. and Newton, F.J. 2016a. Community knowledge about water: Who has better knowledge and is this associated with water-related behaviours and support for water-related policies? PLOS ONE 11(7): 18, https://doi.org/10.1371/journal.pone.0159063

[14] Dean, A.J.; Lindsay, J.; Fielding, K.S. and Smith, L.D.G. 2016b. Fostering water sensitive citizenship – Community profiles of engagement in water-related issues. Environmental Science & Policy 55: 238-247, www.sciencedirect.com/science/article/pii/S146290111530099X

[15] Dolnicar, S.; Hurlimann, A. and Gruen, B. 2011. What affects public acceptance of recycled and desalinated water? Water Research 45(2): 933–943, DOI: 10.1016/j.watres.2010.09.030

[16] Eck, C.; Wagner, K.; Chapagain, B. and Joshi, O. 2019. A survey of perceptions and attitudes about water issues in Oklahoma: A Comparative Study. Journal of Contemporary Water Research & Education 168(1): 66-77, https://doi.org/10.1111/j.1936-704X.2019.03321.x

[17] Enqvist, J.; Ziervogel, G.; Metelerkamp, L.; van Breda, J.; Dondi, N.; Lusithi, T.; Mdunyelwa, A.; et al. 2020. Informality and water justice: community perspectives on water issues in Cape Town's low-income neighbourhoods. International Journal of Water Resources Development

Ahead of Print: 1-22, DOI: 10.1080/07900627.2020.1841605

[18] Esri. "Light Gray Canvas" [basemap]. Scale Not Given. "World Light Gray". September 26, 2011. https://www.arcgis.com/home/item.html?id=8b3d38c0819547faa83f7b7aca80bd76. (accessed 2 August 2021)

[19] Falkenmark, M.; Lundqvuist, J. and Widstrand, C. 1989. Macro-scale water scarcity requires micro-scale approaches: Aspects of vulnerability in semi-arid development. Natural Resources Forum 13(4): 258–267, doi: 10.1111/j.1477-8947.1989.tb00348.x

[20] Giacalone, K.; Mobley, C.; Sawyer, C.; Witte, J. and Eidson, G. 2010. Survey says: Implications of a public perception survey on stormwater education programming. Journal of Contemporary Water Research & Education 146: 92-102, https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1936-704X.2010.00395.x

[21] Gilbertson, M.; Hurlimann, A. and Dolnicar, S. 2011. Does water context influence behaviour and attitudes to water conservation? Australasian Journal of Environmental Management 18(1): 47-60. DOI: 10.1080/14486563.2011.566160

[22] Hussein, H.; Natta, A.; Yehya, A.A.K. and Hamadna, B. 2020. Syrian Refugees, Water Scarcity, and Dynamic Policies: How Do the New Refugee Discourses Impact Water Governance Debates in Lebanon and Jordan? Water 12(2): 325, https://doi.org/10.3390/w12020325

[23] Jordan and Syria. 1953. Agreement concerning the utilization of the Yarmuk waters. United Nations Treaty Series, No. 2437, https://treaties.un.org/doc/Publication/UNTS/Volume%20184/volume-184-I-2437-English.pdf (accessed 2 August 2021)

[24] Jiménez, A.; LeDeunff, H.; Giné, R.; Sjödin, J.; Cronk, R.; Murad, S.; Takane, M. and Bartram, J. 2019. The enabling environment for participation in water and sanitation: A conceptual framework. Water 11(2): 308, https://doi.org/10.3390/w11020308

[25] Khleifat, M. and McElroy, C.W. 2003. Water reuse implementation in the Kingdom of Jordan. Paper presented at XI World Water Congress Madrid, Spain, 5-9 October 2003 https://www.iwra.org/member/congress/resource/MADRID2003_charles_mcelroy_EN.pdf (accessed 2 August 2021)

[26] Krichak, S.; Breitgand, J.; Samuels, R. and Alpert, P. 2011. A double-resolution transient RCM climate change simulation experiment for near-coastal eastern zone of the Eastern Mediterranean region. Theoretical and Applied Climatology 103(1):167-195. DOI: 10.1007/s00704-010-0279-6

[27] Lindsey, U. 2020. Land of no rain: How Jordan is facing a parched future. Al-Fanar Media, 6 August 2020. www.al-fanarmedia.org/2020/08/land-of-no-rain-how-jordan-is-facing-a-parched-future/ (accessed 2 August 2021)

[28] Magiera, P.; Taha, S.; and Nolte, L. 2006. Water demand management in the Middle East and North Africa. Management of Environmental Quality International 17(3): 289-298, DOI: 10.1108/14777830610658700

[29] McDuff, M.; Appelson, G.; Jacobson, S.; and Israel, G. 2008. Watershed management in north Florida: public knowledge, attitudes, and information needs. Lake and Reservoir Management 24(1): 47-56, DOI: 10.1080/07438140809354050

