

**Engaging Women in
Water, Sanitation and Hygiene (WaSH):
A case study in the Irbid Governorate of Jordan**

**by
Maria Kawahara**

B.Sc. (Geography), University of Victoria, 2016

Project Submitted in Partial Fulfillment of the
Requirements for the Degree of
Master of Resource Management

in the
School of Resource and Environmental Management
Faculty of Environment

Project No.: 750

© Maria Kawahara 2020
SIMON FRASER UNIVERSITY
Summer 2020

Copyright in this work rests with the author. Please ensure that any reproduction or re-use is done in accordance with the relevant national copyright legislation.

Approval

Name: Maria Kawahara

Degree: Master of Resource Management

Title: Engaging Women in Water, Sanitation and Hygiene (WaSH): A case study in the Irbid Governorate of Jordan

Project Number: 750

Examining Committee:

Chair: Mark Cantu
PhD Candidate in Resource and Environmental Management

Zafar Adeel
Senior Supervisor
Professor of Professional Practice

Sean Markey
Supervisor
Professor

Date Defended/Approved: July 10, 2020

Ethics Statement

The author, whose name appears on the title page of this work, has obtained, for the research described in this work, either:

- a. human research ethics approval from the Simon Fraser University Office of Research Ethics

or

- b. advance approval of the animal care protocol from the University Animal Care Committee of Simon Fraser University

or has conducted the research

- c. as a co-investigator, collaborator, or research assistant in a research project approved in advance.

A copy of the approval letter has been filed with the Theses Office of the University Library at the time of submission of this thesis or project.

The original application for approval and letter of approval are filed with the relevant offices. Inquiries may be directed to those authorities.

Simon Fraser University Library
Burnaby, British Columbia, Canada

Update Spring 2016

Abstract

Access to water, sanitation and hygiene (WaSH) is essential in achieving good health, nutrition, livelihoods, and education. An important dimension of WaSH is the impact of water scarcity on gender roles. In times or regions of water scarcity, there is an increasing burden to achieve water security while the responsibility to provide these resources remains the same. To better understand the perceptions and gaps in knowledge for water-use behaviours, this study applied a gender lens to identify the gaps in knowledge and education for WaSH within villages located in the Irbid Governorate of Jordan. The responses from five case studies offer valuable insight into behaviours and perceptions that impact sustainable and equitable WaSH practices, as well as regionally-specific educational gaps and recommendations on educational resources. The findings are intended to support the development and implementation of educational programs to promote safe and adequate WaSH practices within water-scarce countries.

Keywords: Gender; water; sanitation; hygiene; water scarcity; Jordan

Dedication

I would like to dedicate this project to the wonderful participants in Jordan who made this research possible. I would like to extend my most sincere thanks for sharing your time and knowledge with me. A very special thank you to the Royal Society for the Conservation of Nature (RSCN) in Jordan for their support and guidance and for sharing their knowledge and time with me.

Acknowledgements

I am very grateful to my supervisor, Dr. Adeel, for sharing your knowledge and perspectives with me during my academic journey. Thank you for giving me the opportunity to do my masters in your lab and for making this such a rewarding experience. I would also like to thank Dr. Adeel and Dr. Markey for their time reviewing my thesis and providing guidance for this project.

I am so thankful to all research participants who shared their time and knowledge with me. Thank you to the Royal Society for the Conservation of Nature (RSCN) who made it possible to engage with the participants in Irbid, and spent time familiarizing me with the various regions, people and culture of Jordan. A huge thanks to the RSCN team who guided me in Jordan. Thank you for all your kindness, patience and laughter during my short time in Jordan. Thank you to those who spent time shaping and reviewing this project, and for sharing your knowledge with me.

Thank you to my cohort for being there for discussions, laughs and adventures. I'm grateful to my friends for their love and laughter even if we weren't always living in the same city. A special thanks to my partner Javi for always believing in me and finding a way to laugh. You're the best adventure partner and friend, and I'm so grateful to have you by my side. A huge thank you to my parents for all their love and my siblings for always being awesome.

Table of Contents

Approval.....	ii
Ethics Statement.....	iii
Abstract.....	iv
Dedication.....	v
Acknowledgements.....	vi
Table of Contents.....	vii
List of Tables.....	x
List of Figures.....	xii
Chapter 1. Introduction.....	1
1.1 Objectives.....	2
1.1.1. Integrated Water Conservation and Management in Yarmouk Nature Reserve Project.....	2
1.1.2. International Collaboration for Women’s Water Security in the Arab Region..	3
1.1.3. Specific Objectives of this Research Study.....	4
Chapter 2. Literature Review.....	5
2.1. Water, Sanitation and Hygiene Context.....	5
2.1.1. Water, Sanitation and Hygiene Indicators.....	6
2.1.2. Gender and the Environment.....	7
2.2. Jordan.....	9
2.2.1. Summary.....	9
2.2.2. Gender.....	11
Control and Decision-Making at a Household Level.....	12
2.2.3. Drinking Water.....	13
Water Quality.....	15
Water Accessibility.....	16
2.2.4. Sanitation and Hygiene.....	18
Chapter 3. Methods.....	20
3.1. Conceptual Framework.....	20
3.1.1. Gender Framework.....	21
3.2. Targets and Indicators.....	22
3.2.1. Water Quality.....	24
3.3. Qualitative Methodology: Multiple case study analysis.....	25
3.3.1. Case and Participant Selection.....	25
3.3.2. Analysis by Gender and by Location.....	26
3.3.3. Literature Review.....	27
3.3.4. Semi-structured Interview Questions.....	27
3.3.5. NVivo Coding.....	27
3.4. Demographic.....	28
Chapter 4. Case Study Context.....	30

4.1.1.	WaSH Services in the Irbid Governorate	32
4.1.2.	The Yarmouk Basin, River, and Nature Forest Reserve	34
4.1.3.	Banai Kenanah District	35
Chapter 5.	Results.....	37
5.1.	Gender Roles Identification	37
5.2.	Drinking Water.....	39
5.2.1.	Safe Consumption of Water.....	39
5.2.2.	Availability	40
5.2.3.	Accessibility.....	42
5.3.4	Perceived Water Quality	43
5.3.	Safe Sanitation and Hygiene Practices.....	45
5.4.1	Sanitation.....	45
5.4.2	Hygiene	46
5.4.	Gender	47
5.4.1.	Gender Needs	47
5.4.2.	Disaggregating the control of resources and decision-making within the household.....	47
5.5.	Knowledge about Safe Household Water-Related Activities	48
5.6.1	Water Reuse.....	49
5.5.1.	Coping Methods	50
5.6.	Education	51
5.6.1.	Past Education	51
5.6.2.	Recommendations and Methods	51
5.7.	Identified Gaps in WaSH Education.....	53
5.8.	Emerging Themes	55
Chapter 6.	Discussion.....	56
6.1.	Exploring the Emerging Themes.....	56
6.1.1.	Trust: Health Impacts & Conflicting Messages in Water Quality.....	56
6.1.2.	Consume it Wisely: Sustainable Water Management.....	57
6.1.3.	Affordability: Ability to Cope with Water Challenges.....	58
6.1.4.	Water Services at the Community Level	60
6.1.5.	Yarmouk Basin: Interactions with the Yarmouk River and Springs.....	62
6.2	Gender Equality.....	64
6.1.6.	Balancing the Triple Role.....	66
6.1.7.	Intersectionality.....	67
6.2.	Overview and Rationale for the Identified Gaps in WaSH Education across the Five Case Studies	68
6.2.1.	Water Use	68
	Water Reuse: Infrastructure and Treatment of Greywater Prior to Irrigation	68
	Water Savings: Advanced Water Savings and Plumbing Techniques	69
	Agriculture: Interest in agricultural programs - Collecting water runoff effectively ...	71
6.2.2.	Drinking Water.....	72
	+Chlorine: Safe Practices on using Chlorine for Household Treatment	72

Storage Tanks: Increasing the number of storage tanks available; promoting education on cleaning and storing water safety in household tanks	72
Rainwater Harvesting Systems: Safe Collection and Storage for Rainwater Harvesting.....	73
6.2.3. Sanitation and Hygiene.....	74
Wastewater.....	74
Land Treatment: Safe Practices for Land Treatment of Wastewater	75
Children Sanitation.....	77
6.3. Summary of the Rationale for Identified WaSH Education	77
Chapter 7. Recommendations and Conclusion.....	79
7.1. Limitations	80
7.2. Recommendations to Deliver Educational Programs	81
7.2.1. Reduce Barriers for Women and Girls to Access Workshops	82
7.2.2. Design programs to Consider the Triple-Role	83
7.2.3. Address Practical and Strategic Gender Needs.....	83
7.2.4. Connect WaSH Education to Reducing Financial Costs	84
References.....	86

List of Tables

Table 3-1.	SDG targets and global indicators (WHO & UNICEF, 2017; WHO & UNICEF, 2018, UNGA, 2015; UN-SDGs, 2016)	21
Table 3-2.	The categorical scale to rate the perceived water quality source from participants (Source: Author, 2019).....	24
Table 3-3.	District, municipality and number of households for each study site (Population and Housing Census, 2016).....	26
Table 3-4.	Demographic information collected from all five case studies.....	29
Table 4-1.	Irbid and Jordan (DOS, 2018a; DOS, 2019; International Labour Organization, 2016; UNHCR, 2019; Department of Statistics, 2018b)....	32
Table 4-2.	Household WaSH services in the Irbid Governorate and Jordan (DOS, 2018b).....	34
Table 4-3.	Data on the Banai Kenanah District for 2013 (International Labour Organization, 2016).....	36
Table 5-1.	Identification of gender household activities	38
Table 5-2.	Domestic Drinking Water Sources Identified by Location	39
Table 5-3.	Domestic Drinking Water Sources Identified by Gender	40
Table 5-4.	Household Water availability by Location	41
Table 5-5.	Household Water Availability Identified by Gender	41
Table 5-6.	Perceived water quality by location based on categorical scales and JMP classifications.....	44
Table 5-7.	Perceived water quality by gender based on categorical scales and JMP classifications.....	44
Table 5-8.	Household Wastewater for each case study.....	45
Table 5-9.	Household Wastewater identified by gender	45
Table 5-10.	Community hygiene resources in each case study.....	46
Table 5-11.	Community hygiene resources identified by gender	46
Table 5-12.	Gender needs assessment for women across the five case studies – Moser Framework	47
Table 5-13.	Control of resources and decision-making within the household disaggregated between female and male based on the literature review.	48
Table 5-14.	Water use practices for water-reuse for all five case studies	49
Table 5-15.	Water use practices for water-reuse identified by gender	50
Table 5-16.	Recommendations for methods of delivering educational material as identified by the participants across all five case studies	52
Table 5-17.	Recommendations for methods of delivering educational material as identified by gender.....	53
Table 5-18.	Identified gaps in education for water use, drinking water, and sanitation and hygiene identified by participants in focus groups across the five case studies	53

Table 5-19.	Identified gaps in education for water, use, drinking water, and sanitation and hygiene identified by gender.....	54
Table 5-20.	Emerging themes from the five case studies across seven villages.....	55

List of Figures

Figure 2-1.	New JMP Service Ladders based off the WHO & UNICEF, 2017 and UNICEF & WHO, 2018 report (WHO & UNICEF, 2017a; UNICEF & WHO, 2018).....	7
Figure 3-1.	Hybrid Framework of the Goals and Indicators based on the WHO/UNICEF JMP Guidelines (WHO & UNICEF, 2017), the UNICEF & WHO report (2018), and Moser Framework (Moser, 1993; Fletcher, 2018)	23
Figure 4-1.	Location of the Irbid Governorate in Jordan (Jordan University of Science & Technology, nd)	31
Figure 4-2.	Closer examination of the study sites (Google, 2020)	36
Figure 5-1.	Household Water Availability Classifications	41
Figure 5-2.	Distribution of gaps in WaSH education based on Water Use, Drinking Water, and Sanitation-Hygiene.....	54

Chapter 1. Introduction

At the conclusion of the period designated for the implementation of the Millennium Development Goals (MDGs) (2000-2015), there were 2.3 and 2.6 billion people that gained access to improved drinking water and improved sanitation¹, respectively (WHO & UNICEF, 2015). More than 5 billion people around the world are using safely managed drinking water services (representing over 70% of the global population). However, there are still 844 million people without a basic drinking water service and approximately 2.3 billion people without a basic sanitation service (WHO & UNICEF, 2017). An important dimension of water, sanitation and hygiene (WaSH) that gained global recognition in recent years is the impact of water scarcity on gender roles. In 2015, it was reported that women and girls were responsible for off-premise water collection in 8/10 households (WHO & UNICEF, 2017a). Traditional gender norms persist in many water-scarce regions where women and girls are responsible for household water-related tasks (i.e. water collection, cleaning, cooking, and washing) despite the water availability declining (Haddadin, 2006). It has been well documented the key role that women play in water conservation and sustainable consumption as they are often the first to experience any changes in quality or quantity of water resources and often engage in coping strategies during times of water shortages or poor water quality (Arafa, El-Fattal & Laamrani, 2007; Klassert, Sigel, Klauer, & Gawel, 2018).

The Sustainable Development Goals (SDGs) were adopted in 2015 and drew global recognition by addressing the impacts of WaSH on women and girls (Abu, Bisung, & Elliott, 2019). Namely, SDG 6.2 aims to *'achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations'*. WaSH initiatives can have a significant role in supporting gender equality and has been extensively explored in published literature. Research in WaSH has highlighted the social inequalities stemming from inadequate infrastructure, education, and the disproportionate burden on accessing clean water, and adequate sanitation and hygiene resources while often being excluded

¹ Between the period of 1990-2015

from higher decision-making of water management or water governance (Das, 2014; Jumare, Bashir, & Ankoma-Sey, 2015; Miirio et al., 2018; Sweetman & Medland, 2017).

This research project supports SDG 6.2 by assessing the impacts of WaSH on women and girls in five case studies in rural regions of Jordan. The aim of the research project is to identify recommendations for improving WaSH education for women and girls that are regionally appropriate in order to reduce the burden of household WaSH tasks as well as to encourage women into higher decision-making roles for water management.

1.1 Objectives

1.1.1. Integrated Water Conservation and Management in Yarmouk Nature Reserve Project

The research study presented in this report was conducted under the umbrella of the *Integrated Water Conservation and Management in Yarmouk Nature Reserve Project* (referred hereinafter as “the Yarmouk Project”) that is developed and implemented by the Royal Society for the Conservation of Nature (RSCN) in Jordan. The RSCN was established in 1996 as an independent national organization with the mission of protecting and managing Jordan’s natural resources (Royal Society for the Conservation of Nature, nd). The RSCN has established seven protected areas that encompass more than 1,200 km². The Yarmouk Nature Reserve is one of these protected areas and is located in the north of Jordan, covering an area of 20 km² (Royal Society for the Conservation of Nature, nd).

The goal of the Yarmouk Project is to “*apply an integrated water natural resource management approach in Yarmouk Forest Reserve that assures a long-term conservation and sustainable use of natural water system in the area*” (Royal Society for the Conservation of Nature, nd). The Yarmouk Project seeks to address the negative impacts on the Yarmouk Nature Reserve through public participation and engagement with the community members and stakeholders that are living in the region. The deliverables of the Yarmouk Project include activities such as sustainable agricultural practices programs, as well as awareness and capacity building (Royal Society for the Conservation of Nature, nd).

This research project aims to provide insight into water-use behaviours and perceptions by engaging in public participation and engagement with community members living in or nearby the Yarmouk Nature Reserve. The findings from this study identify the educational gaps in safe WaSH practices and can be used within the Yarmouk Project to support the development and implementation of educational material and activities to promote sustainable and safe household practices in the Yarmouk Nature Reserve.

1.1.2. International Collaboration for Women's Water Security in the Arab Region

Past discussions and research on international water security in the Arab region have helped lay the groundwork for this research project. The Pacific Water Research Centre (PWRC) at Simon Fraser University, promotes research on water issues at multiple scales and has been involved in international collaboration for discussing and reviewing women and water security in the Arab region.

In 2018, the UN Symposium on Women and Water Security for Peacebuilding in the Arab Region was held in Beirut, Lebanon; organized by the United Nations Department of Economic and Social Affairs (UN DESA) in collaboration with the United Nations Economic and Social Commission for Western Asia (UN ESCWA) and the PWRC. The Symposium aimed to review the emerging water security gender nexus within the Arab region and explore opportunities to strengthen national capacities in support of numerous SDGs such as those that support safe water and sanitation for all (SDG6) and gender equality (SDG 5). Key messages from the Symposium included highlighting the importance of intersectionality noting that women must be considered a diverse group within water security solutions, as well as the importance of equipping women to be agents of change in water security and peacebuilding (United Nations, 2018).

As part of the UN-funded project, I was involved in developing both a discussion paper for the Symposium as well as a policy brief on women and water security for peacebuilding in the Arab region (Adeel, Zaman, Kawahara & Sharma, 2018; United Nations, 2018). The discussions at the UN Symposium in Beirut as well as the research conducted for that event, were essential in laying the groundwork for the research on water security in Jordan presented in this report. This research project offers valuable insight into behaviours and perceptions that impact sustainable and equitable WaSH practices in

a water-scarce country. The findings are intended to support the development and implementation of future educational programs to address water security for women in the Arab region.

1.1.3. Specific Objectives of this Research Study

The specific objectives of this research study are to identify the gaps in knowledge and education for water, sanitation, and hygiene (WaSH), through five focus group interviews with participants from seven villages residing in the Yarmouk Nature Reserve in Jordan. This study also incorporates a gender lens in order to better understand the perceptions and gaps in knowledge for water-use behaviours of women and girls in the Yarmouk Nature Reserve. These findings are intended to support the development and implementation of educational programs to promote safe and adequate WaSH practices within these communities and reduce any adverse environmental impacts in the Yarmouk Nature Reserve.

To meet the objectives, the following steps were undertaken:

1. Conduct a literature review on the linkages between gender and resources, global WaSH targets and indicators; as well as status of WaSH in Jordan, focusing on rural northern communities;
2. Conduct five focus group interviews in seven villages in the Irbid Governorate of Jordan; and,
3. Analyze the data to determine gaps in WaSH education for the five focus groups, each taken as a case study, using data from both the focus groups as well as a literature review.

Chapter 2. Literature Review

2.1. Water, Sanitation and Hygiene Context

The literature review for this research project included the SDG-related documents and various UN reports and guidelines for water, sanitation and hygiene with a gender-lens. That primary review was then expanded to analyze goals and practices in Jordan for WaSH, water resource management, and gender equality. The latter review included academic literature, grey literature, government reports, as well as documents and records on water resources in the Yarmouk Nature Reserve provided by the RSCN. In addition, I was part of the development of the background paper for the UN Symposium in 2018 which reviewed women and water security in the Arab region and included Jordan as a case study (Adeel, Zaman, Kawahara, & Sharma, 2018). That prior literature review and related research was also integrated into the literature review for this research project.

Access to water, sanitation and hygiene (WaSH) is essential in achieving good health, nutrition, livelihoods, and education (World Bank, 2017; Bartram & Cairncross, 2010). The concepts of water security and the human right to water and sanitation have been combined in the SDGs as a pathway for sustainable development and improvement for human wellbeing (UNGA, 2015²; Bradley & Bartram, 2013).

Water security can be discussed at micro and macro scales and take on different meanings for various uses such as domestic/household, and community or livelihood purposes. Generally, water security is understood to mean that there is the ability to have and rely on water of safe quality for all purposes, including agriculture and ecosystem-functions. This definition is reflected in the Millennium Ecosystem Assessment (2005) which describes water security as a basic and key element in achieving human wellbeing. In recent years, the definition of water security has become more comprehensive to adjust to the significant challenges of growing populations, climate change, changes in the global hydrological cycle, as well as social, economic and geo-political conditions (Sandford, 2017).

² Resolution adopted by the General Assembly on 25 September 2015. *A/RES/70/1*.

At a household level, water security can be defined as ‘*access by all individuals at all times to sufficient safe water for a healthy and productive life*’ (Webb & Iskandarani, 1998). Improving a household’s water security is often associated with the idea of improving access to water and is jointly combined into *water, sanitation, and hygiene (WaSH)* efforts (Bradley & Bartram, 2013).

2.1.1. Water, Sanitation and Hygiene Indicators

Since 1990, the UNICEF & WHO Joint Monitoring Programme for Water Supply and Sanitation (JMP) have been monitoring the progress on goals for drinking water and sanitation and developed a framework to meet targets (UNICEF & World Health Organization, 2018). The UNICEF & WHO JMP framework has established benchmarks also called ‘*service ladders*’ to compare and monitor progress towards the WaSH SDG targets at a household level. The highest benchmark includes ‘*safely managed*’ drinking water sources and sanitation services, followed by ‘*basic*’, ‘*limited*’, ‘*unimproved*’, and ‘*no service*’.

To classify as a ‘*safely managed*’ the drinking water source must be protected against contamination, be located on premises, be available when needed, as well as be free from any faecal and chemical contamination (UNICEF & WHO, 2018; Khan et al., 2017). The UNICEF & WHO (2018) report reveals that drinking water sources need to have indicators that expand beyond improving water quality and instead incorporate accessibility and availability, especially for women and girls who are often primarily responsible for managing household water tasks.

The UNICEF & WHO report in 2018 identified *core household WASH Indicators* and suggests that the data be disaggregated by factors such as income, sex, age, race, ethnicity, disability, and geographic location (Bain et al., 2014; Bain et al 2014a; Amjad, Ojomo, Downs, Cronk, & Bartram, 2015; UNICEF & WHO, 2018). The new JMP Service ladder for SDGs relating to WaSH are shown in Figure 2-1 for *Drinking Water, Sanitation and Hygiene* (UNICEF & WHO, 2018). The SDG target 6.2 for hygiene identified handwashing facilities with soap and water as an important indicator at a household level. In addition, menstrual hygiene management (MHM) was also identified as a newly established SDG indicator but was not incorporated into this study (UNICEF & WHO, 2018).

Service Level	Drinking Water Ladder	Sanitation Ladder	Hygiene Ladder
Safely Managed	Improved drinking water source on premise, available when needed, free from contamination	Improved facilities not shared; safely disposed wastewater	N/A
Basic	Improved drinking water source, 30 min or less for collection	Improved facilities not shared with others	On premise handwashing facility with soap and water
Limited	Improved drinking water, over 30-minute collection time	Improved facilities shared	On premise handwashing facility
Unimproved	Drinking water collected from unprotected well or spring	Pit latrines without slab/platform, use of bucket or hanging latrines	N/A
No Service	Drinking water from open source (ie. stream, lake, dam)	Wastewater disposed in open spaces	Not on-premise handwashing facility

Figure 2-1. New JMP Service Ladders based off the WHO & UNICEF, 2017 and UNICEF & WHO, 2018 report (WHO & UNICEF, 2017a; UNICEF & WHO, 2018)

2.1.2. Gender and the Environment

The term *gender* can refer to a variety of meanings but, is generally referring to the political, economic, and socio-culturally constructed roles, responsibilities and expectations that are attributed to an individual related to being male or female (Myrtilinen, Cremades, Frohlich, & Gioli, 2018; The World Bank, 2011). Gender constructs organizes societies, impacts decision-making opportunities, and can determine the level of access and control one may have to resources and benefits (March, Smyth, & Mukhopadhyay, 1999; Moser, 1989).

Differences in the balance of power between women and men as a result of these socially constructed roles is described as gender inequality. Goetz (2007) argues that

gender inequality can be overcome through gender justice which is a process that brings accountability to social institutions with the aim to ensure all individuals have equal access and control over resources (Mukhopadhyay & Singh, 2007; Geotz, 2007). One of the important frameworks to address gender inequalities is shown in SDG 5, which aims to '*achieve gender equality and empower all women and girls*'. The framework for SDG 5 includes targets and indicators to formally recognize unpaid care and household work (SDG 5.4), as well as to promote women's full participation and equal opportunity for leadership in decision-making (SDG 5.5).

It is also critical to recognize the intersectionality within gender and other identity markers such as: age, social class, religious background, disability, marital status, and those living in an urban or rural setting (Thompson, 2016). Recognizing women as a heterogeneous demographic, can facilitate greater understanding in the social-cultural components of a country (Myrntinen et al., 2018). Arora-Jonsson (2011) reported that literature often portrays women as virtuous heroes or vulnerable victims in an environmental conflict. She argues that these generalizations can increase the responsibilities or workload for women while masking the inequalities in decision-making within resource management (Arora-Jonsson, 2011).

It has been argued that women are more familiar with changes in local resources because of the division of household tasks. For instance, women may be the first to identify the degradation of water quality or decrease in quantity available for their household. In times of water insecurity, women play a crucial role in strengthening the household water use efficiency as they adopt practices to conserve and protect water resources (Arafa et al., 2007). Agarwal (1992) describes women as '*active agents in movements of environmental protection and regeneration*' (Agarwal, 1992, p.119). The author recognizes women as key knowledge-holders for local resources and argues for a greater formal acknowledgment of women in resource management decisions (Agarwal, 1992).

2.2. Jordan

2.2.1. Summary

Jordan has made significant improvements to WaSH services over the past few decades with 98% of households reported to have both an improved source of drinking water³ as well as improved toilet facility⁴ (DOS & ICF, 2019). However, Jordan faces significant WaSH-related challenges due to the extreme water shortages in the country. In 2016, the Ministry of Water and Irrigation (MWI) in Jordan reported the annual renewable water resources per person at less than 100m³ (Ministry of Water and Irrigation, 2016). Jordan's water availability per capita is significantly below the identified water scarcity threshold of 1,000m³ capita⁻¹ year⁻¹, and the absolute water stress threshold of <500m³ capita⁻¹ year⁻¹ (Falkenmark, Lundqvist, & Widstrand, 1989; Damkjaer & Taylor, 2017). Jordan is reported to have one of the lowest water levels per capita (Rajsekhar & Gorelick, 2017) and is among the world's ten most water-deprived countries (Assayed, et al., 2013). The severe water scarcity in Jordan can be attributed to a variety of factors including the arid and semi-arid climate with 90.5% of Jordan receiving less than 200mm of mean annual rainfall (Aladaileh, Al Qinna, Karoly, Al-Karablieh, & Rakonczai, 2019), the increasing demand due to population growth and influx of refugees (Ministry of Water and Irrigation, 2016), and inadequate management of water resources (Hussein 2018).

Since 2011, Jordan has taken in over 1.3 million registered refugees, of which 1 million are Syrian, as well as thousands more of unregistered refugees (Rajsekhar & Gorelick, 2017). The water scarcity in Jordan, coupled with the mass migration of refugees into the country has placed immense pressure on the already limited water resources and facilities. Farishta (2014) reported that Jordan's water management strategies and infrastructure was unprepared to meet the demands of both the resident and displaced persons population for both drinking water, wastewater, land use changes, food and energy demands. The water demand in Jordan has already exceeded the delivery

³ **Improved source of drinking water** encompasses piped water, protected springs, and rainwater. Those that use bottled water are also included only if the water source comes from an improved source (DOS & ICF, 2019)

⁴ **Improved toilet facilities** encompass any non-shared toilet that is one of the following: flush/pour flush to piped sewer systems and pit latrines, ventilated improved pit latrines, and pit latrines with slabs (DOS & ICF, 2019)

capacity resulting in the government implementing restrictive policies on water such as water pricing, intermittent and rationed water delivery for piped water (Rosenberg, Talozzi, & Lund, 2008; Klassert, Sigel, Gawel & Klauer, 2015); promoting households to adopt water-efficient technologies; and, implementing water-conservation education programs to alter consumption habits at a household level (Ministry of Water and Irrigation, 2016).

There are three main governmental authorities in Jordan responsible for the water sector including the Ministry of Water and Irrigation (MWI), the Water Authority of Jordan (WAJ) and the Jordan Valley Authority (JVA). The MWI is the central power body for managing the water sector in Jordan responsible for both freshwater supply as well as wastewater systems (Polimeni, Almalki, Iorgulescu, Albu, Parker, & Chandrasekara, 2016). Jordan's National Water Strategy (2008-2022) identified several methods to alleviate water stress on the water resources and focused on strategies to meet the demand for water (Ministry of Water and Irrigation, 2008). The updated National Water Strategy (2016-2025) is responsive to the new changes in the region including the geopolitical conflict an increasing population trends (Ministry of Water and Irrigation, 2016).

Efforts to increase water conservation and water efficiency practices have led the country to significantly decentralize water tasks by relying on multiple water companies and associations for providing water services, delivery and management. These efforts have been identified as improving the system by increasing the population served, improving water quality, and reducing water loss (Haddadin, 2006). For instance, many Jordanian households use alternative water sources to cope with water shortages. The alternative water sources include purchasing water from informal private tanker operators, purchasing filtered piped or tank water bottles from private water stores, or smaller water bottles from markets and other stores (Rosenberg et al., 2008; Klassert et al., 2015). Numerous retail outlets are registered and licensed by the Ministry of Health to sell drinking water and serves hundreds of customers. Purchased water from a retail store is reported to be expensive but is generally identified as a high-quality source that is trusted by the public. In contrast, purchasing water from a private vendor such as a water tanker truck, have varying water quality sources with prices fluctuating based on the season, demand, and flexibility of the driver (Rosenberg et al., 2008).

In times of water scarcity, there is an increasing burden to achieve water security while the responsibility to provide these resources remains the same (Haddadin, 2006). It is important to recognize that different barriers and challenges exist for women of different nationalities, income, family size, and location in Jordan (DoS & Fafo, 1998; Japan Emergency NGO, 2013; Haddadin, 2006; Arafa et al., 2007). For instance, the burden of water collection is reported to be intensified in rural regions where the water sources are located farther from the home and can consume large amounts of time that could be directed towards other tasks (Haddadin, 2006).

2.2.2. Gender

Over the past few decades, Jordan has made significant strides in the empowerment and well-being of women and girls. The Kingdom has experienced an increase in the number of women participating in the labour force and seen an improvement in educational attainment. From 1996-2017, the number of female workers grew by more than 10% (15% to 25.7%), and illiteracy rates for women decreased by more than 12% (20% to 7.2%) (Department of Statistics & Fafo, 1998; Department of Statistics, 2019). Women's health has also improved in Jordan as represented in a decrease in infant mortality rates from 23% in 2010 to 17% in 2018 (Department of Statistics, 2019).

Numerous reports and studies have already recognized different barriers and challenges in achieving water security between those living in rural and urban areas, as well as resident Jordanian women and those who are refugee and internally displaced persons (IDPs) (Japan Emergency NGO, 2013; UNHCR, 2018; UNHCR, 2014; Strategic Foresight Group, 2015). These inequalities are also reflected in the 2018 under-5 mortality rates in Jordan which increase for women living in rural regions as well as those children born to Syrian women (under-5 mortality rate of 25 deaths per 1,000 live births for Syrian mothers in comparison to 16 deaths per 1,000 live births for those of other nationality) (DOS & ICF, 2019).

The United Nations High Commissioner for Refugees (2018) reported that 85% of Syrian refugees in Jordan live below the absolute poverty line (68 JOD per month, equivalent to \$134 CAD⁵). Poverty rates are also found to be higher among Syrian refugee

⁵ Or \$96 USD last updated April 09, 2020

female-headed households than male-headed households. Nearly half of all Syrian refugee households living outside of camps indicated bad or urgent living conditions and two out of five had poor sanitary conditions (UNHCR, 2014).

Women in rural demographic regions, also experience more socio-economic and health challenges due to inadequate water and sanitation sources available compared to women living in urban areas (Haddadin, 2006). In rural regions, the additional barriers to collecting and accessing clean water sources can include traveling far distances to purchase water, treating the water before use, require additional pumping, and greater urgency is placed on women to maintain other activities that support conserving and reusing water sources. These tasks are not only physically and mentally demanding, but also consume time that could be directed towards other educational or economic tasks (Haddadin, 2006; Arafa et al., 2007).

Control and Decision-Making at a Household Level

Jordan has made significant strides in empowering women within political and social spheres. In January 2016, the framework of Gender Justice was adopted in the Arab Region in the seventh session of the Committee on Women of the Economic and Social Commission for Western Asia (UNESCWA) through the Muscat Declaration (UNESCWA, 2016). Jordan has developed their own National Action Plan (NAP), which includes initiatives to promote women's participation in peacebuilding processes and integrates gender-perspectives into strategies and plans. The Jordanian government has also worked to mainstream gender policies by establishing Jordan's National Women's Machinery (NWM), a gender-unit operating within government (The Jordanian National Commission for Women, 2017).

Gender barriers continue to exist in Jordan for issues of economic and political participation impacting women's access to control resources and participate in decision-making within the household. This is reflected in unequal regulations on women through the inheritance and labor laws, as well as social norms that discourage women from equally participating in decision-making and controlling resources.

According to Civil Law Art 1086, women will typically receive half of what is given to men in their inheritance (Al-Dahdah, Corduneanu-Huci, Raballand, Ababsa, & Sergenti, 2016). In practice however, woman will often waive their inheritance all together due to

societal pressures (Al-Dahdah et al., 2016; UNDP, 2018). Women's ownership of land, property and the control of resources (i.e. livestock, tools, machinery) in the family are low, particularly in rural and traditional communities, as a result of these practices (UNDP, 2018). In addition, equal pay between women and men are not identified under the Labour Code No.8 of 1996 despite acknowledged within the constitution. Legal restrictions are also placed under the Labour Code on women's employment where there may be subject to health and or safety risks. Some of these occupations include mineral welding, working in mines, shipping and dock work (UNDP, 2018).

In recent years, the Jordanian government has been recognizing women's crucial role in water management and increasing opportunities for women to participate in non-traditional roles in the labour force. This is reflected in the collaboration between the Jordanian government and local and international groups to develop leadership and management skills for women in water-related programs. The Jordan's Ministry of Water and Irrigation has partnered with the Germany Agency for International Cooperation to implement the *Water Wise Women* program that works with communities to provide training in plumbing for women. The *Water Wise Women* program integrates local knowledge and strategies to increase education on water security and empower women in water management (Prieto, 2018).

2.2.3. Drinking Water

The drinking water sources in Jordan vary and are influenced by factors including the household's socio-demographics and geographic location (Klassert et al., 2015; Al Mahasneh, Mousa, Jalamneh, Hani, & Zawahreh, 2010). Rosenberg et al (2008) conducted a study in/outside the capital Amman in 2004 and reported that water treated in home or purchased at a store are an expensive but a trustworthy source that are '*used exclusively for drinking and cooking*' purposes. However, a 2017-18 national household study in Jordan reported that for both rural and urban households, the most common drinking water source identified was first piped water, and secondly, bottled water (DOS & ICF, 2019). Approximately 95% of the population living in urban regions in Jordan are connected to a piped water supply and almost 90% in rural areas (Ministry of Water and Irrigation, 2017). Rural households reported relying more on bottled water (42%), and rainwater (7%) for their drinking water source in comparison to urban households (37% and 2% respectively) (DOS & ICF, 2019).

While a household in Jordan may be connected to the piped network, it does not ensure adequate access to the quantity, quality, or regularity of the water resource (Potter & Darmame, 2010). The piped network is distributed at an intermittent, rationed, and priced system (Assayed et al., 2013; Rosenberg et al., 2008; UNICEF, nd) with over 50% of the population receiving piped water for 24 hours once per week or less, and the remaining Jordanians have reported to receive water more than 24 hours of supply per week (Ministry of Water and Irrigation, 2017). The municipal water service is divided into zones with rotating days and times for distributing water (Rosenberg et al., 2008). Piped water distribution in rural regions is less frequent reported at often less than once every two weeks (UNICEF, nd).

Due to the irregular distribution of the piped network, most households engage in coping strategies in times of water shortage or poor water quality to ensure their basic needs, such as drinking water, can be met. Coping strategies include storing water in/around the household including rooftop, groundwater tank(s) or cistern(s) (Klassert et al., 2015; Assayed et al., 2013); purchasing alternative water sources such as tanker truck operators, or markets (Rosenberg et al., 2008); and/or utilizing pumps to draw extra water from the pipes (Mustafa & Talazi, 2018). Many households also adopt water-conservation behaviour such as water reuse, installing water-saving devices, altering their landscape water demands, and searching and fixing water-leaks (Rosenberg et al., 2008).

Many households rely on alternative water sources and home-filtration units for their household needs (Klassert et al., 2015). According to Klassert et al. (2015), alternative water sources to piped water include purchasing water from private tanker operators, 10-20L bottles from water stores that filter the tanker/piped water, or 1-2L water bottles from stores (Rosenberg et al., 2008). In rural regions, many households rely on rainwater harvesting systems (Rosenberg et al., 2008; Al Mahasneh et al., 2010; DOS & ICF, 2019; Assayed et al., 2013).

Rainwater harvesting is an important strategy promoted by the Jordanian government since 1995 to help address the water scarcity in the country. Rainwater harvesting systems can be used for both household and irrigation purposes (Abdulla & Al-Shareef, 2009). The rainwater harvesting systems can be seen across the country and are commonly collected from rain on the rooftop into a cistern or ground tank (Rosenberg et al., 2008). The rainwater harvesting wells in the northern regions of Jordan account for

91.8% of the total wells in the country, with 7.4% in the middle governorates, and less than .8% for regions in the south (Abdulla & Al-Shareef, 2009). The Jordanian government has also enacted laws that requires new homes to construct water collection storage tanks (Abdulla & Al-Shareef, 2009).

Water Quality

In 2004-2005, Jordan participated in a national study in partnership with WHO/UNICEF to examine their drinking water quality. The study found that Jordan's tap water quality was within the permissible limits established by the Jordanian standards (JISM, 2001, 2004) as well as the World Health Organization's (WHO) recommendations for safe drinking water (1998). Additional studies have been conducted on Jordan's water quality (Batarseh, 2006; Alomary, 2013) which sampled various drinking water sources and reported that they all generally fell within the permissible limits. However, both studies reported that some tap water samples indicated significant concentrations of metal that were beyond the Jordanian standards (JISM, 2001) or international guidelines. Both authors noted that this could dissolution of metals form storage tanks or metal pipes.

Despite numerous studies indicating the drinking water sources in Jordan are within permissible limits outlined by national and international water quality recommendations, gastrointestinal illnesses are still reported in Jordan including *Escherichia coli* (*E. coli*), and *Cryptosporidium* (specifically *C. parvium*) (Swedan & Alrub, 2019; Ibrahim, 2019; Hijjawi, Ng, Yang, Atoum, & Ryan, 2010; Youssef et al., 2000; Nimri, 2003; Abo-Shehada, Hindyia, & Saiah, 2004). The presence of *E. coli* indicates contamination from faecal matter in water sources and is a well-known contaminant (Swedan & Alrub, 2019; Ibrahim, 2019). *Cryptosporidium* species are a protozoan parasite that can cause acute diarrhoea, nausea, vomiting, and weight loss (Ryan, Zahedi, & Papparini, 2016). The parasite has been documented to be prevalent in Jordan (Hijjawi et al., 2010; Youssef et al., 2000; Nimri, 2003; Abo-Shehada et al., 2004), surviving chlorination and filtration (Steiner, Flores, Pizarro, & Guerrant, 1997) and having more serious impacts on infants (Shrivastava, Kumar, Smith, & Sahu, 2017) and on those with immune-compromised conditions (Steiner et al., 1997).

However, ensuring that the water source is free from contamination is only one component in providing safe water, as numerous reports also highlight the importance of hygienic storage practices including materials, and activities and practices in the

surrounding area (Abo-Shehada, et al., 2004; Batarseh, 2006; Alomary, 2013). For instance, one study in the northern regions of Jordan found that harvested rainwater stored in underground cisterns was exposed to contamination from seepage of wastewater from nearby pits, faecal contamination from animals, from runoff, and the implements used to transport the water were unclean and as a result posed serious health risks to households using these systems (Abo-Shehada et al., 2004; Rabi & Abo-Shehada, 1995; Barreil, 1989). Therefore, it is crucial that household behaviours, practices, and environmental factors are also considered when examining water quality (Abo-Shehada et al., 2004).

In order to help eliminate potential health risks from drinking water, many households in Jordan perform home water treatment on various water sources prior to consumption (Al Mahasneh et al., 2010; Klassert et al., 2015; DOS & ICF, 2019). In-home water treatment could include filters (ceramic or sand), reverse osmosis membranes (RO), ultraviolet disinfection (Rosenberg et al., 2008), and/or lower-cost methods to treat the water such as boiling or adding bleach/chlorine to the water (DOS & ICF, 2019). Perceptions of the quality of water sources vary across households in Jordan. For example, Rosenberg et al (2008) reported that in Amman it is less common than other areas to drink or cook with untreated municipal water. The study also noted that some households view rainwater as 'superior quality' whereas others see it as inadequate, indicating variability in perceptions around water quality (Rosenberg et al., 2008).

Water Accessibility

Almost all households, both urban and rural, have water on the premises (99%) in Jordan; and 98% of households have access to an improved source of drinking water (DOS & ICF, 2019). However, socio-economic inequalities exist, particularly for those of lower income and households residing in rural areas. This can be attributed to the irregular and unpredictable distribution of the piped network which results in households engaging in coping strategies to ensure their daily water needs are met (Potter & Darmame, 2010; Gerlach & Franceys, 2009; Rosenberg et al., 2008; UNICEF, nd; Haddadin, 2006; SFG, 2015).

Significant differences were reported between households of high and low income in their ability to connect to the water network and cope with water shortages (Potter & Darmame, 2010; DOS & ICF, 2019; Rosenberg et al., 2008). Potter & Darmame (2010)

reported that high income households had a water storage capacity five times greater than the average low-income family ($16.25m^3$ and $3.12m^3$ respectively). Further, low-income households were more likely to share a water meter and water storage structures (56%) in comparison to high-income households (12%); and there were differences between low-and-high income households with access to water pumps (28% and 40% respectively) (Potter & Darmame, 2010).

Filtering water is a common practice in Jordan of treating the water to ensure it is safe for consumption. However, almost twice as many urban households (33%) utilized a water filter in comparison to rural families (15%), and more rural households reported to not treat the water prior to drinking (76% rural vs 61% urban) (DOS & ICF, 2019). While the quality of the water is high, the home water treatment units can have high financial costs due to the additional operational and maintenance costs, as well as requiring a large amount of water. According to Rosenberg (2008), *'Most units generate saline waste streams and require raw water inputs up to four times the volume of treated water generated'* (p.498). In addition to the financial costs related to coping strategies, there are costs associated with using the piped water network including a one-time fee to connect, and households are charged for their water based on their usage, which is monitored through a water meter. The rates include water and sewage chargers, as well as water reading and pumping fees (Rosenberg et al., 2008).

The location of the household can also have a significant impact on a family's ability to readily access water sources as the piped network distributes water less frequently to rural regions (UNICEF, nd). Rural households in Jordan reported a lower percentage connected to the piped network (49% rural and 59% urban), a higher number of households collecting rainwater (7% rural and 2% urban), as well as slightly more households using an unimproved water source for drinking water (3.2% rural and 1.5% urban) (DOS & ICF, 2019).

While Jordan has reported water expenditure accounting for only 1% of a household monthly cost (Al-Saidi & Dehnavi, 2009), it is argued that other factors influence water demand and should be considered including the number of household members, the dwelling and location of the household (Klassert et al., 2018), and that affordability should be assessed locally due to households purchasing from private vendors that are priced higher than network prices (OECD, 2009). These factors can be particularly

important when assessing water availability in rural regions as the number of household members is generally larger than urban areas (DOS & ICF, 2019).

2.2.4. Sanitation and Hygiene

Despite the existing water scarcity challenges in Jordan combined with the mass migration of people into the country, Jordan has made significant progress in sanitation and drinking water for the population with 68% of the country connected to a sewage network, and approximately 98% of the wastewater that is collected is treated (UNHCR, 2014). However, prolonged strain on infrastructure has created sanitation challenges including pollution from inadequate disposal of wastewater from cesspools, as well as treated/untreated and wastewater (Salameh, Shteivi, & Al Raggad, 2018).