[30] March, H.; Domènech, L.; and Saurí, D. 2013. Water conservation campaigns and citizen perceptions: the drought of 2007–2008 in the Metropolitan Area of Barcelona. Natural Hazards 65(3): 1951–1966, DOI 10.1007/s11069-012-0456-2

[31] Middlestadt, S.; Grieser, M.; Hernández, O.; Tubaishat, K.; Sanchack, J.; Southwell, B. and Schwartz, R. 2001. Turning minds on and faucets Off: Water conservation education in Jordanian schools. The Journal of Environmental Education 32 (2): 37-45, https://doi.org/10.1080/00958960109599136

[32] MWI (Ministry of Water and Irrigation). 2016. National Water Strategy 2016 – 2025. Amman: Ministry of Water and Irrigation. www.fao.org/faolex/results/details/en/c/LEX-FAOC156264/#:~:text=The%20National%20Water%20Strategy%202016,and%20environmentally%20water%20sector%20development (accessed 2 August 2021)

[33] NAMA Strategic Intelligence Solutions. 2020. Perception of refugees in Jordan survey (Wave I). Amman: UNHCR. https://data2.unhcr.org/en/documents/download/83522 (accessed 2 August 2021)

[34] Rabadi, A. 2016. "The Red Sea–Dead Sea desalination project at Aqaba." Desalination and Water Treatment 57(48-49): 22713-22717, DOI: 10.1080/19443994.2016.1157991

[35] Rajsekhar, D. and Gorelick, S. 2017. Increasing drought in Jordan: Climate change and cascading Syrian land-use impacts on reducing transboundary flow. Science Advances 3(8): e1700581. DOI: 10.1126/sciadv.1700581

[36] Salvaggio, M.; Futrell, R.; Batson, C.D. and Brents, B.G. 2014. Water scarcity in the desert metropolis: how environmental values, knowledge and concern affect Las Vegas residents' support for water conservation policy. Journal of Environmental Planning and Management 57(4): 588–611. doi:10.1080/09640568.2012.756806

[37] Smiatek, G.; Kunstmann, H. and Heck, A. 2014. High-resolution climate change impact analysis on expected future water availability in the Upper Jordan catchment and the Middle East. American Meteorological Society 15(4): 1517–1531. DOI: 10.1175/JHM-D-13-0153.1.

[38] Steel, B.; Lovrich, N.; Lach, D. and Fomenko, V. 2006. Correlates and consequences of public knowledge concerning ocean fisheries management." Coastal Management 33(1): 37-51. DOI: 10.1080/08920750590883105

[39] Talozi, S. Altz-Stamm, A.; Hussein, H. and Reich, P. 2019. What constitutes an equitable water share? A reassessment of equitable apportionment in the Jordan–Israel water agreement 25 years later. Water Policy 21(5): 911–933. DOI: https://doi.org/10.2166/wp.2019.143

[40] Israel and Jordan. 1994. Treaty of Peace between the State of Israel and the Hashemite Kingdom of Jordan: Annex II. Volume 2042, No. 1-35325, https://peacemaker.un.org/sites/peacemaker.un.org/files/IL%20JO_941026_PeaceTreatyIsraelJordan.pdf (accessed 2 August 2021)

[41] Waslekar, S. 2011. The Blue Peace: Rethinking Middle East Water. Mumbai, India: Strategic Foresight Group.

[42] WAJ (Water Authority of Jordan). 2017. Jordan Water Sector-Facts and Figures 2017. Amman: Water Authority of Jordan. www.waj.gov.jo/sites/en-us/Hot%20Issues/Jordan%20Water%20sector-Facts%20and%20Figures%202017.pdf (accessed 2 August 2021)

[43] WRI (World Resources Institute). 2019. Baseline Water Stress Country Ranking. www.wri.org/applications/aqueduct/country-rankings/ (accessed 2 August 2021)

[44] Zawahri, N.; Sowers, J. and Weinthal, E. 2011. The politics of assessment: Water and sanitation MDGs in the Middle East. Development and Change 42(5): 1153-1178, https://doi.org/10.1111/j.1467-7660.2011.01730.x

[45] Zietlow, K.; Michalscheck, M. and Weltin M. 2016. Water conservation under scarcity conditions: testing the long-run effectiveness of a water conservation awareness campaign in Jordan. International Journal of Water Resources Development 32(6): 997-1009, DOI: 10.1080/07900627.2016.1159947

[46] Zeitoun, M.; Abdallah, C.; Dajani, M.; Khresat, S.; Elaydi, H. and Alfarra, A. 2019. The Yarmouk tributary to the Jordan River I: Agreements impeding equitable transboundary water arrangements. Water Alternatives 12(3): 1064-1094, https://www.water-alternatives.org/index.php/alldoc/articles/vol12/v12issue3/555-a12-3-11/file