According to the Department of Statistics, 98% of all households in Jordan used an improved toilet facility (DOS & ICF, 2019). However, the document reported significant differences between rural and urban households in their sanitation facilities with households connected to a flush/pour flush to piped sewer system at 74.4% and 28.2% respectively. Rural areas face greater sanitation challenges with only 6% of households connected to a sewage network (Ministry of Water and Irrigation, 2017). As the public sewage networks are not fully available, particularly in rural regions, the wastewater is often disposed of in seepage pits due to the low-costs and absorption of soil (Abo-Shehada et al., 2004). In rural households, wastewater collection is often through private or shared cesspits that are emptied by either private or the municipal tankers that moves the wastewater to a centralised treatment plant (Lienhoop, Al-Karablieh, Salman, & Cardona, 2014). However, the wastewater in rural regions has led to numerous environmental and health issues as many cesspits are not properly sealed leading to groundwater pollution, households are not able to afford to call a tanker to remove the wastewater causing overflow and potentially spreading diseases, and some private tankers illegal dump wastewater in wadis (Lienhoop et al., 2014).

Water scarcity can lead to an increase in waterborne diseases, such as diarrhea and hepatitis A, due to contamination of water and food sources (Polimeni et al., 2016). The national study in Jordan for 2017-2018 found that 10% of children under the age of five reported diarrhoea in the two weeks prior to the survey, with 21% of these children not receiving any treatment (DOS & ICF, 2019). A study by Okour et al. (2012) in the

Jordan Valley explored the relationship to household conditions and diarrhea in children. The study found that the mother's education, family's income, family size, and household cleanliness were associated with diarrhea occurrence (Okour, Gharaibeh, & Al-Ghazawi, 2012). The study also noted that water availability for tap water (i.e., quantity) negatively impacted more than 76% of the families and was associated with diarrhea.

Chapter 3. Methods

Participant knowledge on safe water, sanitation, and hygiene practices were crucial components in this study to understand the needs for educational resources in WaSH that would benefit the local communities in each case study. This study employed a multiple-case analysis using a semi-structured interview for five focus groups to identify the current knowledge and practices on WaSH. This research project interviewed resident women and men, community leaders, as well as refugee women living in villages in the Yarmouk Nature Reserve.

3.1. Conceptual Framework

The interview questions were guided by the Sustainable Development Goals' (SDGs) framework to address gender equality (SDG 5), clean water and sanitation (SDG 6), and poverty (SDG 1), (UNGA, 2015) shown in Table 3-1. Gender-related goals are reflected in SDG 5 which aims to '*achieve gender equality and empower all women and girls*' with targets to recognize and value unpaid care and domestic work (5.4) and ensure women's full and effective participation for leadership (5.5). Goals to achieve clean water and sanitation are established in SDG 6 which aims to '*ensure availability and sustainable management of water and sanitation for all*'. The targets for SDG 6 are aimed at ensuring improving drinking water services (6.1), and sanitation, and hygiene to all (6.2). WaSH-related goals are addressed again in SDG 1 which aims to '*end poverty in all its forms everywhere*' and includes targets (1.4) that aim to ensure equal rights and access to basic services is provided to all.

Table 3-1. SDG targets and global indicators (WHO & UNICEF, 2017; WHO & UNICEF, 2018, UNGA, 2015; UN-SDGs, 2016)

Sustainable Development Goals	Targets
Goal 1: End Poverty in all its forms everywhere	SDG 1.4 Ensure equal rights to economic resources, basic services, ownership and control over land and other forms of property, inheritance to all men and women, as well as the poor and vulnerable
Goal 5: Achieve gender equality and empower all women and girls	SDG 5.4 Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as national appropriate SDG 5.5 Ensure women’s full and effective participation for leadership at all levels of decision-making in political, economic and public life
Goal 6: Water and Sanitation	SDG 6.1: Safe and affordable drinking water SDG 6.2: Access to adequate and equitable sanitation and hygiene, and end open defecation

3.1.1. Gender Framework

A gender analysis gathers and examines information on gender differences and social relations with the aim to better understand and identify the inequities (March et al., 1999). There are numerous approaches to gender analysis; however, it is argued that there is not one framework to capture all the necessary components to apply a gender lens to the complicated dynamics within the needs for WASH (Lala, Basu, Cronin, & Cronin, 2015). A hybrid framework has been developed in this study to incorporate the strengths from Moser’s Gender Planning Framework (Moser) (Moser C. O., 1993) and the *Gender in environmental crisis and conflict*, which will now be referred to as *Gender in Environment* (Fletcher, 2018). The hybrid framework used for this research project is shown in Figure 3-1.

The *Moser Framework* was developed in the 1980s with the aim to achieve gender equality, equity and empowerment through gender planning. The framework provides guidance on potential interventions to support these initiatives (Moser, 1993). As the focus

in the Moser Framework is placed on the division of activities between women and men, it has been criticized for not analyzing the relationship and dynamics between genders and how decisions are made (March et al., 1999). To accommodate the shortcomings of the Moser framework, *Gender in Environment* framework is chosen as it aims to identify assumptions, important areas of focus, and help future studies avoid over-generalizing or becoming too context specific (Fletcher, 2018). Fletcher's approach aims to integrate important factors such intersectionality to examine the dynamics between and within groups.

3.2. Targets and Indicators

The SDG global goals, targets, and indicators relating to SDG 5, SDG 6, and SDG 1 are discussed in UNICEF & WHO (2018) report, and in the Moser Framework (Moser, 1993) as shown in Figure 3-1. The goals and indicators relating to SDG 5 and SDG 1 includes the identification of gender roles, gender needs, and control of resources and decision-making (Moser, 1993). The goal for gender equality includes the identification for gender roles, specifically the triple-role activities which include reproductive work (childcare and household tasks), community work (volunteering), and productive work (employment) in efforts to bring to light the invisible work women are often engaged in.

Other indicators include a gender needs assessment which identifies the practical (basic needs) and strategical gender needs (needs that advance gender equality). The Moser Framework requires a *Gender Needs Assessment* which evaluates the practical gender needs and the strategic gender needs. The practical gender needs don't challenge gender barriers but rather are intended to assist women in meeting their basic needs including water provision, health-care provision, income opportunities, housing and distribution of food. Women are often responsible for meeting their families' needs and therefore identify these services specifically as their own (March et al., 1999). Strategic gender needs are those that challenge the inequalities between women and men. Actions to address women's strategic gender needs may include those related to division of labour, burden of domestic labour and childcare, and the removal of institutional forms of discrimination through laws or other government action (March et al., 1999).

The indicator for the control of resource and decision-making include determining the female and male's access to resources (i.e. land, education, farms, livestock), and to

benefits (i.e. income, education). Determining control of resources and decision-making in the household was largely informed in this study through the literature review. Previous reports and studies have examined the role that institutions such as laws, regulations and social norms, influence the balance of power between women and men at a household level in Jordan (UNDP, 2018).

I also identified the following indicators related to SDG 6, to be aligned with the purpose of the research paper (Gine-Garriga, Jimenez-Fernandez de Palencia, & Perez-Foguet, 2013). The indicators for drinking water are identified as accessibility, availability and quality; for sanitation the indicators are wastewater disposal and safety; and for hygiene the indicators are the presence of a hygiene facility as well as soap and water.

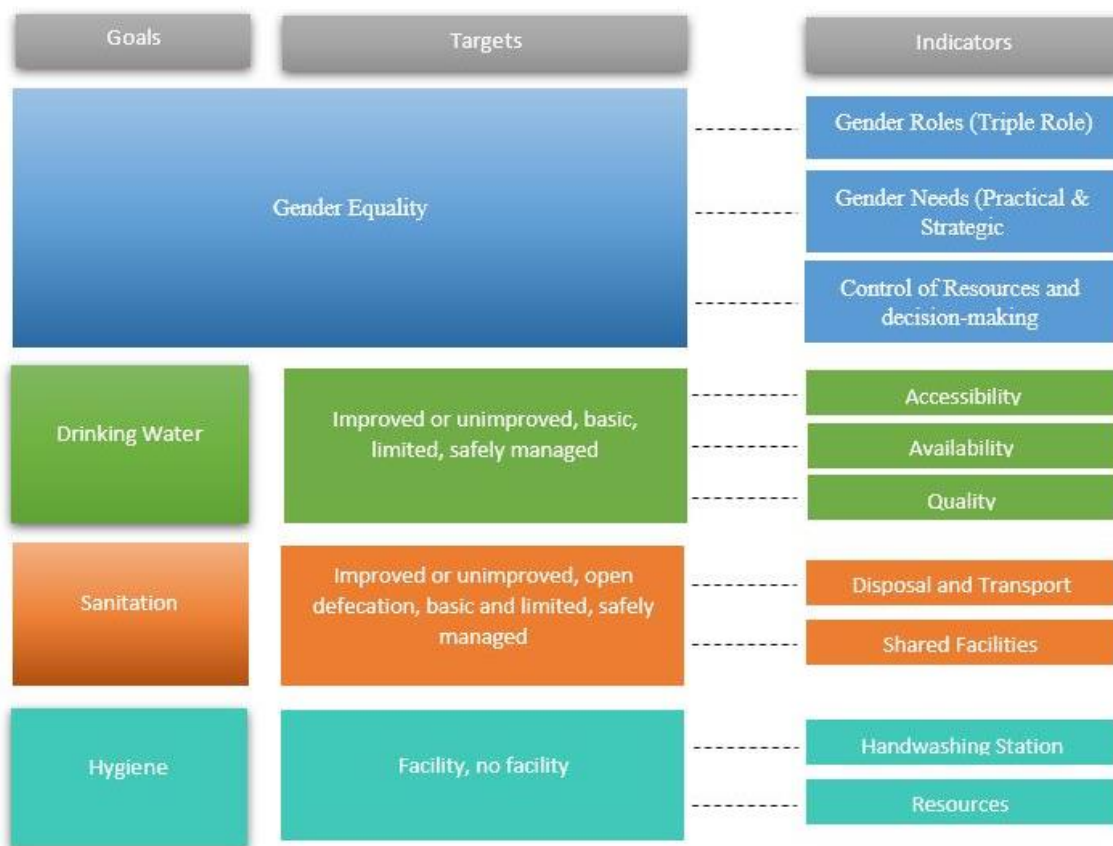


Figure 3-1. Hybrid Framework of the Goals and Indicators based on the WHO/UNICEF JMP Guidelines (WHO & UNICEF, 2017), the UNICEF & WHO report (2018), and Moser Framework (Moser, 1993; Fletcher, 2018)

3.2.1. Water Quality

For the indicator of water quality, a categorical sampling guideline was developed based on the information gathered from participants and is shown in Table 3-2. This was created uniquely for this indicator since no water samples were taken in this research. Therefore, the water quality was assessed based on the knowledge given by participants drawn from answers related to water-use, water-related health issues, and general experiences with a given water source (i.e., smell, taste, and local knowledge). While user perception of water quality is important, it should be acknowledged that there is risk of inherent bias as users are influenced by their level of education or awareness of safe water quality indicators and sources within their community. According to the categorical sampling guideline, the water quality source was then classified as ‘very poor, poor, medium, good, or excellent’.

Table 3-2. The categorical scale to rate the perceived water quality source from participants (Source: Author, 2019)

Categorical Scaling	Description of Water Source related to Scale
Very poor	Water source is described as contaminated; related to health issues; is not a drinking water source; often kept being used outside of the home or not at all
Poor	Water is described as 'bad', has a strong smell, debate with participants or unclear on the health impacts from water source
Medium	Water source is used within the household but preferred to not be consumed; describing some type of smell or strange taste
Good	Water is used for drinking or hygiene purposes, no negative health impacts; however not the preferred water choice
Excellent	Water is used for drinking or hygiene purposes with no negative health impacts brought up; water is described as 'very clean'

3.3. Qualitative Methodology: Multiple case study analysis

This study utilized qualitative methods to provide depth and investigate variables with uncertainty, and to produce information on the reality, perceptions and other factors that influence human behaviour (Creswell, 2007). In addition, I used grounded theory in the analysis of the data to discover emerging patterns within the dataset and also researched topics that arose from the interviewees' responses to corroborate the findings and offer explanations to the research question (Glaser, 1978). A multiple case study analysis was deemed appropriate to strengthen findings (Stake, 1995) and explore the differences and similarities within and across cases (Tight, 2014; Merriam, 1998). Using multiple-case study analysis can lead to the researcher identifying similar findings that allow for comparisons between the cases, and eventually allows the researcher to develop a theory that can predict similar or contrasting results across the chosen case studies (Yin 2003; Baxter & Jack, 2010).

3.3.1. Case and Participant Selection

In total, there were seven villages participating in this research study across the five focus group interviews. Local knowledge was used in determining if certain villages should be either combined (i.e., Samar & Saham; and Al Mansourah & Malka), or separated (Mokhaibah Al Foga and Mukhaibah Al Tahta) for each of the focus group interviews based on similarity and proximity of the villages. This knowledge was provided by locals living in the area who coordinated the focus groups in Jordan. The villages participating in this study were interviewed in a focus group shown in Table 3-3 in this order: Um Qais (herein referred to as "Site 1"), Al Mansourah/Malka (herein referred to as "Site 2"), Samar/Saham (herein referred to as "Site 3"), Mokhaibah Al Foga (herein referred to as "Site 4"), and Mukhaibah Al Tahta (herein referred to as "Site 5"). The villages for the sites were combined or separated based on their difference or similarity in socio-economic conditions and location identified by local contacts, or key knowledge holders, in Jordan who were familiar with the region. These key knowledge holders identified Site 2 and Site 3 as being two villages close in proximity as well as experiencing similar WaSH challenges and therefore suggested they should be grouped together. In addition, Site 4 and Site 5 are neighbouring communities but were separated for interviews

based on the local knowledge that identified these villages to experience different WaSH conditions.

Purposeful sampling is when the participant sampling criteria is selected before any research is conducted (Merriam, 1998). In accordance with Merriam (1998) guidelines, this study chose a purposeful sampling method in which those living in the selected villages of Jordan were chosen to be interviewed. Participants were identified through the RSCN which had contacts in their organization that were connected to each of the villages visited in the Irbid Governorate. The RSCN identified participants who then inviting their own contacts to join the focus group. The participants were required to be over the age of 18 years of old and had to live in the community for at least one year.

Table 3-3. District, municipality and number of households for each study site (Population and Housing Census, 2016).

Site	1	2		3		4	5
Site number & Village Name	Site 1 Um Qais	Site 2 Al Mansourah	Site 3 Malka	Site 4 Samar	Site 5 Saham	Site 6 Mokhaibah Al Foga	Site 7 Mukhaibah Al Tahta
#Participants	11	14		21		10	19
#Households	1303	1184	2437	1218	2094	656	808
#Population	6124	5502	11,706	5589	9,617	2,803	3,637

3.3.2. Analysis by Gender and by Location

As shown in Figure 3-1, this study analyzed responses from all five case studies based on location in relation to the identified WaSH goals (drinking water, sanitation, and hygiene), targets, and indicators. The objective was to identify the gaps in WaSH education for each focus group which took place in different communities within the Yarmouk Nature Reserve. In addition, this study performed a gender analysis for each case study identifying gender roles (triple-role), gender needs, and control of resources and decision-making. The gender analysis is also applied to the responses from the WaSH-related goals and indicators to disaggregate the data from the mixed focus groups (both women and men) which include Site 3 and Site 5. The responses from the women's-

only case studies (WO) which include Site 1, Site 2, and Site 4⁶ were used within the discussion to provide more insight into the findings identified in the mixed focus group case studies.

3.3.3. Literature Review

The literature review provided background on WaSH indicators and frameworks focusing on the WHO & UNICEF JMP reports and guidelines; as well as Jordan's resource management practices. While the literature review does not provide a complete overview of all the academic and grey literature on these topics, it served as a source of information to frame the discussion for the research topics. The review included both academic documents, grey literature, and reports recommended by RSCN in Jordan.

3.3.4. Semi-structured Interview Questions

Simon Fraser University (SFU) had undertaken an ethics review of the interview questionnaire and approved the project before the research study began. The focus groups were conducted with a translator from the RSCN who introduced the project, discussed the informed consent process. Each of the participants provided their consent (verbally or written) to participate, with the option of being recorded and having their photograph taken. The interviews were conducted entirely in Arabic with a translator and then answers were translated back to English. One of the RSCN workers that accompanied us to each of the sites, worked primarily in the Yarmouk Nature Reserve and was able to provide additional information on the community during the drive through the region, as well as help clarify unclear topics, practices, and discuss local knowledges. Before the interview began, I introduced myself in Arabic and thanked the participants for attending the session.

3.3.5. NVivo Coding

I used NVivo 12 Plus to organize and classify my qualitative datasets. NVivo 12 is a data organizing software program that uses Nodes to classify selected data for coding

⁶ Mokhaibah Al Foga had one male community leader attended. However, this individual did not always participate in all the questions and appeared to act more as a support to the women participating.

and find themes. Coding is described as heuristic as it allows the researcher to explore problems and link data and ideas or theories together (Richards & Morse, 2007). Coding works to organize and group similarly coded data into categories as they follow some sort of pattern.

For the first cycle coding, I employed attribute, structural, descriptive, in vivo, and evaluative coding as described by Saldana (2009), in order to organize, explore, and evaluate the data. I performed multiple cycles of coding, generally employing pattern coding in the later cycles, to organize the data into broader categories with a shared characteristic (Saldana, 2009). Each of the cases were studied within and across all the topics to view for gaps in education for WaSH and emerging themes that arose within these topics. I used the matrix coding on NVivo to perform queries on selected nodes and villages to measure understand the frequency of topics.

3.4 Demographic

Each focus group ranged from 10 – 21 participants over a three-day period from December 16th to 19th, 2018. All the participants consented to participating in the research project and the focus-group discussions were recorded. The total number of participants in the five focus groups was reported at 75 individuals. Of all the participants (n=75), most were female (n=63) and 12 were male. Of the 75 participants, 69 were of Jordanian nationality, 6 were Syrian. Three focus groups included those who identified or acted as community leaders (2 female and 3 men) The results of the demographic information collected are shown in Table 3-4. In some of the demographic questions such as age and employment, not all interviewees chose to respond or participate.

Most of the participants in this study are Jordanian residents (69 Jordanians out of 75, with 6 Syrian), female (63 female and 12 male), and many lived either in the village their whole life or more than 15 years. There were 23 individual who were employed, of these include 5 out of the 6 men, and 18 women and over half of the female participants reported being either unemployed and/or a housewife. There were approximately 5 community leaders, identified either as the manager of the charity where the focus groups took place, or as a community leader. The community leaders were all men except for one female identified in Site 5.

Table 3-4. Demographic information collected from all five case studies

Case Studies	Site 1	Site 2	Site 3	Site 4	Site 5	%	N
Total							
	11	14	21	10	19	100	75
Gender							
Female	11	14	16	9	13	84	63
Male	0	0	5	1	6	16	12
Resident Status							
Jordanian	9	12	19	10	19	92	69
Syrian	2	2	2	0	0	8	6
Community							
Leader ⁷	1	0	1	1	2	6.67	5
Years Living Here⁸							
whole life ⁹	8	7	N/A	N/A	16	41.33	31
> 15	1	3	N/A	N/A	2	8	6
> 5	1	4	2	N/A	N/A	9.33	7
>1	1	0	N/A	N/A	N/A	1.33	1
Employment							
Employed	3	3	5	5	7	30.67	23
Female	3	3	5	4	3	24	18
Male	0	0	N/A	1	4	6.67	5
Unemployed	8	9	11	5	11	58.67	44
Housewife ¹⁰	8	9	11	5	N/A	58.67	44
Retired	N/A	2	N/A	N/A	N/A	2.67	2

⁷ **Community leader total** all men except for Site 5

⁸ Not all case studies include answers to the length of living in the village (particularly in Site 3 and Site 4) due to the group being too large (Site 3) or due to time constraints in the interviews.

⁹ **Whole life** incorporates those who mention 30 years or higher, those that lived in a nearby village their entire life, and those that said a high enough number that it was unclear if this was their whole life or not

¹⁰ **Housewife** indicates marriage rather than work history, as some participants were retired. In all cases, except Site 5, the women identified as a housewife. In Site 5, the women identified if they were employed or not, and the assumption is that the remaining were housewives.

Chapter 4. Case Study Context

This research project takes place in the Irbid Governorate of Jordan which is in the north-western part of Jordan as shown in Figure 4-1. The Irbid Governorate is located approximately 80km north of the capital city, Amman (Elkanzi, Mohammad & Ezeldin, 2016). It has the second largest population out of the twelve governorates in Jordan estimated at over 1.9 million by the end of 2018 (DOS, 2018a). According to the Population and Housing Census (2015), this governorate hosts the second highest number of Syrian refugees in Jordan, at 27% (343,000) (DOS, 2015). The Irbid Governorate has a diverse climate with the agricultural sector in this region identified as one of the most important features in Jordan accounting for 11% of the country's total cultivated land. The agriculture focuses on olive and fruit trees which account for approximately 20% of the total cultivated land in Jordan (International Labour Organization, 2016).

Women and men have similar educational levels in the Irbid Governorate with slightly more men completing secondary education than women (7.7% and 7.5% respectively). Women had higher education than men in the Irbid Governorate. However, more women have a higher level of education than men at 25.7% in contrast to 23.3% (DOS, 2019). Despite the similar level of education between women and men, women are far less likely to be employed. Employed women in the Irbid Governorate (9%) are low in comparison to the rest of Jordan (14.3%). However, men are much more likely to work than woman in the Irbid Governorate according to a survey conducted by the Jordanian Department of Statistics from 2017-18. The report found that 54.8% of men in Irbid were currently employed which is similar to the Jordanian average of 55%. In addition, in the Governorate of Irbid, men are more likely to own a house than a woman (21.8% and 7% respectively), as well as land (16.3% and 2.3%) (DOS, 2019).

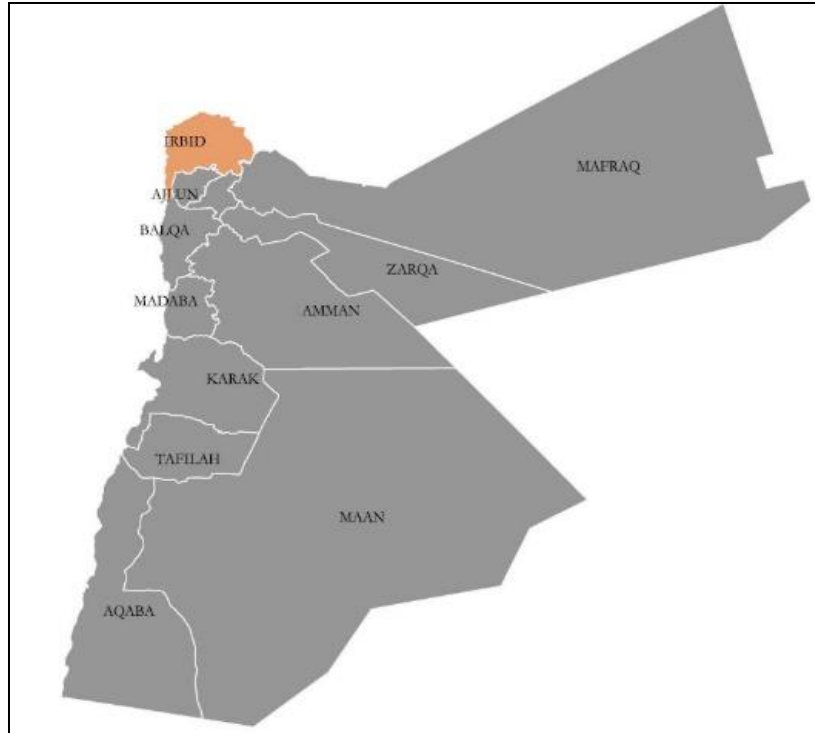


Figure 4-1. Location of the Irbid Governorate in Jordan (Jordan University of Science & Technology, nd)

Table 4-1. Irbid and Jordan (DOS, 2018a; DOS, 2019; International Labour Organization, 2016; UNHCR, 2019; Department of Statistics, 2018b).

Region	Irbid Governorate	Jordan
#Population (2018)	1.9 million ¹¹	10,309,000
Population Density (/km ²) (2018)	1216.2	115.1
Area (km ²)	1572	88,794
Employment (2017-18)	9% (F); 54.8% (M)	14.3% (F); 55% (M)
Unemployment Rates (2018)	16.5%	18.6%
Poverty (%) (2016)	15%	14.4%
Average family income (2016)	\$15,500 CAD ¹²	\$17,360 CAD ¹³
Ownership of Assets (2017-18)		
Owning house (%)	7 (F); 21.8% (M)	12 (F); 27 (M)
Owning Land (%)	2.3 (F); 16.3 (M)	8.3 (F); 11.9 (M)
Educational Attainment of the female/male household population (2017-18) Jordanian		
No education (%)	6.1 (F); 2.6 (M)	5.9 (F); 2.7 (M)
Completed secondary (%)	7.5 (F); 7.7 (M)	9.9 (F); 9.2 (M)
More than Secondary (%)	25.7 (F); 23.3 (M)	27.7 (F); 24.9 (M)

4.1.1. WaSH Services in the Irbid Governorate

In 2015, the Irbid Governorate had the lowest per capita water supply (72.4 liter/day) in the country with the national per capita water supply reported at 127.2 liter/day (DOS, 2018b). According to Jordan's Environmental Statistics report (2014-2015), approximately 59,000 households in the country rely on water harvesting for their main drinking water source, with the Irbid Governorate making up more than 75% of the country's total number of households.

¹¹ 9.7% of the population living in rural regions (146,200) and 90% urban areas (1,765,400)

¹² 7877 JD 2016 or approx. \$11,110 USD. Currency exchange rate (as of May 18, 2020): 1 CAD = .51 JD. 1 USD = .71JD.

¹³ 8824 JD 2016 or approx. \$12,445 USD. Currency exchange rate (as of May 18, 2020): 1 CAD = .51 JD. 1 USD = .71JD.

The barriers to safe WaSH resources and services increases dramatically for those that are residing in rural regions. Most households living in the rural regions indicated in 2015, that their household sewage system was an absorbency hole, followed by no distribution sewage system. The same year, more households in the Irbid Governorate indicated that they used an absorbency hole for a household sewage system (172,087) in comparison to those that reported being connected to a sewage network (137,762) (DOS, 2018b).

In 2015, the Irbid Governorate reported some violations in water quality for springs (4.1%) and drinking water tanks (0.6%). Drinking water sources were also analyzed and with the highest rates of non-conforming samples found in private resources (7.7%) which is far above the Jordanian average of 2.0% (DOS, 2018b). The major springs of the Yarmouk Basin were also tested to determine seasonal water quality variations. A report by Batayneh (2010) report found that some water samples indicated heavy metals present at levels that exceeded Jordanian limits and are unsafe to human health and other organisms. The results show that there may be negative human health impact from consumption of contaminated spring water in the Yarmouk Basin, as well as negative impacts to surrounding ecosystem (Batayneh, 2010).

Table 4-2. Household WaSH services in the Irbid Governorate and Jordan (DOS, 2018b)

Region	Irbid Governorate	Jordan
Distribution of Households Main Drinking Source (2015)		
Public Networks	169,730	1,010,498
Filters	17,630	238,894
Tanks	11,293	67,090
Water Harvesting	45,528 ¹⁴	59,008
Mineral Water	74,452	389,001
Other	2,815	28,801
Results of Monitoring Programme (2015)		
Violations for springs (%)	4.1	15
Violations for agricultural Wells (%)	0	.8
Violations for drinking water tanks (%)	.6	1.1
Results of Microbial Analysis of Drinking Water Sources (2015)		
Private Tanks: Non-conforming samples (%)	1.1	1.2
Private Resources: Non-conforming samples (%)	7.7	2.0
Public Networks: Non-conforming samples (%)	.3	.4
Public Resources: Non-conforming samples (%)	0	.4
Quantity of Collected Solid Waste (2014)		
Dump (Ton)	469,755	1,976,110
Distribution of Households Sewage System (2015)		
Sewage Network	137,762	1,085,432 (9,621 rural & 1,075,811 urban)
Absorbency hole	172,087 ¹⁵	619,626 (150,991 rural & 468,635 urban)
None	8817	46,651 (12,331 rural & 34,320 urban)
Other	2872	41,583 (1844 rural & 39739 urban)

4.1.2. The Yarmouk Basin, River, and Nature Forest Reserve

The Irbid Governorate is home to important geographic features of Jordan including the Yarmouk Basin, the Yarmouk River and the Yarmouk Nature Forest Reserve.

¹⁴ Highest between all other Governorates in 2015; the next highest is Ajloun at only 4,882

¹⁵ Highest between all other Governorates in 2015; second highest is Amman at 156,259

The Yarmouk Basin (6833 km²) is a major transboundary basin with 75% of the area extending into Syria (5257 km²), Jordan (1370 km²) and Israel (197 km²) (Shentis, Inbar, Rosenthal, & Magri, 2018). The Yarmouk River Basin is a tributary of the Jordan River basin and is a key hydrological region in Jordan. The Yarmouk Basin receives the most rainfall in the country; has significant rain-fed agricultural areas and is a critical area for biodiversity due to the Jordan rainforest within the basin (Mohammad, Jung, Odeh, Bhuiyan, & Hussein, 2018).

The Yarmouk Basin is controlled largely by the Yarmouk River which extends from Syria into Jordan (Shentis et al., 2018) and is considered the Jordan Valley's backbone for development as it provides water for the King Abdullah Canal which is the nation's largest irrigation canal system (FAO, 2009). The water quality of the Yarmouk River is largely impacted by the catchment area for both Syria and Jordan which consists primarily of farmland, agricultural and rural, as well as small industries. As a result, effluents from wastewater treatment plants and solid waste disposal sites are reported to reach the Yarmouk River during floods, or heavy rainfall events (Salameh et al., 2018). One of the challenges in this region is the high demand on water resources for irrigation purposes. In particular, the surface waters of the Yarmouk River have been heavily utilized for agricultural purposes (Zietlow, Michalscheck, & Weltin, 2016).

4.1.3. Banai Kenanah District

The *Banai Kenanah District* is one of the nine administrative divisions in the Irbid Governorate, and is a rural area located in the northern regions of Jordan. All the villages participating in the five focus group interviews took place in the *Banai Kenanah*¹⁶ District which has a total population of approximately 142,330 (DOS, 2018a). A map of the study sites can be seen in Figure 4-2. According to the Population and Housing Census in 2015, the seven communities participating in this study have a population size ranging from 2,803 to 11,706 (Mokhaibah Al Foga and Malka respectively) as shown in Table 4-3 (Population and Housing Census, 2016). The total agricultural area for the *Banai Kenanah*

¹⁶ Also written as Bani Kenanah

District in 2017 was reported at 54.575km^{217} , with almost all the land dedicated to growing crops (51.002km^2) (DOS, 2018).

Table 4-3. Data on the Banai Kenanah District for 2013 (International Labour Organization, 2016)

Region	Banai Kenanah District
Dependency Ratio (%)	68
Area (km)	252.9
Population Density (%)	370
Below 15 years (%)	36.6
Between 15-64 years (%)	59.5
65+ years (%)	3.9

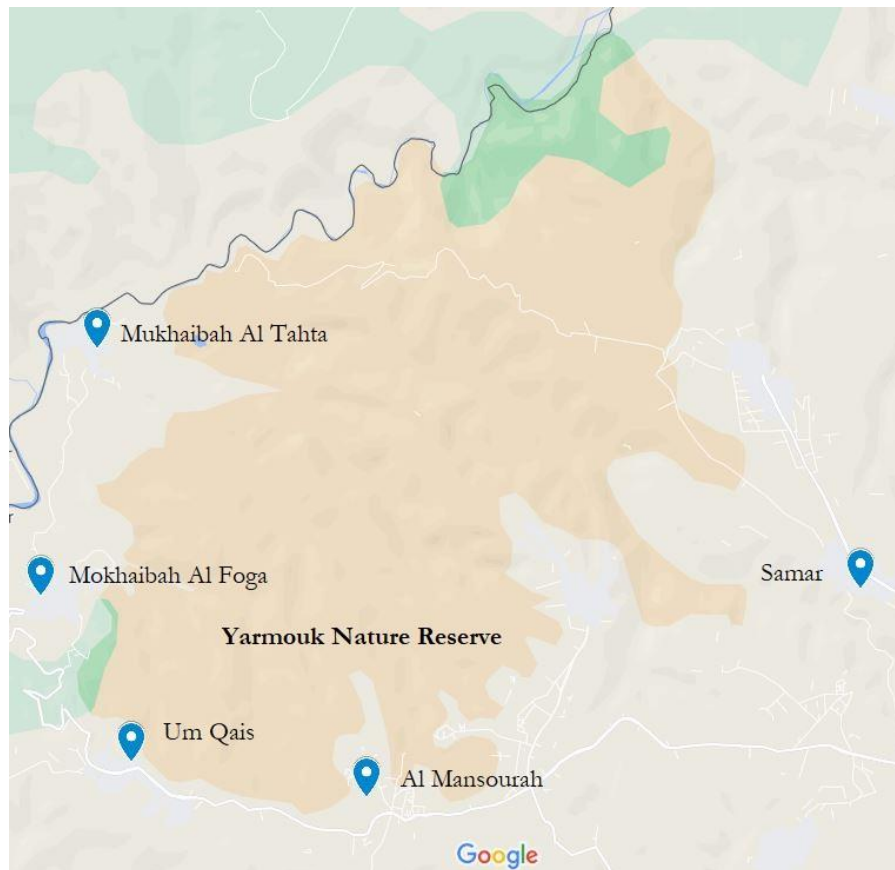


Figure 4-2. Closer examination of the study sites (Google, 2020)

¹⁷ 54575 dunam. 1 Dunam = .001 km².

Chapter 5. Results

In this chapter, I share the findings of the current knowledge within each case study for their education in water, and sanitation behaviours at a household level, provide insight into their community hygiene resources and services and apply a gender lens to identify the differences in knowledge between women and men for WaSH education at a household level. I also identify emerging themes across the five case studies that impact or influence these results. The results are then further analyzed for the gaps in clean water, and safe sanitation as well as hygiene education within and across each case study and gender.

5.1. Gender Roles Identification

The division of labour between women and men are divided into three sections: a) Reproductive Work, b) Productive Work, and c) Community Work. The labour division was identified by at least one participant (female or male) who identified engaging in these activities. However, these results remain incomplete as not all focus groups discussed the same tasks or noted they had limited information to contribute.

Across the case studies, women's primary activity fell under reproductive tasks such as taking care of the children, water-related activities, and meal preparation. The only case study with men engaging in these activities was in Site 3. The men noted that on the day water was received, both women and men would help complete household chores. Many women across the case studies provided little information on activities relating to farming, livestock care, and wastewater evacuation. Some participants reported these activities falling under the man's role. However, this was not the case for each village. For instance, in Site 4 and Site 5, women were able to provide more knowledge on farming activities in comparison to other groups.

Table 5-1. Identification of gender household activities

Case Studies	Site 1	Site 2	Site 3	Site 4	Site 5
	Total (F = female M = male)				
	11 (11F)	14 (14F)	21 (16F/5M)	10 (9F/1M)	19 (13F/6M)
Productive					
Farming	Undetermined	Undetermined	M	Undetermined	F/M
Irrigation	F	F	F/M	F	F/M
Livestock care	Undetermined	Undetermined	M	Undetermined	F
Employed	F = 3	F = 3	F = 5 M = 5	F = 4 F = 1	F = 3 M = 4
Reproductive					
Conserving Water	F	F	F/M	F	F
Reusing Water	F	F	F/M	F	F
Treating Water	F	F	M	F	F
Repairs HH Water	F	Undetermined	Undetermined	Undetermined	F
Collecting Water (Municipal)	F	F	F/M	Undetermined	Undetermined
Staying awake pumping water	F	F	Undetermined	N/A	F
Pumping Water	F	F	M	F	F
Purchasing Drinking Water	F	F	F/M	F/M	F/M
Health	Undetermined	F	Undetermined	F	F
Food	F	F	F	Undetermined	Undetermined
Children	F	F	Undetermined	F	F
Wastewater	F	Undetermined	Undetermined	M	Undetermined
Sanitation	Undetermined	F	F	F	undetermined
Community					
Events	F	F	Undetermined	Undetermined	Undetermined
Advocating	F	M	F/M	F	F/M
Education	F	F	F	F/M	F

5.2. Drinking Water

5.2.1. Safe Consumption of Water

The two most common drinking water sources that emerged within and across the five case studies was rainwater and filtered water. The term filtered water generally meant that it was purchased filtered from a marketplace; however, some participants referred to simply using home-filters on various water sources. Rainwater harvesting systems were utilized heavily in three of the five cases studies for drinking water (Site 1, Site 2, and Site 3). Many participants in these three case studies reported that filtered water was purchased when they ran out of rainwater. In contrast, for the case studies of Site 4 and 5, most participants relied on purchased filtered water from the marketplace for their drinking purposes. In addition, there were some participants in Site 1, Site 4, and Site 5 that reported other water sources for drinking purposes such as water tanks, piped water, and spring water. The drinking water sources identified by participants in the five case studies are shown in Table 5-2.

Table 5-2. Domestic Drinking Water Sources Identified by Location

Case Studies	Site 1	Site 2	Site 3	Site 4	Site 5
Total	11 (11F)	14 (14F)	21 (16F/5M)	10 (9F/1M)	19 (13F/6M)
Purchased Filtered	Y (All)	Y	Y	Y (All)	Y (All)
Rainwater	Y	Y (Majority)	Y (Majority)	N	N
Water Tanks	Y	N	N	Y	N
Piped Water	Y	N	N	Y	Y
Springs	N	N	N	Y	N

In the mixed focus groups (Site 3 and Site 5), women were able to identify more drinking water sources than the men and linked water quality to the rationale for choosing a drinking water source. When identifying drinking water sources, some women reported that not all sources were clean and that individuals drinking them did so out of necessity to meet their basic needs.

Table 5-3. Domestic Drinking Water Sources Identified by Gender

Case Studies	F	M
Total	19	11
Mixed-Groups: Site 3 & Site 5		
Purchased Filtered Water	Y	Y
Rainwater	Y	Y
Water Tanks	Y	N
Piped Water	Y	N

5.2.2. Availability

Water availability is categorized as non-accessible, on premise, or market (i.e., purchased) as shown in Figure 5-1 and Table 5-4. In all the case studies, most participants had tap water available to them. There were some households reporting the piped network was unavailable to their households as they lived either outside the main road (Site 1, Site 3, and Site 5) or were outside the municipality (i.e., small village called Al'Ashay¹⁸ near Site 3). Those connected to the piped network reported receiving water once a week during the night with a distribution described as 'weak' or 'low pressure' often between 2-4 hours. However, in some case studies participants reported receiving piped water less frequently such as once every two weeks (Site 2 and Site 5), and three participants reported once a month (Site 3). The distribution of the piped water network appeared to be strongly tied to seasonal changes, with one participant in the case study of Samar/Saham reporting he once went six weeks without water in the summer.

Rainwater harvesting systems were only available in Site 1-3. Most participants in Site 4-5 reported that rainwater systems were not available due to climatic and topographic factors such as low rainfall, and tough soil. Some participants also reported that they lived on a small area of land and did not have space to build a rainwater system on their property. Other water sources include the hot springs, which connected to some households in Site 4, and purchased water from marketplaces which was reported safe and available in three of the case studies (Site 1-3).

¹⁸ Al'Ashay is located near Samar/Saham where approximately 50 houses were reported to not have any coverage by the piped water network

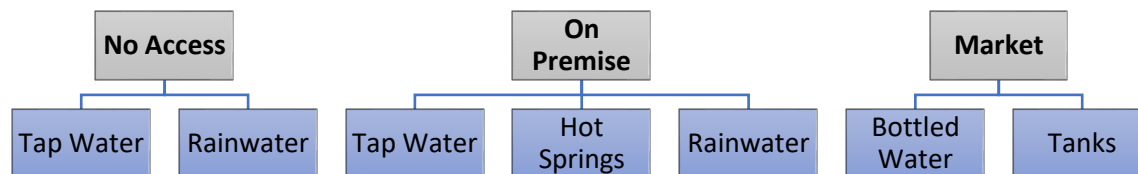


Figure 5-1. Household Water Availability Classifications

Table 5-4. Household Water availability by Location

Case Studies		Site 1	Site 2	Site 3	Site 4	Site 5
Total		11	14	21 (16F/5M)	10 (9F/1M)	19 (13F/6M)
No Access	Tap	1	NA	3	Majority	NA
	Rainwater	NA	1 Syrian HH	NA	10	18
On Premise	Hot Springs	0	0	0	3	0
	Rainwater	Majority	13	15	0	1
	Tap	10	14	17	Few	NA
Market	Bottled & Tanks	1	13	12	Majority	19

Both women and men were able to identify the level of access to various water sources in their community. However, women and men answered differently, particularly regarding payments or sources located outside the household. For instance, in both of the mixed focus groups when discussing the municipal water system, women would generally focus on the quality and use of the resource within their homes. In contrast, men would provide insight into the concerns regarding the costs of water and sometimes comparing the availability of water distribution to neighbouring villages or households.

Table 5-5. Household Water Availability Identified by Gender

Case Studies		F	M
Total		19	11
Mixed-Groups: Site 3 & Site 5			
No Access	Tap	Y	Y
	Rainwater	Y	Y
On Premise	Hot Springs	N	N
	Rainwater	Y	Y
	Tap	Y	Y
Market	Bottled & Tanks	Y	Y

5.2.3. Accessibility

Each case study reported different factors influencing the ability to access safe drinking water including cost, time, distance and location, limited water from the tap, family support, community or government support, and education. Affordability was identified as a barrier with all case studies except Site 2. In Site 4, affordability influenced the ability of a household to purchase water infrastructure or equipment to adequately store water resources (i.e., floating valves, water tanks, pumps, equipment, counters, home filtration units), as well as accessing various water sources (i.e., municipal water system or the purchased water sources). In the case of Site 5, water infrastructure was also difficult to purchase (i.e., storage containers, and water counters), therefore households shared water counters but identified water bills to be alarmingly high. One participant reporting being billed almost three times higher than other communities¹⁹.

The location of the community also played a role in accessing water resources. Only participants from Site 2, received advanced notice of water schedule changes for the piped network. Distance and time were reported to be barriers in accessing drinking water sources for the case studies of Site 4. For instance, one participant reported that for their household it takes 4-5 days for her husband to refill their drinking water. In some cases, the municipality would aid to farmers or households during times of water shortages or if they were outside of the main road (Site 1 and Site 2).

The gender barriers to achieving water security and water education appeared greater for women than men. For instance, women who were employed found it difficult to find extra time to complete tasks to save or reuse water around their home. The focus group that identified the highest number of barriers to access for women was those participating in Site 5. Some women in Site 5 noted they did not have permission to leave their community and travel far distances or have access to a phone and/or social media. These barriers restricted them from participating in water-related education such as plumbing workshops held in neighbouring villages. These women also identified that water management was removed from the curriculum for the girls and young women in school as it deemed a male-role and was discouraged by the government.

¹⁹ Based on local knowledge sources. Participant reported paying 200 JD for 6 months; while other communities report paying 60 JD for 6 months

5.3.4 Perceived Water Quality

This research project did not test the water quality within each village. Instead, the water quality assessment was based only on the user's perception of the source. Participants identified key information related to water sources such as sicknesses, changes in taste, or differences within texture. It is important to note the limitations on relying only on perception of water quality. For instance, participants may be impacted by their level of awareness or education for water sources and may not be able to identify substances which cannot be detected during consumption.

Within each case study, participants debated on the water quality for various sources. Participants reported that water in their community, except for purchased water from marketplaces, was not monitored or tested by authorities. When participants were asked about the water quality, they often discussed how the water was used, related health concerns and issues, local knowledge, as well as personal experiences such as the smell or taste; these results are shown in Table 5-6. Overall rainwater and purchased filtered water were generally considered the best water quality source as it was used for drinking and cooking purposes. Rainwater was often described as clean and hygienic. Purchased filtered water was believed to be safe for consumption and not associated with any health risks, except for Site 5, where seven participants reported that the quality of water was poor unless shops brought it in from other villages such as Site 1.

The spring and tank water were generally described as not fit for drinking or hygienic purposes due to contamination from either wastewater disposal, faecal matter from wild animals, pollution from other villages, or organic pesticides. In Site 4 and Site 5, the private water companies were reported to collect spring water and sell it unfiltered. In Site 4, multiple participants reported having stomach issues such as diarrhea from drinking water from the purchased water tanks.

All case studies except Site 4, reported tasting chlorine from piped water and noticed calcium covering countertops, sinks, pipes, water heaters, and storage tanks. In Site 2, participants reported that the chlorine was destroying the washing and filter machines, and some found stones in the water. There were no negative health impacts from piped water for Site 1 or Site 2. However, participants in Site 3 reported bladder infections from small stones, and general sickness from the piped water was reported in

Site 5. In contrast, numerous participants in Site 4 described stomach bacteria, microbes, and bladder infections that would send people regularly to the hospital. Community members would regularly get their bladders cleaned and checked on. One participant reported staying 10 days in the hospital and another 15 days at home to recover, while a child would take approximately 5 days to recover.

Table 5-6. Perceived water quality by location based on categorical scales and JMP classifications

Case Studies	Site 1	Site 2	Site 3	Site 4	Site 5
Total	11	14	21 (16F/5M)	10 (9F/1M)	19 (13F/6M)
Piped Water	Poor-Medium	Medium	Poor-Very poor	Very poor	Very poor
Springs	Very poor	Poor-Very poor	NA	Very poor	Poor-Very poor
Water Tanks	NA	Medium-Poor	NA	Very poor	Very poor
Filtered Water	Good	Good	Good	Good	Good ²⁰
Rainwater	Excellent	Excellent	Good-Excellent	NA	NA

Both women and men were able to identify various levels of water quality for different water sources. However, when asking women to describe the quality of their water resources, women would often engage in discussions with one another on the best source of water to drink. For instance, women were more likely to identified health issues in association with the water source. In Site 5, the men identified the spring water to be contaminated from pollution whereas the women questioned if the spring water could be used.

Table 5-7. Perceived water quality by gender based on categorical scales and JMP classifications

Case Studies	F	M
Total	19	11
Mixed-Groups: Site 3 & Site 5		
Piped Water	Y	Y
Springs	Y	Y
Water Tanks	Y	Y
Filtered Water	Y	Y
Rainwater	Y	Y

²⁰ The filtered water is only reported to be good from markets that bring water from outside the village such as Um Qais; purchased filtered water from other shops was reported to be poor quality

5.3. Safe Sanitation and Hygiene Practices

5.4.1 Sanitation

All participants across the case studies were not connected to the municipal network and described having ‘traditional’ septic tanks. The traditional septic tanks took on a range of descriptions including ruins/caves (CAV), man-made built structures using cement and stones (STO), tanks (TNK) and a system that would directly send wastewater into the ground and soil also known as cesspools (CSP), as shown in Table 5-8. The frequency of the evacuation varied across the different types of tanks and between case studies with the STO system being evacuated regularly in contrast to caves/ruins or cesspits where the wastewater would flow underground. Instead of evacuation, some participants reported planting a plant and tree species, a tree species called ‘*Qina*’ which is Arabic for *Eucalyptus camaldulensis* (red gum), to pull toxins out from the ground.

Table 5-8. Household Wastewater for each case study

Case Studies	Site 1	Site 2	Site 3	Site 4	Site 5
Total	11	14	21 (16F/5M)	10 (9F/1M)	19 (13F/6M)
TYPE	CAV; TNK	STO; CSP	STO	STO; CSP	STO; CSP
EVACUATION	Na	STO: time to time. CSP: forget	16 ²¹ if full; monthly (3); 20 years	don't know (2); never (2) STO: 1/100 years (1)	1x/month (5); 5 years or less (3); Not aware

In Site 3 and Site 5, both women and men participated in the discussion to identify the type of system that was used in each household. When we asked participants about the evacuation of wastewater in Site 5, the men provided more details into the structure of the system and why evacuation was or was not needed.

Table 5-9. Household Wastewater identified by gender

Case Studies	F	M
Total	19	11
Mixed-Groups: Site 3 & Site 5		
Type	Y	Y
Evacuation	Y	Y

²¹ including 2 Syrian women

5.4.2 Hygiene

When asked about hygiene resources available in the community, the participants answered the question by discussing hygiene services that were available in public spaces rather than households. Therefore, household hygiene levels are largely unknown and results for this section are based on a community scale. For community hygiene, each case study was scaled based on their access to handwashing facilities including soap and water. The scale is categorized as *no facility* (no station and no resources), *limited* (handwashing facility present but soap and water are not available), and *basic* (handwashing facility with soap and water), as shown in Table 5-10. In some focus groups, participants noted that sanitation resources were available only in a limited number of public places such as mosques and schools.

Table 5-10. Community hygiene resources in each case study

Case Studies	Site 1	Site 2	Site 3	Site 4	Site 5
Total	11	14	21	10	19
Facilities	Y	Y	Y/N	Y/N	N
Soap	Y ²²	N	Y/N	Y/N	N
Water	NA	N	N	N	N
Scale	Basic	Limited	Limited	Limited	No Facility

In Site 3, both women and men engaged in the discussion on wastewater systems identifying the presence of facilities in the community. However, the difference between genders was shown with men identifying public spaces such as the mosque. In contrast, the women spoke of the hygiene resources in schools for their children which they noted were limited in their resources and were asking households to provide these resources for their children.

Table 5-11. Community hygiene resources identified by gender

Case Studies	F	M
Total	19	11
Mixed-Groups: Site 3 & Site 5		
Facilities	Y	Y
Soap	Y	Y
Water	Y	Y

²² Hand sanitizer

5.4. Gender

5.4.1. Gender Needs

The practical gender needs for women in the table below are challenges that could apply to the entire family, including men and children. In contrast, findings in the strategic gender needs would specifically challenge inequalities between women and men. For instance, women would sometimes describe that they needed permission for certain activities or had limited knowledge on a topic since it was deemed the man’s role.

Table 5-12. Gender needs assessment for women across the five case studies – Moser Framework

Practical Gender Needs	Strategic Gender Needs
<ul style="list-style-type: none"> • Clean drinking water • Clean water for cooking • Clean water for hygiene • Soap and hygiene resources • Water Pumps • Water Storage Containers • Floating Valves and other infrastructure to maintain water storage tanks • Water harvesting wells • Water treatment resources • Safe water reuse education • Rooftop rainwater harvesting designs and infrastructure • Resources and knowledge on cleaning and maintaining storage containers • Education for safe wastewater storage and evacuation practices • Menstrual hygiene resources 	<ul style="list-style-type: none"> • Skills in leadership for water testing and monitoring • Access to public education in water management for female youth and children • Ability to freely choose to travel outside the community • Ability to freely choose to access social platforms • Assistance in household water-related chores particularly on the day water is received • Education on wastewater evacuation practices • Skills in building leadership related to advocacy for water concerns to water authorities • Access to higher education in plumbing workshops • Access to higher education in agricultural workshops • Access to higher education in water savings workshops tied to reducing financial costs for each household

5.4.2. Disaggregating the control of resources and decision-making within the household

The female interviewees in this study experienced greater barriers than men in accessing societal resources such as education. In addition, some women in this study shared personal experiences indicating that they did not completely control the resources

and benefits for their household. In some cases, women directly stated some tasks were the responsibility of the men including purchasing drinking water for livestock on farms evacuating wastewater, travelling outside of the community, using a smartphone, and contacting water authorities. This study did not ask women or men on the ownership of these resources and benefits. As such, the ownership of land and resources are assumed to fall largely under the ownership of men as discussed in the literature review on inheritance laws and practices in Jordan. Employment was undetermined as women appeared to have control of this in certain fields while there are employment laws that restrict women from certain sectors.

Table 5-13. Control of resources and decision-making within the household disaggregated between female and male based on the literature review.

Resources and Benefits	Access		Control	
	Women	Men	Women	Men
Land	Y	Y	Less likely	Y
Water Resources	Y	Y	Less likely	Y
Livestock	Y	Y	Less Likely	Y
Employment	Y*	Y	Undetermined	Y
Education	Y*	Y	Y/N	Y
Social Media	Y/N	Y	Y/N	Y
Cell Phones	Y/N	Y	Y/N	Y
Traveling	Y/N	Y	Y/N	Y

* indicates barriers to access

5.5. Knowledge about Safe Household Water-Related Activities

Participants were asked about their household’s water-related tasks and reported findings that were generally similar within and across the five cases. The common household tasks include cleaning, washing, cooking, drinking, irrigation, irrigation, praying, and hygiene. All participants within and across the five case studies also agreed that seasonal changes impacted various water supplies and therefore their household use. Households would use more water in the summertime particularly for irrigation, showering, drinking, and cleaning.

5.6.1 Water Reuse

Participants in the focus groups for the five case studies were also asked about their water re-use practices within the home (HH) and in their community (Co), as shown in Table 5-14. The most common household water reuse practice was for irrigation purposes. Only the case studies of Site 2, Site 3, and Site 5 had some participants expressing concern and knowledge on the safe water reuse practices and health risks. Some participants reported that they used ‘clean water’ sources for reuse, however, it was unclear what water sources classified as clean and are therefore placed under ‘identified clean’. The most common water-reuse sources include leftover water from dishes, the laundry machine, and washing vegetables. In the case studies of Site 1, Site 3, Site 4 and Site 5, some interviewees noted they reused leftover filtered water for cleaning or irrigation purposes. Most participants across the case studies did not discuss treating the water prior to reusing it. However, in Site 2, Site 3, and Site 5, there was at least one participant expressing concern or sharing safe water practices when handling greywater.

Table 5-14. Water use practices for water-reuse for all five case studies

Case Studies	Site 1	Site 2	Site 3	Site 4	Site 5
Total	11	14	21	10	19
Household					
Greywater	Y	Y	Y	Y	Y
Identified Clean	Y	Y	N	Y	NA
Treat	NA	Y/N/Concern	N/Concern	NA	Concern
Community					
Greywater	Y	N	Y	N	N
Identified Clean	NA	N	N	N	N
Treat	N	NA	N	NA	N

In Site 3, both women and men engaged in discussion on greywater tasks. One Syrian women expressed concern that the chlorine used to wash dishes was unsafe to be reused for plants. The other interviewees in Site 3 did not comment, it appeared they were unaware this issue. In Site 5, only women answered questions about reusing greywater resources. One woman noted that when washing dishes with greywater she would avoid using chemicals because this will affect the plants and instead use alternatives like citrus, lemon, and bi-carbonate sodium instead of chlorine. This idea was approved by a man who said that people here shouldn’t use chlorine because it affects the body.

Table 5-15. Water use practices for water-reuse identified by gender

Case Studies	F	M
Total	19	11
Mixed-Groups: Site 3 & Site 5		
Household		
Greywater	Y	Y
Identified Clean	N	N
Treat the Water	Concern	Concern
Community		
Greywater	Y	N
Identified Clean	N	N
Treat the Water	N	N

5.5.1. Coping Methods

Households discussed a variety of coping methods not only to ensure the water was safe but also to meet their basic needs when their supply was running low. The coping methods to ensure that the water was safe to be used or consumed were identified by women and include filtering, boiling, adding chlorine, and throwing water away. There were some participants in all the case studies that reported having home-filters to treat water prior to consuming. One interviewee in Site 2 reported that she once used tap water to cook meals and had to throw away the food due to the strong chlorine taste. A participant in Site 4 reported boiling the water from the purchased water tank prior to drinking to ensure the water was safe, and another suggested that adding chlorine to the storage tanks would remove algae.

The coping methods households engaged in to meet their basic water-related needs were identified by both women and male interviewees and includes sharing water resources (i.e. water hoses, water counters), drinking unclean water, and purchasing water. Sharing water resources, equipment, or facilities was used in the case studies of Site 3, Site 4, and Site 5. In Site 3, one man reported that when the piped water was distributed some households reported the water would not flow to every house and so the water hose would be shared between neighbours. In Site 5, another male interviewee reported that multiple households (ratio of 4:1) would share one water counter which allowed them to gain access to the municipal water network. In Site 4, women reported that they would share filtered water with the school children who were begging for water. One of the households reported that if they ran out of the clean filtered water, the family

would resort to drinking unclean water sources. In all the case studies many participants particularly in the summertime reported purchasing filtered water to ensure that their basic needs would be met.

5.6. Education

5.6.1. Past Education

Participants were asked about the past workshops or education they received that was WaSH related. In all the case studies there were participants that reported attending workshops or awareness sessions held either within or outside of their community. Only women identified as attending these workshops which included topics such as greywater, water conservation, water harvesting, agriculture, plumbing, and water saving devices.

The interviewees were also asked about the barriers in engaging in WaSH-related workshops with responses. Women who attended these workshops responded as well as some male community leaders who helped organize the event. These barriers include time and distance to travel to receive training (Site 1 and Site 5), number of participants being invited to a workshop or resources available (Site 3 and Site 4), commitment to work (Site 1 and 3), and low education (Site 4 and Site 5). In Site 3, participants mentioned that some community members were not interested in attending.

As discussed under *Accessibility*, the focus group of Site 5 reported significant gender barriers in engaging with water-related education. The women in this focus group reported that they needed to receive permission from their families to travel outside of the village or far from their home, and that some had limited or no access to a mobile phone as it was monitored by family members. Furthermore, one female teacher in Site 5 reported that the Jordanian government removed the curriculum on water management stating that these tasks were only for boys and men.

5.6.2. Recommendations and Methods

Participants were asked about their recommendations on topics and methods for employing water education for their community and are shown in Table 5-16. The topics of interest that participants identified include *Rainwater harvesting*, *Agriculture*, *greywater*

reuse, water conservation, and energy use. Most participants in each of the five case studies expressed interest in learning more about rainwater harvesting systems, water conservation, and sustainable agriculture practices. Participants were also asked about their recommendations for distributing education including if/how they used *Social Media*. The recommendations provided by the participants include *Facebook* (under social media), *printed materials, practical training, lectures, location, and education that shows how financial costs can be reduced by increasing water efficiency and promoting conservation* (herein referred to as ‘*Ties to Cost*’).

Across all case studies, the most recommended and agreed upon method for distributing WaSH education was through *Practical Training* which refers to activities that allow for community members to have hands-on engagement in the topics studied. Other methods identified include using *Social Media* (including Facebook), *printed materials* (flyers, pamphlets and similar written educational materials), and *Lectures* (workshops, presentations, forums, meetings and discussions, and awareness sessions). In addition, participants also noted that the *Location* of the educational initiative could be a significant determinant for members of the community particularly for women. It was recommended by both women and men that the education be held in the local community at centres, charities or co-ops. Lastly, male interviewees highlighted the importance of discussing the costs associated with water. It was noted that an effective method to get members of the community interested in WaSH education was *Tied to Cost* which shows how the actions could reduce their water bills and lower their costs.

Table 5-16. Recommendations for methods of delivering educational material as identified by the participants across all five case studies

Case Studies	Site 1	Site 2	Site 3	Site 4	Site 5
Total	11	10	21	10	19
Social Media	Y	Y	N/A	Y & N	N/A
Facebook	Y	10	16	N/A	6
Printed Materials	N/A	Y	N/A	N	Y & N
Practical Training	Y	Y*	Y	Y	Y
Lectures	Y	Y	Y	Y	Y
Location	Y	N/A	Y	N/A	Y
Tied to Cost	N/A	N/A	N/A	Y	Y

Table 5-17. Recommendations for methods of delivering educational material as identified by gender

Case Studies	F	M
Total	19	11
Mixed-Groups: Site 3 & Site 5		
Social Media	N	N
<i>Facebook</i>	Y/N	Y
Printed Materials	Y	N
Practical Training	Y	Y
Lectures	Y	Y
Location	Y	Y
Tied to Cost	N	Y

5.7. Identified Gaps in WaSH Education

The gaps in education for WaSH were identified for water use, drinking water, sanitation, and hygiene. The answers for each topic and case study are identified through a yes or no (Y/N) to show if a gap in knowledge was identified, as shown in Table 5-18. In order to better understand the community's gap in education for WaSH, the past educational programs that participants engaged in related to WaSH were identified and taken into consideration. These past education programs include *Water Reuse* for the case studies of Site 2 and Site 5; and *Water Savings* for all the case studies. The distribution of the gaps in education for WaSH are shown in Figure 5-2 across the five case studies.

Table 5-18. Identified gaps in education for water use, drinking water, and sanitation and hygiene identified by participants in focus groups across the five case studies

Case Studies	Site 1	Site 2	Site 3	Site 4	Site 5
Total	11	14	21	10	19
Water Use					
<i>Water Reuse</i>	Y	Y	Y	Y	N
<i>Water Savings</i>	Na	Y	Na	Y	Y
<i>Agriculture</i>	Y	Y	Y	Y	Y
Drinking Water					
+Chlorine	Na	Na	Na	Y	Na
<i>Storage Tanks</i>	Na	Y	Y	Y	Y
<i>Rainwater Harvesting</i>	Y	Na	N	Y	Y
Sanitation-Hygiene					
<i>Wastewater</i>	Y	Y	Y	Y	Y
<i>Land Treatment</i>	Na	Y	Y	Na	Na
<i>Children Sanitation</i>	N	Y	Y	Y	Y

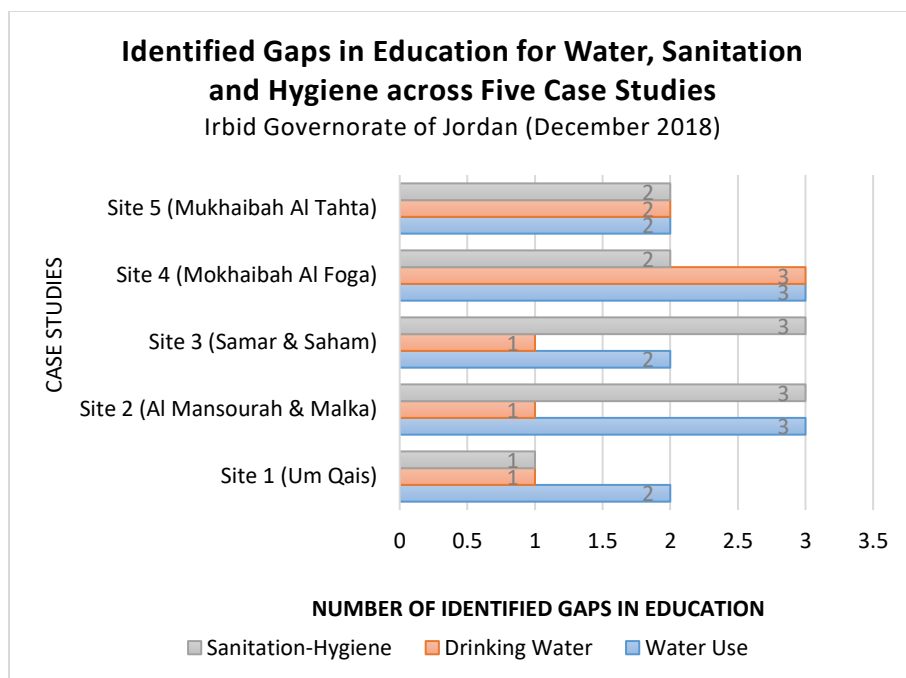


Figure 5-2. Distribution of gaps in WaSH education based on Water Use, Drinking Water, and Sanitation-Hygiene

The gaps in education for WaSH were identified for water use, drinking water, sanitation, and hygiene were also disaggregated by gender. The answers for each topic and case study are identified through a yes or no (Y/N) to show if a gap in knowledge was identified, as shown in Table 5-19. The gaps in education were similar for both women and men, with differences reflected only for education in water savings and rainwater harvesting.

Table 5-19. Identified gaps in education for water, use, drinking water, and sanitation and hygiene identified by gender

Case Studies	F	M
Total	19	11
Mixed-Groups: Site 3 & Site 5		
Water Use		
<i>Water Reuse</i>	Y	Y
<i>Water Savings</i>	Y	N
<i>Agriculture</i>	Y	Y
Drinking Water		
<i>+Chlorine</i>	Y	Y
<i>Storage Tanks</i>	Y	Y
<i>Rainwater Harvesting</i>	Y	N
Sanitation-Hygiene		
<i>Wastewater</i>	Y	Y
<i>Land Treatment</i>	Y	Y
<i>Children Sanitation</i>	Y	Y

5.8. Emerging Themes

Using the grounded theory approach, common themes or trends appeared during the coding structure in NVIVO. The emerging themes appeared frequently throughout most of the case studies and were comments or discussions that were not identified prior by the interviewer for the focus groups. There are five overarching themes that emerged throughout the focus groups as shown in Table 5-20 of *Trust, Consume it Wisely, Affordability, Community Resources, and Yarmouk Basin*. These five emerging themes were identified in the analysis and can be used to provide a deeper understanding of the gaps in knowledge for WaSH education.

Table 5-20. Emerging themes from the five case studies across seven villages

Name	Description
Trust	There are conflicting messages on which water source is the best quality
Consume it Wisely	Participants have established sustainable water management practices in households based on cultural, religious, and practical beliefs
Affordability	The ability to cope with water issues is strongly impacted by the household socio-economic conditions
Community Resources	The resources and services available by the community alleviate or increase the burden on households
Yarmouk Basin	Interactions with the Yarmouk River and Springs

Chapter 6. Discussion

6.1. Exploring the Emerging Themes

6.1.1. Trust: Health Impacts & Conflicting Messages in Water Quality

Trust was an emerging theme that influenced the household's behaviours and WaSH-related practices. The level of trust in water authorities, local and community leaders, and cultural knowledge played a role in determining if the education and resources relating to clean water, sanitation, and hygiene practices would be adopted or ignored. Unsurprisingly, the communities experiencing water-related health issues, seemed to place greater trust on the education received from or at community centres, as well as personal experiences, rather than outside government assistance.

Across all case studies, except Site 4, there was some distrust expressed in the water authorities. For instance, in the case studies Site 1, Site 2 and Site 3 participants reported hearing announcements made by the water authority for the safe consumption of tap water but reacting in a variety of ways. In Site 1, some participants changed their behaviour to include tap water whereas in Site 2 and Site 3, participants heard the government announcements but did not trust them. Participants in Site 5 noted that the water authorities had built a water station in the village, but the people were not trusting of the water resource because of the smell and minerals inside of it.

One of the factors contributing to the public's distrust in water sources was the mixed messages given by from authorities, private water companies, as well as cultural traditions or beliefs. An example of the mixed messages is shown in Site 5, where a female community leader described being confused with which water source to drink.

"...she has been invited to several workshops with the Ministry of Water talking about water quality in the community and she gets confused which is the best source of water that they can drink. The Minister of Health says its only bottled water, private companies [says] no it's the filtered water...Ministry of Health and Ministry of Water [says] that these filters available at house level and even in water shops are not clean because ...microbes in these waters." – Female community leader in Site 5 (Mukhaibah Al Tahta)

Some participants described trusting in the health of the water based on minerals or natural properties occurring in various water sources. Participants in Site 1, Site 2 and Site 5 mentioned these minerals but often disagreed if the minerals were found in rainwater, filtered or tap water. Participants in these focus groups described that these healthy minerals could be removed if the water was filtered, or if the water was boiled due to evaporation.

In Site 4 and Site 5, participants placed their trust in clean water practices based on personal experiences, and community or local knowledge. The level of trust was more community centred potentially because of the numerous digestive concerns that emerged from both water from private companies and water from the municipal authorities. Potential or known negative health impacts from poor water quality or inadequate WaSH practices served as a cue for some households in these case studies to change their activities. In Site 5, participants reported illnesses associated with tap water and tank water and either switched to filtered water or boiled the water to stop the sickness.

“I used to drink from the tap, I used to buy water tanks then I was always sick with water calcium but then I started using only filtered water and I get rid of all these sickness” – Female interviewee from Site 5 (Mukhaibah Al Tahta)

“In the past we used to see our parents or grandparents collect the water from the rooftop using big pipes then they used like a ..piece of cloth in order to filter the water...but nowadays you cannot see it at all because we believe that our rooftops are not clean to collect this type of water but this water was usually used to prepare tea” – Female interviewee from Site 4 (Mokhaibah Al Foga)

6.1.2. Consume it Wisely: Sustainable Water Management

Participants across the case studies would describe actions and strategies that they had developed for sustainable water management within the household. Female participants would often state that they promoted and implemented these practices within their household in order to *Consume it Wisely* which include strategies of reducing and consuming less, as well as reusing water resources. For reducing and consuming less, some participants described setting rules or training the household, particularly children, for household and WaSH-related activities.

“...some people have water network from the municipality and the water authority but we for example do not have this so we purchase water so

that is why we take so much consideration to protect and conserve the amount of water that we...consume” – Interviewee from Site 5 (Mukhaibah Al Tahta)

“...when the kids use the bathroom, they make the flush for the water they try and play with it so she makes a rule in her home that no one can use this water only the mother because she wants to manage it very well” – Female interviewee from Site 1 (Um Qais)

The participants described motivations behind these practices including *problem-based* or *value-based*. The problem-based motivation is driven by the knowledge that there is a water problem and they are trying to cope with this issue. It was evident across all case studies and in all participants that the efforts to reduce, reuse, and consume less water were motivated by the water problems experienced in their household or communities. The values-based motivations are based on numerous motivations such as religion, role or responsibility of the individual, and the intrinsic values of water and the environment.

“In general, we are Muslims and we try to protect water according to our religion isn’t that we have a big amount of water, but we have limited water, but we try and consume it wisely” – Female interviewee from Site 1 (Um Qais)

6.1.3. Affordability: Ability to Cope with Water Challenges

Affordability emerged as an important factor influencing household’s ability to cope with water shortages and water distribution challenges. Participants in all case studies, except Site 2, identified affordability to be a challenge that affected meeting their WaSH needs for the household. In particular, the communities and households most vulnerable to affordability barriers were those without a rainwater harvesting system including all participants in Site 4, all except one participant in Site 5, and one Syrian participant in Site 2. These households reported relying on purchased water (i.e., tap water or marketplace) at a much higher frequency than households with access to rainwater harvesting systems. For instance, the Syrian participant in Site 2 reported purchasing water daily whereas the rest of the participants purchased water either weekly in the summer or rarely.

The costs for constructing a new rainwater harvesting wells were beyond what a household could typically afford (approximately \$980 -\$1970CAD equivalent to 500-1000JD). As rainwater is seen to be the cleanest source of water, a rainwater harvesting system was identified to be critical to both drinking water as well as hygiene as described

in Site 1. Financial challenges were also identified to be a factor influencing the construction of rainwater systems in Site 3 for their drinking purposes.

“... she said that if we want to go [build] to the water harvesting wells this will cost up from 500 JD up to 1000 JD which is costly for families so that is why they cannot reach a hygiene situation because they believe that rainwater is much cleaner than other sources” – Female interviewee from Site 1 (Um Qais)

Both Site 4 and Site 5 identified as being low-income communities that experienced financial challenges in connected to the piped network, storing and maintaining water equipment and infrastructure, and purchasing clean filtered water for drinking water purposes. In the case of Site 4, participants reported that the initial costs to engage with the network were too high (i.e. installation of water counters reported at 250JD) and was one of the factors impacting the low number of community members that were connected to the network. In Site 5, families coped with the high financial costs of the piped network by sharing water counters between households, with up to four households per counter. However, the water bills in Site 5 were reported to be alarmingly high, with one participant reporting being billed almost three times higher than other communities²³.

It appeared that both Site 4 and Site 5 experienced financial challenges in purchasing clean filtered water, installing water counters, purchasing storage tanks, and paying water bills. However, participants in Site 4 was particularly vulnerable in comparison to other case studies as they described barriers in purchasing even low-cost technologies important for water storage such as water pumps and float valves for their water tanks. The float valve sits inside the water tank and controls the flow of the water into a tank. Without a float valve the water tank was reported to overflow.

“..the majority of people do not have...a circuit it’s like a ball ...it stops filling the tanks...but the majority of people do not have this ball in their tanks so if the water comes and midnights they still filling the tanks and it drops and ..it overflows...” – Male community leader Site 4 (Mokhaibah Al Foga)

²³ Based on local knowledge sources. Participant reported paying 200 JD for 6 months; while other communities report paying 60 JD for 6 months

6.1.4. Water Services at the Community Level

The resources and services of the community or municipality had a significant impact on either alleviating or increasing the water, sanitation and hygiene burden on households. Socio-economic factors such as the income, education, as well as the location of the community influenced the availability of resources in public spaces. The community's ability to cope with water shortages, as well as hygiene and sanitation challenges were also impacted by higher authorities responsible for maintaining the water infrastructure and network systems, as well as donor organizations that would provide WaSH infrastructure, services, and equipment to households.

Each of the case studies mentioned various benefits or assistance provided by the municipal government. However, the aid by the authorities varied across the case studies. For instance, in Site 2 the municipality would dig wells and pay for the well preparation against contamination for households that had more than 3 acres or were located outside the border of the municipality. In addition, participants could order water testing from wells from the Minister of Health. Households in Site 1 reported that when tap water was not received, they would have to *'prove to the municipality that they [did] not receive water [and] show them the water bill'*. In response, the municipality would provide a discounted water tank filled with water (i.e. 4JD instead of 8 JD), however it could take 2-3 weeks for it to be delivered. In Site 5 the water authority built a water station, however, it was not trusted because of the smell and the minerals of the water. A participant in Site 4 noted the development committee and the charity to be more active organizations in the community for awareness and training programs.

When asked about contacting authorities about the water concerns participants noted that they contacted the governor (Site 3), water authorities (Site 1, Site 4 and Site 5), Minister of Water and Irrigation (Site 1), employees living in the area (Site 5) and parliament members living in the area (Site 1). In addition, Site 1 used Facebook to share water-related problems. Site 2 often reported having their own 'decentralized committee' where the elected men and women would communicate with the local and main government (Site 2).

Across all case studies, handwashing facilities, as well as soap and water were not always available in public spaces such as mosques, community centres or schools.

However, centres or areas identified to be an economic generator for the community such as tourist sites, were reported to have these resources more available. For instance, in the case study of Site 1, the ruins are a popular site for tourism and participants noted that these public spaces were well-equipped with hygiene facilities and resources. Similarly, in Site 4, despite the major financial challenges reported for accessing clean water and hygiene resources in the community in general, the hot springs which was a popular spot among local Jordanians, had hygiene facilities and resources such as soap, water and filters.

The availability of handwashing stations, soap and water, as well as clean drinking water at schools in each community was identified to have a major impact on the burden of clean water as well as hygiene for families with children. The communities that reported having no water or hygiene items available at schools include Site 2, Site 4 and Site 5, and four participants in Site 3 mentioned that some schools also don't have these resources. In these cases, the participants noted that the children could be asked to bring in water and hygiene resources such as tissues from home. The participants in Site 4 reported the most significant impacts out of all the case studies, reporting that the children were only able to bring in one small bottle of water from home and would have to leave school early to get more water for drinking or to use the bathroom.

"...they do not have water to drink so they leave their schools earlier to go home to drink and in other cases bathrooms in schools don't have water so how can they use them, so they go home to use them" – Female interviewee from Site 4 (Mokhaibah Al Foga)

Participants working with the municipality or living near the schools would report that when children left school they would come to the workplaces and households and beg for clean water to drink.

"...she is...living opposite to one of the schools...when the schools get out everybody even though she doesn't know them...they go asking her to provide her with water and sometimes they say we do not have enough water which is filtered so we are obliged to drink from the water tanks which is not clean and not good quality...mentioned about a sick time she faced like she had diarrhea..." – Female interviewee from Site 4 (Mokhaibah Al Foga)

One participant described that after the providing water to students, their own household would run out of clean water.

"...and sometimes...we do not have enough clean water which is filtered so we are obliged to drink from the tanks which is not clean and not good quality...mentioned about a sick time she faced like she had diarrhea". – Female interviewee from Site 4 (Mokhaibah Al Foga)

The availability of clean water, sanitation and hygiene resources in a community were also impacted by the donations from donor organizations such as Mercy Corps, GIZ, USAID, and a religious Mennonite group, that was reported to have WaSH projects in the case studies of Site 3, Site 4 and Site 5. The donor organizations would provide a range of services including constructing new wells, providing water tanks, fixing leakages and providing education. Despite the assistance of external organizations, for the case studies of Site 4 and Site 5, communities were identified to still struggle with meeting their basic water and adequate hygiene and sanitation needs, largely due to issues of affordability.

6.1.5. Yarmouk Basin: Interactions with the Yarmouk River and Springs

The interactions between households and the Yarmouk River and surrounding springs varied across the five case studies with many participants reporting that they wanted to see the water authorities to rebuild the streams (Site 2 and Site 5) and monitor the quality of the water (Site 1).

Across all the case studies, except Site 3, the springs were reported to be contaminated and thus not well-managed. The spring water was believed to be contaminated from the faecal matter of wild animals (Site 4), grease (Site 1), wastewater (Site 1, Site 2, Site 5) organic pesticides, or pollution from other villages (Site 5). In Site 3, the participants reported that the wastewater contaminated groundwater but did not specifically mention springs.

The use and management of spring water varied across the case studies but was most accessible to participants in Site 4 as they were unique in having a hot spring within their community. Some households in Site 4 were receiving water from the hot springs directly and using it for cleaning purposes. A Mennonite group had previously created a network that transported water from the hot springs to some households as well as further out to farms. Participants noted that the houses are made of cement and the hot springs crack the walls and bring a mineral like sulfur that has a strong smell. However, participants also noted that industry changed and many of the farmers closed and built swimming pools instead.

"The Mennonites ...bring the water through these tanks...they add a pipe and bring it to the house...and in the second phase they transfer this kind of water to farmers in order to irrigate the plants because its like get colder through the pipes...and they provide the farmers with locks so they open it whenever they need it for each farm but by the time so many people changed this industry let's say and they moved to water to swimming pools...so like a quarter of the community ...received this kind of water...hot springs at their house..." – Male community leader interviewee from Site 4 (Mokhaibah Al Foga)

One participant in Site 5 noted that some wells were free to be used in the nearby village of Site 4 by the community for irrigation purposes.

"So, they ask why our community not this privilege have as well to use some wells for free as in the other village" – Female interviewee from Site 5 (Mukhaibah Al Tahta)

In Site 5 the springs were reported not to be well cared for or well-managed. One participant mentioned that the government had dried up a canal in the area resulting in the area not being able to be used for planting purposes or irrigation. Another participant noted that during the rainy seasons the springs would flow onto the farmland. While the spring water was not used for drinking water purposes because of the pollution, participants in Site 4 reported still using it for irrigating farmland. One participant in Site 5 expressed interest in using more spring water in the community.

"...there is a spring it's not built well it's been used 2 or 3 times a week to provide water for the people but what about the rest of the amount of the water? Where does it go? Why do we not benefit from it? It's a waste they are losing water they could be using it they just pick what they need when they fill the tanks through the pipes but what about the rest?"- Female interviewee from Site 5 (Mukhaibah Al Tahta)

The level of access, availability, and quality of the spring water was sometimes discussed in relation to having to share the water resource with other villages or countries. In the case studies of Site 3 and Site 5, participants reported that extracting water from the springs was political due to the transboundary nature of the Yarmouk River. For instance, participants in Site 3 and Site 5, reported that the construction of groundwater wells is prohibited because their community is close to the borders of Israel and the Yarmouk River.

"There is a political situation here because they are close to the borders you know that Israel is here and the Yarmouk River so it is prohibited that anyone can build a well here...if the Jordanian government says don't dig [a] well here, local people may think this is because of the

politics.' It was further explained that 'the wells in this scenario is talking about groundwater wells by the time you absorb anything so the water will not stay in the Yarmouk River this is not in the benefit of Israel."
- Female community leader from Site 3 (Samar/Saham)

When asked about potential solutions that the community would like to see participants in Site 5, noted that not all the springs could be used by the community and that Jordan should receive more benefits from the river.

"They are asking for clean groundwater springs and they are very healthy..it is acceptable to use two springs of those four and the other two they send it to the Yarmouk River which is for the benefit of the other side it seems. It seems like a political situation its prohibited to dig wells by the government and they mention that it is the law that for 12km from the border you cannot dig wells..."- Male interviewee from Site 5 (Mukhaibah Al Tahta)

6.2 Gender Equality

This research applied a gender lens to five focus groups with participants from seven villages in the Yarmouk Nature Reserve. Within each focus group this study performed a gender role identification for reproductive, productive and community work; a gender needs assessment to determine practical and strategic gender-specific needs for women; and, a disaggregated analysis on access and control to household resources and decision-making.

Across the case studies women identified as being primarily responsible for household reproductive tasks such as water-related chores, meal preparation, and childcare. Many women also indicated they participated in reproductive work as teachers or employed by the local municipality. Some of these employed women noted that they were still responsible for household chores and care for the children. These results are important, as it is emphasizing the invisible role that many women carry as a result of the domestic and childcare work not being fully recognized at home.

The practical and strategic gender needs were identified in Chapter 5 Table 5-19 from participants across the five case studies. The findings for practical gender needs could also be applied to men, except for menstrual hygiene needs, as the communities in general experienced significant challenges in accessing clean water, sanitation and hygiene resources. This study did not discuss menstrual hygiene needs; however, women noted that schools were without any hygiene resources and asked households to bring

them in (i.e. toilet paper, and sanitizer). For instance, in Site 4, female interviewees reported that school children would have to go home to drink and use the bathroom since there was no water or hygiene resources at the school.

The strategic gender needs identified in this study highlight the existing inequalities between women and men in the five case studies. The topics that were identified to be the men's role or responsibility by the participants were similar across the case studies and include contacting authorities on water-related concerns, purchasing water for livestock on the farm, and evacuating wastewater. To corroborate these findings, in the case studies where men were participants, the topics identified to be the male's responsibility were largely answered by men.

"the majority are contacted by men and not women, the municipality and sometimes the water authority. The husbands are contacting them [the authorities] this is the role of the man" – Female interviewee from Site 1 (Um Qais)

"...the other lady said they don't know everything is done by the man in the house, so those ladies don't know what is happening here [wastewater systems evacuation]" – Female interviewee from Site 4 (Mokhaibah Al Foga)

Women and men were both able to contribute to the conversation on water-related financial purchases including fees to connect to the municipal water system, monthly payments to the government for the municipal water, and costs of tanks. In the mixed focus group of Site 5, the men appeared to have more direct knowledge on the costs for municipal water payments. This was indicated only through non-direct statements where a man would report *'I used to get 7JD for 3 months [price of the water]'* while the woman noted that *'she heard 200JD for 6 months...'*. Through these statements I assume that the men are primarily responsible for handling the finances for municipal water payments.

Other strategic needs identified include activities where women reported societal restrictions or norms impacting their full participation including water management education, employment, travel, and access to social media and phones.

Women and men appeared to have similar access to land and water resources due to the significant obstacles in obtaining clean water, sanitation and hygiene resources for the community. As shown in Chapter 5 Table 5-13, the control of resources and decision-making within the household was disaggregated between female and male.

However, there were gender barriers for women accessing higher decision-making levels of water management such as at the national and/or community level. For example, in Site 5, the curriculum in schools as mandated by the government was reported to remove sections on water issues and plumbing stating that this was only for “*youth men or boys*”. In the case of Site 5, women encountered more gender-based barriers in comparison to other case studies which impacted their education or training. In this case study, women reported having to get permission to go out or have access to mobile phones.

“... 9 have problems with the families where girls are prohibited to go out to get training, it’s not about training it’s about going out” – Interviewee from Site 5 (Mukhaibah Al Tahta)

“Only 6 who have Facebook. I ask why and they said because it is prohibited by the families...they monitor us, and the lady said even that so many of them do not have smartphones” – Interviewee from Site 5 (Mukhaibah Al Tahta)

Since this study did not ask participants questions of ownership for resources and benefits, it relied on the literature of the laws and practices in Jordan regarding inheritance. This study assumes that the control of land, water resources and livestock are under the control of men only. Only the women in Site 5 reported that they did not have control for some benefits such as education, social media, cell phones, and traveling. However, across the case studies, women participants were not always recognized as decision-makers for certain activities and thereby were not able to have engage in equal control over some resources or benefits. For instance, in Site 2, women noted that both women and men were elected as leaders in decentralized committees for the local community government. However, contacting the water authorities about any water-related concerns was generally still assumed by the husband.

“The majority are contacted by men and not women. The municipality and sometimes the water authority, the husbands are contacting them. This is the role of the man.” – Female interviewee in Site 2 (Al Mansourah/Malka)

6.1.6. Balancing the Triple Role

Many women in these case studies noted that they have demands on their responsibilities for reproductive, productive, and community work. For instance, when discussing WaSH workshops, one female interviewee in Site 1 reported that the workshop was too far away, and that she didn’t have the time to attend because of these competing

work demands. She noted that she is responsible for organizing a cooperative organization for women as well as well as operating a home-business for her family. Similarly, women in Site 3 also reported they had commitments to work and were not able to attend the workshops. Another woman in Site 1 reported that she is unable to engage in water-reuse activities due to demands on her time.

“I organize...like a society...it’s a cooperative organization for women...I do not have the time and it’s far distance and I have a lot of commitment in my kitchen.... like a business” – Female interviewee from Site 1 (Um Qais)

“This lady is a teacher.... I used to reuse the water and take it from the cleaning the clothes and cleaning the dishes as well and use it to clean the floor. But when I get used to work, I don’t have time to think about reusing water...” – Female interviewee from Site 1 (Um Qais)

It is important for WaSH educational programs to examine if a project will increase the workload for a woman in one of her roles. Moser (1989) discusses that some projects, such as those that aim to increase the income of women, assumes women have free time and often results in an increased workload and demand on time.

6.1.7. Intersectionality

This study adopted an intersectionality approach to better understand the differences between the participants. Across these case studies, there was a total of 6 female Syrian participants that engaged in this study. Due to the limited number of participants, only general observations were made contrasting the Syrian interviewees and Jordanian residents. These general observations include Syrian households having limited resources such as gardens, and rainwater harvesting systems compared to Jordanian households. In addition, the levels of education between Syrian and resident women in Jordan differed on certain topics. For instance, one Syrian women in Site 3 expressed safe water reuse household practices while the other participants seemed unaware.

The education and memories from Syria could also influence household water management behaviour as one participant noted she would often remember water-related practices she could do in her home country.

“She is comparing here and Syria about their water and there we drink directly from the hose so when I open the hose here, I start imagine how was I drinking from this water in my country” – Female Syrian interviewee from Site 2 (Al Mansourah/Malka)

6.2. Overview and Rationale for the Identified Gaps in WaSH Education across the Five Case Studies

The gaps in water and sanitation at a household level were identified for each case study using the responses from interviewees from the five focus groups as well as a literature review. The results were shown in Chapter 5 Table 5-18 with the identified gaps in WaSH education divided into the following headings: *Water Use*, *Drinking Water*, and *Sanitation-Hygiene*. Since the participants answered the questions relating to hygiene at the community level, I recognize that the results related to *Hygiene* cannot be used to identify precise challenges at the household level. Therefore, it is important to note that not all the issues related to WaSH education are captured in this study. Instead, the results from this study reflect general missing information and awareness in the identified topics as reported by interviewees within as well as across the five case studies.

6.2.1. Water Use

Water Reuse: Infrastructure and Treatment of Greywater Prior to Irrigation

Under education in *Water Use* the identified gaps includes safe *Water Reuse* which refers to the proper selection and treatment of water sources. Knowledge regarding safe household water-related activities such as water-reuse did not appear to differ significantly between women and men but gaps in knowledge did appear between the communities visited. Four out of five of the case studies had an identified need for education in safe *Water Reuse* practices, particularly for reusing water for household irrigation purposes. There were 53 out of the total 75 participants that reported having a garden or farmland. All the case studies, except Site 5, reported gaps in education for safe reuse practices for irrigation purposes and largely appeared to be unaware of the potential negative health or environmental impacts.

In Site 5, one female participant reported using safe alternatives of chlorine to wash dishes so that they could reuse the water for irrigation purposes such as bi-carbonate sodium, citrus or lemon. Female participants in Site 2 reported using ‘clean

water' for water reuse but included water sources such as leftover water from dishes, the laundry machine, and washing of vegetables for irrigation purposes. Other participants, in Site 1, Site 3, Site 4, and Site 5 reported that they gathered leftover filtered water to reuse it for cleaning and irrigation purposes. Most participants in both Site 2 and Site 3 did not report concerns for safe greywater reuse practices. Participants in Site 1 had the most gaps in knowledge for safe water reuse practices compared to other case studies. Missing knowledge of water-reuse systems include installing a piped network and treatment/filtration systems. For instance, interviewees in Site 1 reported that a reuse system for irrigation purposes was established at a school using leftover greywater from dishwashing. However, the water did not have any filtration or treatment applied to it and was reported to smell. Site 1 was the only case study that reported having a water-reuse system established at a community space (i.e., school). Therefore, the participants may have simply brought up more of their questions about this topic in comparison to other case studies.

Reusing untreated greywater for irrigation purposes is a well-studied practice that is commonly used in countries and areas experiencing water scarcity. However, inadequately or untreated greywater reuse has potential public health and environmental risks (Maimon, Friedler, & Gross, 2014). These negative environmental impacts could include altering soil characteristics, contaminating surface and groundwater sources through runoff or leaching, and impacting plant growth (Siggins, Burton, Ross, Lower, & Horswell, 2016; Maimon, Friedler, & Gorss, 2014; Eriksson, Auffarth, Henze, & Ledin, 2002). In addition, the health impacts from using untreated greywater shows that greywater can have high levels of bacteria, and faecal coliforms such as *Escherichia coli* (*E. coli*) and faecal enterococci (Birks & Hills, 2007). This effect has been already demonstrated in Jordan where a 2008 study identified high concentrations of ammonia in untreated water-reuse samples attributed to households with children not wearing diapers (Halalsheh, et al., 2008). Therefore, safe water reuse practices, particularly for irrigation, should be highlighted in all five case studies.

Water Savings: Advanced Water Savings and Plumbing Techniques

Education for *Water Savings* was identified for three of the five case studies (Site 2, Site 4, and Site 5). Female interviewees in these three case studies expressed interest in water savings techniques particularly plumbing workshops. Some of the women in these

three case studies reported engaging in the plumbing workshops hosted by the German organization, *Gesellschaft für Internationale Zusammenarbeit (GIZ)* workshops in one of the villages of Site 2, Al Mansourah. A female interviewee in Site 5, reported participating in the GIZ workshop but wanting to learn more; '*they learned other skills it was like one week, but it was not advanced*'. Women in Site 2 reported that they wanted to know how to deal with household plumbing issues such as when a tap becomes broken or damaged. Women in Site 5 also reported that the plumbing information in the curricula at schools was removed by the Ministry because it was '*...only for the youth men or boys*.'

Despite these gender-barriers, the female participants expressed interest in training and education because they wanted to contribute to their homes and children.

"As long as those girls and those ladies from the community are not going away to study or going out to study at get education at least provide them with some training in order to benefit their homes and their houses even if it simple training and education it will have good impact on their lives"- Interviewee from Site 5 (Mukhaibah Al Tahta)

Importantly, the ladies from Site 5 also identified methods of training and education that would be permissible to their families stating that education received within the community at the local charity would be accepted due to the proximity to their homes.

".... I ask if they will let them to come here to get trained, they said yes because it is very close" - Interviewee from Site 5 (Mukhaibah Al Tahta)

It appeared that women attending water management workshops were passing their knowledge along to their families and neighbours thereby reducing the gap in education for the community overall. The value of training women in safe household water-related activities was reflected in a comment made by women in Site 1, one described that she tries to get '*everybody in the family to use it [water] wisely...*'. Another female participant in Site 1 shared that she teaches her children how to save water within the household.

Education on water savings such as plumbing could also have major benefits to the households in Site 4 where the challenges on accessing safe water centred on affordability such as costs of maintenance or basic equipment for their water tank. It was reported by a male community leader in the interview that many households in the area did not have a floating valve in the tank to prevent the water from overflowing and were unaware of how to stop the water loss.

“the majority of people do not have this ball in their tanks so if the water comes at midnight, they still filling the tank and it drops and...it overflows and especially in winter people are inside they do not go and check. So, some families are aware, so they have a key inside the house, so they open it and close it when finished filling the tank”. – Male interviewee from Site 4 (Mokhaibah Al Foga)

Water savings education for both plumbing and maintenance for storage tanks for these three case studies could reduce water-related costs and provide women with new skills to share at their household.

Agriculture: Interest in agricultural programs - Collecting water runoff effectively

The interest in learning about agricultural practices was expressed by participants when asked about what educational programs they were interested in or solutions for their community. Participants identified the following topics: hydroponic agriculture (Site 2 and Site 3), drip irrigation (Site 2), solutions to prevent evaporation (Site 2), and how to consume less water for the garden (Site 5).

One of the gaps in knowledge for agriculture that was identified for all case studies was the collection of water runoff. As agriculture is important for people in the Irbid Governorate, many participants in the case studies expressed concern over irrigation of the crops as the rainfall was reported to be decreasing. In addition, when participants were asked about water runoff some participants noted that it went into the ground (Site 1), farmland (Site 5), into streets (Site 1, Site 2, and Site 4), and into the dams (Site 1). Participants in Site 3 noted they could all see the flow ‘*on the surface after the rain*’. Participants from Site 1 reported that the runoff in their community appeared to have a greasy texture.

A traditional farming system used extensively in arid and semi-arid countries is the runoff-capture agriculture collected and stored in plots or cellars (Shangguan, Shao, Lei, & Fan, 2002; Ben-Asher and Berliner, 1994). The primary goal for the runoff-captured is to increase the supply of water for crops however, it can also provide important nutrients and organic material contributing to the soil fertility (Tesfai and Sterk, 2002); therefore, reducing the need for fertilizers (Dias, Tejedor, Jimenez, & Dahlgren, 2011).

6.2.2. Drinking Water

+Chlorine: Safe Practices on using Chlorine for Household Treatment

For the topic of Drinking Water, the educational gap in +Chlorine was identified in Site 4 when an interviewee in the focus group suggested that adding chlorine to the storage tank would treat the water source and remove algae. While the impacts of adding chlorine as a household treatment intervention has been documented to decrease the risk of child diarrhea (Arnold & Colford, 2007), the improper use can also present health risks (Cantor, 2010; Corillo, Canistro, Vivarelli, & Paolini, 2016; King, Marrett, & Woolcott, 2000). Chlorine treatments at a household level are not reported to be effective against parasites that can cause gastrointestinal infections (Arnold & Colford, 2007). Education needs to be implemented to increase awareness of the health risks from using chlorine as a household treatment intervention and help prevent participants engaging in this activity.

Storage Tanks: Increasing the number of storage tanks available; promoting education on cleaning and storing water safety in household tanks

Education in *Storage Tanks* was identified by women and men to be an important gap in education for the case studies of Site 2, Site 3, Site 4, and Site 5. It is important that the storage tanks are regularly cleaned and maintained to protect the water source from contamination. In Site 2 and Site 3, both case studies had some participants report what they believed to be a white layer of calcium on the sinks, water heater, and/or in the storage tanks, and were finding small stones in the drinking water from either tap water or rainwater. In Site 3, both women and men discussed finding a high percentage of calcium and chlorine in their water tanks and debated if the water is becoming contaminated from this despite the water tanks being regularly cleaned. In Site 5, participants would report being sick with the calcium from the tap water. In Site 3, some of the participants debated if the stones found in their water were from the water source or caused because households were not cleaning their tanks.

While the participants identified the white material to be calcium, further research indicates that the material may also be limescale which appears to be white, chalky deposits often found in water containers such as old pipes or hot water boilers (Park & Allaby, 2017). A study by Godsskesen et al (2012) discusses the removal of limescale deposits requiring the use of such as cleaning agents and acetic acids. It is generally well understood that the water quality challenges in Jordan are exacerbated by the inadequate

maintenance or inadequate storing practices for drinking water which are often stored on rooftop tanks for at least one week until the next distribution of water is received (Al-Omari, Fayyad, & Jamrah, 2008). According to Al-Omari et al (2008) the longer the water stays in the tanks, there is an increase risk to biological re-growth particularly during summer months. The study found that tank cleanliness is related to the growth rate of Total Heterotrophic Plate Count (THPC), which indicates the amount of bacteriological quality of the drinking water (Al-Omari et al., 2008). Therefore, education on cleaning storage tanks to ensure that they are free from contamination during storage can be an important step in reducing potential water-related health risks.

Rainwater Harvesting Systems: Safe Collection and Storage for Rainwater Harvesting

The expressed lack of knowledge by participants in the case studies of Site 1, Site 4 and Site 5, for collecting and storing rainwater should be addressed in order to reduce health risks cause by unsafe harvesting practices. Some of the participants in these three case studies expressed both an interest and a lack of knowledge in developing rainwater harvesting systems. In Site 1, households were experimenting in building water harvesting systems through barrels. However, the collection of the rainwater was reported to be potentially contaminated because '*...they don't bring it in to a safe way*'. While a female participant in Site 4 reported that rooftop rainwater harvesting systems were used in the past, participants abandoned the practice because '*...we believe that our rooftops are not clean to collect this type of water*'. In addition, the challenging soil/rock type as well as limited land prevented community members in Site 4 and Site 5 to dig wells or land-based rainwater harvesting systems. For instance, a woman in Site 5 noted that one of the issues for the community was that their '*...environmental situation doesn't help us to dig wells...*'. This was corroborated by other women participants who noted that their community experienced challenges to access rainwater due to limited rainfall, type of soil, and a dry climate. However, one female interviewee reported that her household used a rooftop harvesting structure directing rainwater to a water source for livestock water sources.

"She has two ways to provide the cows with water. Either the water from the filter leftover or the hose... or she bring the water from the filter to the area to drink the cows. And the other source is she has like a water harvesting from the rain which is a very simply technique... she has a pipe from the roof, and she send it to the container for the cows to drink." – Female interviewee from Site 5 (Mukhaibah Al Tahta)

In 2004, a study in the *Banai Kenanah District* reported that some households stored their rainwater in underground cistern reservoirs (Abo-Shehada, Hindyia, & Saiah, 2004) and were exposed to contamination of *E.coli* (17%) and *C. Parvium* (2%) due to unhygienic and environmental factors. The authors noted that the hygienic and environmental factors include the proximity of the underground cisterns to a seepage pit, the storage location of the bucket used for transporting the water out of the underground reservoir, and the level of the cistern opening (Abo-Shehada et al., 2004). Similarly, high fecal coliform levels identified in some rooftop rainwater harvesting storage tanks in Jordan (Abdulla & Al-Shareef, 2009). The authors reported that numerous factors can impact the quality of their rainwater including how often it is cleaned and maintained (i.e. cracks should be patched), pollution from automobiles, air pollution, rainfall intensity, and the number of days without precipitation prior to a rainfall event (Abdulla & Al-Shareef, 2009).

Almost all participants across the five case studies were interested in learning more about rainwater harvesting. Rainwater is seen to be a high-water quality source and many reported drinking the water directly (i.e. unfiltered) from their rainwater harvesting wells. In addition, many participants also expressed interest in testing their water quality and; therefore, it can be assumed that the collected rainwater is not generally tested prior to consumption. Increasing education for safe rainwater collection could highlight potential water quality issues and concerns and propel individual's into accepting and utilizing these practices.

6.2.3. Sanitation and Hygiene

Wastewater

Across all the case studies, there were some participants that indicated unsafe sanitation practices in the storage and disposal methods for their wastewater. As the municipal sewage system is not connected to any of the villages that participated in this study, households had to rely on alternative methods to dispose of their wastewater, relying on local knowledge to create these '*traditional systems*'. Unsafe sanitation practices were identified for households using the ruins/caves to dispose of their wastewater that would '*...goes into the springs and valleys*' as well as the soil and ground systems, commonly known as cesspools. Cesspools do not safely store the wastewater

as the bottoms and walls of the system are often permeable resulting in the water not being able to be transported for treatment. Cesspools are known for groundwater infiltration, particularly when created at shallow depths (Salameh, Shteivi, & Al Raggad, 2018). Many participants in Site 1, Site 2, Site 3 and Site 5 reported that the wastewater used in these open systems were contaminating their springs but did not report any educational initiatives to address these topics.

Due to the absence or limited water and hygiene resources available in the community, for the cases of Site 2, Site 3, Site 4 and Site 5 it is critical that sanitation and hygiene education is promoted at a household level. In this study, it was found that women of the household were not always included in the education for wastewater storage and evacuation.

The women participants in the case study of Site 4 were not able to determine how frequently the evacuation of the wastewater occurred.

“at the beginning every 100 years they evacuate the stone. Then she said she evacuates it this year... then I ask who evacuate it by the tanks and she raises her hand as if to say I don’t know.” Another participant followed her response “...they doesn’t know everything is done by the man in the house so the ladies doesn’t know what is happening there...”
– Interviewee at Site 4 (Mokhaibah Al Foga)

Some participants in Site 5 also reported they were ‘*not aware of need to evacuate*’. Therefore, it is difficult to determine if there is a gap in knowledge on the frequency of evacuation for cement/stone latrines within households for these two case studies since women were not always informed or familiar with the process.

Land Treatment: Safe Practices for Land Treatment of Wastewater

A major gap in education that has potential human health and environmental risks includes awareness of human exposure to wastewater fields; particularly for those engaged in planting of tree species in the area. In the case studies of Site 2 and Site 3, numerous participants reported disposing wastewater into the soil and planting species such as ‘*Qina*’ around or on top of the wastewater disposal site. ‘*Qina*’ is Arabic for a tree species commonly known as *red gum* or *Eucalyptus camaldulensis*. It appeared that for the participants using cesspools, planting *Qina* was sometimes used as an alternative method to evacuate the wastewater. In Site 2 the participants reported that planting *Qina*

in the area where the wastewater was stored to *'pull all the things from the septic tank'* and in Site 3, participants noted that *Qina* was planted since the *'plants absorb everything'*.

Land treatment has been documented as one of the oldest strategies for disposing and treating wastewater (Mexal, Zachritz, & Sammis, 2002) and is commonly utilized in arid countries today to treat wastewater through low cost natural physical, chemical, and biological processes (Bhargava & Lakmini, 207; Mexal et al., 2002). In order to minimize human exposure to these systems, it is commonly accompanied by a buffer area and fencing (EPA, 2002; Mahmood et al., 2013). While these systems act as an alternative to costly treatment plants, they still require treatment, reuse practices as well as effluent disposal (Tzanakakis, Paranychianakis, Kyritsis, & Angelakis, 2003). It is unclear if the participants in Site 2 and Site 3 had designed the cesspool to treat the water such as selecting sites with appropriate soils/clays to filter the wastewater as it makes its way farther into the ground. In addition, participants did not report a buffer area and it appeared that community members were free to go into the wastewater site to plant which increases their exposure to contact with the wastewater contaminants.

Alarmingly, some participants were unclear if there were any negative impacts to the plant or tree species planted around the wastewater sites. In Site 3 while all the participants agreed that they do not eat from fruit growing in the wastewater area there was a debate within the group if there was a negative impact from wastewater on fruit trees and plants. One women participant noted the abundance of caterpillars appearing on the trees growing on the septic tank area.

While using treated wastewater for agricultural purposes has been well documented to be a safe practice when used appropriately (Bedbabis, Rouina, Boukhris, & Ferrara, 2014), the impacts from consuming untreated wastewater for agricultural purposes is tied to significant health risks and issues particularly for children (Melloul, Amahmid, Hassani, & Bouhoum, 2002) including intestinal parasitotic (El Kattani et al., 2008), giardiasis and salmonella (Melloul et al, 2002; Amahmid & Bouhoum, 2000).

A study in Morocco found that children living in the spreading fields of the wastewater disposal area had a higher number of infections due to the direct contact with the contaminated wastewater such as playing in the field, placing their hands in the soil area while planting or harvesting from the site, or eating contaminated agricultural

products (Melloul et al., 2002). Preventative measures for health impacts in these previous studies include wastewater treatment; measures to limit human exposure in the area; crop restriction; (Amahmid & Bouhoum, 2000), and education on faecal hygiene and health impacts from wastewater (El Kettani et al., 2008).

Children Sanitation

An important gap in hygiene education was identified for schoolchildren for all the case studies except Site 1. In the cases of Site 2, Site 4 and Site 5, there was no soaps or toilet paper reported at schools. In Site 3 four of the 14 participants with children reported that the school asked the students to bring in these hygiene items. Menstrual hygiene was not discussed in this study as both women and men were present in each focus group. Existing literature on menstruation in many countries reports that it is considered a taboo and embarrassing topic (Jarrah & Kamel, 2012; Cheng, Yeng, & Liou, 2007) However, menstruation has had a negative impact on some students, particularly those in developing countries, for their daily tasks and education as they may avoid going to school or need to take longer breaks to rest (Dasgupta & Sarkar, 2008; Sharma, Taneja, Sharma, & Saha, 2008). As each focus group included both women and men, it was determined that question on menstruation would not be discussed.

The lack of data surrounding the menstrual hygiene makes it difficult in this study to properly assess the full impact to women and girls. Without access to handwashing facilities, soap or water, the ability to teach and enforce safe hygiene practices for children through teachers becomes more difficult and places greater importance of this education onto the families. For example, in Site 1 it was identified that the hygiene situation in the community would potentially improve if more rainwater systems were available. Therefore, more resources and education on clean water sources for hygiene purposes could promote safe practices even when the rainwater levels are low or cannot be relied upon.

6.3. Summary of the Rationale for Identified WaSH Education

The identified gaps took into consideration topics which were brought up by numerous participants or actions that stood out as being a health concern. Figure 5-2 in Chapter 5 should only serve as an indication of general WaSH needs and not as a case study priority list. Instead, the importance of identified gap varies across each case study

and are discussed above in greater detail. All case studies reported gaps in the education for *Water Reuse, Agriculture, Evacuation and Storage*, as well as *Women Sanitation and Hygiene*.

It should be noted that for the case studies of Site 4 and Site 5, the identified gaps in WaSH education are more urgent as a whole in comparison to other case studies, particularly for education in *Drinking Water* due to the unavailability of rainwater harvesting systems, barriers in accessing clean water or education because of time, affordability, gender, as well as low education. Participants in these two case studies presented unique challenges as well as water-related health issues that participants in other case studies did not discuss. A second important missing WaSH education gap that should be highlighted is *Sanitation-Hygiene for Land Treatment* for the case studies of Site 2 and Site 3 as the participants in the case studies reported planting tree and plant species in the wastewater field. The most important WaSH education gap for Site 1 is the lack of knowledge about water reuse practices where participants reported reusing water for irrigation purposes at schools without any treatment or filtration of the water.

Chapter 7. Recommendations and Conclusion

This study has analyzed within and across the five case studies of seven rural and northern villages in the Irbid Governorate of Jordan for gaps in clean water, and safe sanitation and hygiene practices at a household level. According to WHO & UNICEF JMP Guidelines the household education practices have been further divided into assessing the perceived quality, accessibility, and availability of drinking water sources, as well as type of sanitation facility, and presence of a handwashing facilities with soap and water. The responses to the WaSH indicators were also disaggregated by gender for the mixed case studies (Site 3 and Site 5) to better understand the differences in knowledge between women and men. All five case studies were also assessed for their gender roles identification, gender needs, and access or control over resources and benefits.

There were five identified emerging themes in this study that were determined to have an impact on sustainable and equitable WaSH practices and well as informing the management perspectives for surrounding environmental systems: *Trust, Consume it Wisely, Affordability, Community Resources, and Yarmouk Basin*. The study crossed-analyzed the participant's responses from the focus group interviews, the literature review, and the emerging themes to identify the gaps in WaSH education within and across each case study.

The results from this study identified a total of nine WaSH educational gaps across the five case studies for the topics of *Water Use, Drinking Water, and Sanitation and Hygiene*. All five of the case studies had gaps identified for *Water Reuse, Agriculture, Evacuation and Safe Storage, and Women in Sanitation and Hygiene* at a household level. The results also indicated that the case study with the highest number of gaps in WaSH was Site 4 (8) followed by Site 2 (7), Site 3 and Site 5 (6), and Site 1 (4). However, the number of the identified gaps in WaSH does not reflect the number of participants impacted nor the severity of the gap. Therefore, future WaSH education should tailor the programs based on the needs of each case study.

This report identified four recommendations directed towards the RSCN or other agencies interested in developing WaSH educational resources for the villages in the Yarmouk Nature Reserve. These recommendations reflect the needs and aspirations participants identified during the focus group interviews and include ways of reducing

barriers for women and girls to access workshops, designing programs to consider the triple-role for women and girls, addressing practical and strategic gender needs, and connecting WaSH education to reduce financial household costs. Applying a gender lens in developing future WaSH educational programs is essential to increase opportunities for women to challenge gender inequalities while also improving the household water security. WaSH education provides a unique opportunity to not only improve the well-being of the household but also, strengthens the voice of women and girls to become agents of change within their community.

7.1. Limitations

This study was designed to target Jordanian and Syrian women living in the communities within the Yarmouk Nature Reserve for focus group interviews. However, the study adapted to include community residents who were men as well as community leaders (both female and male). It was evident that there are differences in knowledge between the community residents and the leaders. Community leaders often shared information relating to the history of the community and the larger-scale problems that impacted their village. Therefore, a limitation of this study is that I did not hold separate interviews with community leaders to provide more context to each case study.

As this case study included both Jordanian and Syrian women, the needs and perspectives from these two groups should be further assessed in developing educational programs. According to literature, Syrian households in Jordan face greater barriers in achieving water security as a result of numerous factors such as high poverty rates, and challenges to gaining employment. However, I was not able to meaningfully assess the potential differences and similarities in WaSH education for Jordanian and Syrian participants due to the low number of Syrian refugees attending the focus groups.

A third limitation to the study was the assessment of hygiene resources was undertaken only at the community scale and not at the household scale. Providing additional information into the hygiene resources and education within households would benefit WaSH educational programs. Menstrual hygiene was not discussed in this study due to social taboos but should be considered for future research. The lack of water and hygiene resources available in schools that was reported in three of the five case studies indicates that there could be additional barriers for young female students who would have

limited hygiene resources during menstruation. For instance, in Site 4, students were reported to leave the school to use the washroom since there was no water or hygiene services available. In this case, it is evident that without additional measures the female students would be more adversely impacted by the lack of resources available in the community.

This study lacked quantitative data around water quality within these five case studies. Relying only on the perception of interviewees about water quality is an important limitation. Harmful substances, such as arsenic, can only be detected through a dedicated laboratory test because it has no odor or taste. Furthermore, participants view of water quality appeared in some cases to be influenced by social norms, as well as the level of trust in government. For instance, a common belief in rural regions of Jordan is the high quality of rainwater. Many participants in these focus groups shared this belief accompanied by a general distrust in the municipal water sources. Without quantitative data, it is impossible for this study to develop recommendations identifying safe water resources.

The final limitation to this study was the language barrier between the participants and the researcher. For instance, a language barrier could mean that contextual information may have been lost. In addition, I was not always able to separate answers between individuals in each focus group which could have been used to provide a deeper analysis into the participants responses.

7.2. Recommendations to Deliver Educational Programs

In order to help identify gaps in WaSH education as well as to help inform culturally appropriate methods to deliver the educational programs, the five focus group interviews were asked about past WaSH education, as well as recommendations for future topics and methods for distributing information. The following recommendations for delivering programs are discussed within the context of the hybrid framework and are related to the SDGs 1, 5, and 6.

7.2.1. Reduce Barriers for Women and Girls to Access Workshops

As women are identified to be the primary household water managers it is important that educational programs apply a gender lens in efforts to reduce the barriers of access for women and girls in rural communities. This recommendation address SDG target 5.5 '*Ensure women's full and effective participation for leadership at all levels of decision-making in political, economic, and public life*'.

One recommendation for reducing the barriers for women and girls to access water-related programs is to assess the traveling time, distance within and between communities to identify best locations to host workshops. Female participants in Site 5 reported that educational programs would be more accepted if they were hosted within their community as they must seek permission from their families to travel to other villages. The local charities, co-ops and community centres where the focus group interviews took place for this study was often emphasized by participants and community leaders as an important educational public space. The case studies where community leaders were present in the focus group interviews, expressed interest in hosting and being part of more WaSH educational activities. These existing structures and organizations are a key community resource that is already trusted and accepted by the public. The WaSH educational programs could ensure that the content fit the needs and interests of the community by increasing collaboration and communication with these organizations.

WaSH education in rural communities should also evaluate each communities' level of access and acceptance for social media platforms prior to distributing information. Participants in this research project responded differently to the question on the best way to communicate to households and communities about water educational programs. In Site 1, women noted that social media platforms like Facebook were effective methods to distribute information and noted that some households use Facebook already to discuss water-related concerns within their community. Similarly, many participants in Site 2 and Site 3 reported using social media, such as Facebook, within their daily life. However, participants in Site 4 and Site 5, reported that not everyone has mobile phones. One participant in Site 4 noted that it was only for educated individuals and for the youth. In Site 5, female participants reported barriers in accessing mobile phones or social media stating that they can be prohibited from owning these devices or, if they do have one, will be monitored by family members.

7.2.2. Design programs to Consider the Triple-Role

Many women in these focus groups indicated that they have competing demands on their time. Therefore, it is important that potential projects are examined to determine if they will increase the workload for women in one of her roles of productive, reproductive, or community responsibilities. This recommendation is reflected in the SDG target 5.4 *“Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate.”*

WaSH educational programs should be designed to ensure that the benefits of the project will alleviate some of the burden in one of the work roles. For instance, income-generating projects should also alleviate the burden for women, such as providing childcare, in order for the project to be successful in meeting even the practical needs for women (Moser, 1989).

7.2.3. Address Practical and Strategic Gender Needs

WaSH planning educational programs should also consider meeting objectives beyond the practical gender needs and seek to integrate actions to change existing divisions of labor or have equal rights to decision-making within in the household. Training women in traditionally men’s work has been seen in Jordan to begin to break down the division of labour between genders and support strategic gender needs.

This recommendation falls under the SDG target 5.5 *“Ensure women’s full and effective participation for leadership at all levels of decision-making in political, economic, and public life”*; as well as SDG target 1.4 addresses this recommendation in that it *“Ensures equal rights to economic resources, basic services, ownership and control over land and other forms of property, inheritance to all men and women, as well as the poor and vulnerable”*.

Participants across all case studies reported that an important method to provide WaSH education was through *‘practical training’* where community members would be able to engage in hands-on experience with the topic. This was particularly highlighted for students, children, or youth that could engage in education through games, field education, or workshops. A participant in Site 4 recommended that the youth could get

trained on the water issues for the community and then visit households to disseminate and educate the other members of the community on WaSH-related education. Practical training was also recommended to target women and housewives since the education that they would receive would benefit the entire family.

Some participants reported that their community had low education and therefore practical training was essential since not everyone was able to read printed materials (Site 4 and Site 5). Water costs from water bills or purchasing water from the market can be a financial burden for some households. Therefore, it was recommended that providing practical training that shows how water conservation techniques can reduce water-related bills can be an effective strategy.

There were multiple cases the participants asked for programs that requires more in-depth education particularly for agricultural activities. Participants were interested in hydroponic agricultural solutions where soil was not needed to grow crops and vegetables, sustainable methods to prevent evaporation, solutions to irrigation as rainwater was reported to decrease in some areas over the years. In addition, in the case of Site 5, participants were also interested in more advanced training for plumbing.

7.2.4. Connect WaSH Education to Reducing Financial Costs

Participants across all the case studies reported limited water-related infrastructure and resources such as water storage tanks, water pumps, and rainwater harvesting systems. The costs of accessing some of the basic water resources prevents households from coping with water shortages and low water distribution, particularly in the summer months. Therefore, some participants in these focus groups suggested that WaSH education be tied to the costs of water to encourage all members in the community to participate.

Ensuring everyone can access drinking water is reflecting in SDG target 6.1 “*Safe and affordable drinking water*” and SDG target 6.2 “*Access to adequate and equitable sanitation and hygiene and end open defecation*”.

In addition, as training women in WaSH education and finances may also break down the division of labour between women and men, it also supports SDG target 5.5 which “*Ensure women’s full and effective participation for leadership at all levels of*

decision-making in political, economic, and public life”; and SDG target 1.4 “Ensures equal rights to economic resources, basic services, ownership and control over land and other forms of property, inheritance to all men and women, as well as the poor and vulnerable”.

Households of all income levels are impacted by the intermittent and rationed piped water distribution, particularly in the summer months when distribution is low or when construction halts the water supply. However, low-income households and those away from the main road were particularly vulnerable to these water disruptions as their ability to cope was limited due to the high water-related costs. While some case studies reported having various levels of support from the community centres, municipal government, and water authorities, many households still reported having serious barriers in accessing clean water and adequate hygiene and sanitation resources for their daily needs.

References

- A V, S., Krishna, A., & Abidi, N (2017). Identifying Determinants of Toilet Usage by Poor in Urban India. *Procedia Computer Science*. 122., 634-641.
- Abdulla, F. A., & Al-Shareef, A. W (2009). Roof rainwater harvesting systems for household water supply in Jordan. *Desalination*. 243, 195-207.
- Abo-Shehada, M.N. and Rabi', A (1997) Bacteriological evaluation of drinking water reservoirs in northern Jordan. The proceedings of the International Conference on "Water management, salinity and pollution control towards sustainable irrigation in the Mediterranean region" MAIBari, Italy, 22 – 26 September 1997. Volume 2, pp. 229 – 238.
- Abo-Shehada, M. N., Hindyia, M., & Saiah, A (2004). Prevalence of *Cryptosporidium parvum* in private drinking water cisterns in Bani-Kenanah district, northern Jordan. *International Journal of Environmental Health Research*, 14(5): 351-358.
- Abou Elseoud, A., & Matthews, M (2013). Transnational water management in the Arab region. *Environmental Development* 7, 119-124.
- Aboud, F., & Singla, D (2012). Challenges to changing health behaviours in developing countries: A critical overview. *Social Science and Medicine*. 75, 589-594.
- Abu, T. Z., Bisung, E., & Elliott, S. J (2019). What if Your Husband Doesn't Feel the Pressure? An Exploration of Women's Involvement in WaSH Decision Making in Nyanchwa, Kenya. *International Journal of Environmental Research and Public Health*, 16: 1763.
- Abu-Rukah, Y., & Ghrefat, H (2001). Assessment of the anthropogenic influx of metallic pollutants in Yarmouk River, Jordan. *Environmental Geology*: 40(6), 683-692.
- Adeel, Z., Zaman, H., Kawahara, M., & Sharma, I. (2018). Women and Water Security for Peacebuilding in the Arab Region, PWRRC Discussion Paper Series, No. 1, Pacific Water Research Centre, Simon Fraser University, Burnaby BC, Canada.
- Agarwal, B. (1992). The Gender and Environment Debate: Lessons from India. *Sociology Collection*, 92(18), 119.
- Ahmed, A., Mustafa, U., & Khalid, M (2011). Rooftop Rainwater Harvest Technology and Women Time Allocation in District Bagh and Battagram Pakistan. *The Pakistan Development Review*, 50:4; pp.459-470.

- Al Naber, s., & Shatanawi, M (2004). The role of women in irrigation management and water resources development in Jordan. In A. Hamdy, J. Sagardoy, R. Quagliariello, & G. Trisorio-Liuzzi, *Integration of Gender Dimension in water management in the Mediterranean region: INGEDl Project. Bari.* (pp. 97-113). CIHEAM.
- Aladaileh, Haitham & Al Qinna, Mohammed & Karoly, Barta & Al-Karablieh, Emad & Rakonczai, János (2019). An Investigation into the Spatial and Temporal Variability of the Meteorological Drought in Jordan. *Climate*. 7. 82. 10.3390/cli7060082.
- Al-Ansari, N., Alibrahiem, N., Alsaman, M., & Knutsson, S (2014). Water Demand Management in Jordan. *Engineering*: 6, 19-26.
- Al-Bakri, J., Ajlouni, M., & Abu-Zanat, M (2008). Incorporating land use mapping and participation in Jordan: An approach to sustainable management of two mountainous areas. *Mountain Research and Development*: 28(1), 49-57.
- Al-Bakri, J., Suleiman, A., Abdulla, F., & Ayad, J (2010). Potential impact of climate change on rainfed agriculture of a semi-arid basin in Jordan. *Physics and Chemistry of the Earth*: 35, 125-134.
- Al-Dahdah, E., Corduneanu-Huci, C., Raballand, G., Ababsa, M., & Sergenti, E. (2016). Exclusion and Norms: Enforcing Women's Rights to Property in Jordan. In A. Al-Dahdah, C. Corduneanu-Huci, G. Raballand, M. Ababsa, E. Sergenti, & A. Vodopyanov, *Rules on Paper, Rules in Practice: Enforcing Laws and Policies in the Middle East and North Africa* (pp. 93-121).
- Ali, A., Oweis, T., Salkini, A., & El-Naggar, S. (2009). *Rainwater cisterns: traditional technologies for dry areas*. Aleppo, Syria: ICARDA.
- Al-Kharabsheh, N., Al-Kharabsheh, A., & Ghnaim, O (2013). Effect of Septic Tanks and Agricultural Waste on Springs' Water Quality Deterioration in Wadi Shu'eib Catchment Area-Jordan. *Jordan Journal of Agricultural Sciences*: 9(1), 86-101.
- Al-Mahasneh, M., Mousa, H., Jalamneh, H., Hani, I. B., & Zawahreh, M (2010). Evaluation of calcium content of drinking water supplies and its effect on calcium deficient in Jordan. *Desalination and Water Treatment*, V. 21 pg. 181-188.
- Al-Omari, A., Fayyad, M., & Jamrah, A (2008). Drinking water quality in roof storage tanks in the city of Amman, Jordan. *Water International*, 33:2; 189-201.
- Alomary, A (2013). Determination of trace metals in drinking water in Irbid City-Northern Jordan. *Environmental Monitoring Assessment*. 185, 1969-1975.
- Al-Saidi, M., & Dehnavi, S (2009). Comparative Scorecard Assessment of Urban Water Pricing Policies - The Case of Jordan and Iran. *Water*, 11: 704.

- Al-Taj, M (2008). Structural Control on Groundwater Distribution and Flow in Irbid Area, North Jordan. *Jordan Journal of Earth and Environmental Sciences: 1(2)*, 81-88.
- Amahmid, O., & Bouhoum, K (2000). Health effect of urban wastewater reuse in a peri-urban area in Morocco. *Environmental Management and Health*, 11:3, pp.263-269.
- Amjad, U.; Ojomo, E.; Downs, K.; Cronk, R.; Bartram, J (2015). Rethinking sustainability, scaling up, and enabling environment: A framework for their implementation in drinking water supply. *Water*, 7, 1497–1514.
- Ammary, B (2007). Wastewater reuse in Jordan: Present status and future plans. *Desalination* 211, 164-176.
- Arnold, B. F., & Colford, J. M (2007). Treating water with chlorine at point-of-use to improve water quality and reduce child diarrhea in developing countries: A systematic review and meta-analysis. *The American Society of Tropical Medicine and Hygiene*, 76(2): 354-364.
- Arafa, D., El-Fattal, L. and Laamrani, H (2007). Gender & WDM in the Middle East & North Africa, Water Demand Management Research Series by the Regional Water Demand Initiative in the Middle East and North Africa.
- Arora-Jonsson, S. (2011). Virtue and vulnerability: Discourses on women, gender and climate change. *Global Environmental Change*, 21, 744-751.
- Assayed, A., Hatokay, Z., A-Zoubi, R., Azzam, S., Qbailat, M., Al-Ullayan, A., Abu Saleem, M., Bushnaq, S., Maroni, R (2013). On-site rainwater harvesting to achieve household water security among rural and peri-urban communities in Jordan. *Resources, Conservation and Recycling*. 73, 72-77.
- Bartram, J., Cairncross, S (2010). Hygiene, sanitation, and water: Forgotten foundations of health. *PLoS Med*.
- Bain, R; Cronk, R; Hossain, R; Bonjour, S; Onda, K; Wright, J; Yang, H; Slaymaker, T; Hunter, P; Pruss-Ustun, A. et al (2014). Global assessment of exposure to faecal contamination through drinking water based on a systematic review. *Tropical medicine international Health*. 19. 917-927
- Bain, R; Cronk, R; Wright, J; Yang, H; Slaymaker, T; Bartram, J (2014a) Faecal contamination of drinking water in low- and middle-income countries: A systematic review and meta analysis. *PLoS Medicine*. 11.
- Bain, R; Johnston, R; Mitis, F; Chatterley, & Slaymaker, T (2018). Establishing Sustainable development Goal Baselines for Household Drinking Water, Sanitation and Hygiene Services. *Water*. 10. 1711.

- Batarseh, M (2006). The Quality of Potable Water Types in Jordan. *Environmental Monitoring and assessment* 117(1-3):235-44 DOI: 10.1007/s10661-006-0992
- Batayneh, A (2010). *Heavy metals in water springs of the Yarmouk Basin, North Jordan and their potentiality in the health risk assessment*. International Journal of the Physical Sciences 5(7) pp. 997-1003.
- Barreil, R.A.E (1989) The microbiology of treated and untreated small water supplies in relation to the European Community Guidelines. *Environ. Health*. 15, 171 – 73.
- Baxter, P.E & Jack, S.M (2010). Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers. *The Qualitative Report*. 13:3. 544-559.
- Bazeley, P (2013). *Qualitative Data Analysis: Practical Strategies*. Thousand Oaks, California: Sage.
- Bedbabis, S., Rouina, B. B., Boukhris, M., & Ferrara, G (2014). Effects of Irrigation with Treated Wastewater on Root and Fruit Mineral Elements of Chemlali Olive Cultivar. *The Scientific World Journal*, 8.
- Ben-Asher, J., Berliner, P.R (1994). Runoff irrigation. In: Tanji, K.K., Yaron, B. (Eds.), *Advanced Series in Agricultural Sciences: Management of Water Uses in Agriculture*, vol. 22. Berlin, Springer, pp. 127–155.
- Bhargava, A., & Lakmini, S (2017). Land Treatment as Viable Solution for Wastewater treatment and disposal in India. *Journal of Each Science and Climate Change*, 7: 375.
- Birks, R., & Hills, S (2007). Characterisation of Indicator Organisms and Pathogens in Domestic Greywater for Recycling. *Environment Monitoring Assessment*, 129: 61-69.
- Bradley, D., & Bartram, J (2013). Domestic water and sanitation as water security: monitoring, concepts and strategies. *Philosophical transactions of the Royal Society A371*.
- Cantor, K (2010). Carcinogens in drinking water: the epidemiologic evidence. *Environmental Health Perspectives*, 26:9-16.
- Carr, G., & Potter, R (2013). Towards effective water reuse: drivers, challenges, and strategies shaping the organizational management of reclaimed water in Jordan. *The Geographical Journal*: 179(1), 61-73.
- Cheng C, Yang K, Liou S (2007). Taiwanese adolescents' gender differences in knowledge and attitudes towards menstruation. *Nursing and Health Sciences*; 9: 127–134.

- Cirillo, S., Canistro, D., Vivarelli, F., & Paolini, M (2016). Effects of chlorinated drinking water on the xenobiotic metabolism in *Cyprinus carpio* treated with samples from two Italian municipal networks. *Environmental Science Pollution Res*, 23: 18777-18788.
- Creswell, J.W (2003). *Research design: qualitative, quantitative, and mixed method approaches*. Sage Publications. Thousand Oaks, California.
- Creswell, J. W., Hanson, W. E., Clark Plano, V. L., & Morales, A (2007). Qualitative Research Designs: Selection and Implementation. *The Counseling Psychologist*, 35(2), 236–264. <https://doi.org/10.1177/0011000006287390>
- Crocker, J., Shields, K. F., Venataramanan, V., Saywell, D., & Bartram, J (2016). Building capacity on water, sanitation, and hygiene programming: Training evaluation theory applied to CLTS management training in Kenya. *Social Science and Medicine*: 166, 66-76.
- Das, P (2014). Women's Participation in Community-Level Water Governance in Urban India: The Gap Between Motivation and Ability. *World Development*. 64. 206-218.
- Dasgupta A, Sarkar M (2008). Menstrual hygiene: How hygienic is the adolescent girl? *Indian Journal of Community Medicine*; 33: 77–80.
- Department of Statistics (DOS) (2004). *Population and Housing Census of 2004*. Annual Report. Amman, Jordan. www.dos.gov.jo
- Department of Statistics (DOS) (2015). *Population and Housing Census of 2015*. Amman, Jordan.
- Department of Statistics (DOS) (2018). *Environment and Water*. *Jordan Statistical Yearbook 2018*. Retrieved from <http://dosweb.dos.gov.jo/products/jordan-statistical-yearbook-2018/>
- Department of Statistics (DOS) & Fafo Institute for Applied Social Science (1998). *Jordanian Society Living Conditions in Hashemite Kingdom of Jordan*. Retrieved from https://www.fafo.no/media/com_netsukii/253.pdf
- Department of Statistics (DOS). (2018a). *Jordan Statistical Yearbook (2018)*. Department of Statistics. Retrieved from <http://dosweb.dos.gov.jo/products/jordan-statistical-yearbook-2018/>
- Department of Statistics (DOS) (2018b). *Environmental Statistics 2014-2015*. Department of Statistics. Retrieved from http://dosweb.dos.gov.jo/databank/publication/Environment_2014-2015Eng.pdf
- Department of Statistics (DOS) (2019). *Jordan in Figures 2018*. Department of Statistics, Jordan. Retrieved from <http://dosweb.dos.gov.jo/products/jordan-in-figure2018/>

- Department of Statistics (DOS) (2019a). *Agricultural Statistics 2017*. Department of Statistics. Retrieved from <http://dosweb.dos.gov.jo/products/agricultural-statistics-2017/>
- Department of Statistics (DOS) (2019). *Jordan Population and Family Health Survey 2017-2018*. Amman, Jordan and Rockville, Maryland, USA: DOS and ICF.
- Dias, F.J., Tejedor, M., Jimenez, C., & Dahlgren, R.A (2011). Soil fertility dynamics in runoff- capture agriculture, Canary Islands, Spain. *Agriculture, Ecosystems and Environment*. 144. 253-261
- El Kettani, S., Azzouzi, E., Boukachabine, K., El Yamani, M., Maata, A., & Rajaoui, M (2008). Intestinal parasitosis and use of untreated wastewater for agriculture in Settat, Morocco. *Eastern Mediterranean Health Journal*, 14:6, 1435.
- Elkanzi, M.H.A., Mohammad, Al., & Ezeldin, M (2016). The study of Natural Radioactive Pollution in the Samples Water of Natural Spring in the Governorate of Irbid. *Elixir Pollution*. 100. 43634-43636.
- EPA. (2002). *Onsite wastewater treatment systems Manual*. Environmental Protection Agency.
- Environmental Protection Agency (EPA) (2002). *Onsite wastewater treatment systems Manual*.
- Eriksson, E., Auffarth, K., Henze, M., & Ledin, A (2002). Characteristics of grey wastewater. *Urban Water*. 4:85 104.
- Fan L, Liu G, Wang F, Geissen V, Ritsema CJ (2013) Factors Affecting Domestic Water Consumption in Rural Households upon Access to Improved Water Supply: Insights from the Wei River Basin, China. *PLoS ONE* 8(8): e71977. doi: 10.1371/journal.pone.0071977
- Farishta, A (2014). The Impact of Syrian Refugees on Jordan's Water Resources and Water Management Planning (Thesis). *Columbia University Academic Commons*.
- Firestone, W (1993). Alternative arguments for generalising from data as applied to qualitative research. *Educational Research*. 22(4), 16-23.
- Fletcher, A.J (2018). More than Women and Men: A Framework for Gender and Intersectionality Research on Environmental Crisis and Conflict. In C. Fröhlich., G. Gioli, R. Cremades & H. Myrntinen (Eds.), *Water Security Across the Gender Divide*. Cham: Springer International
- Flick, U (2007). *Managing quality in qualitative research*. London: Sage.

- Florke, M., Kynast, E., Barlund, I., Eisner, S., Wimmer, F., & Alcamo, J (2013). Domestic and industrial water uses of the past 60 years as a mirror of socio-economic development: A global simulation study. *Global Environmental Change*, 23. 144-156.
- Food and Agriculture Organization of the United Nations (FAO) (2009). AQUASTAT Water report 34. Retrieved from http://www.fao.org/nr/water/aquastat/countries_regions/JOR/
- Food and Agriculture Organization (FAO) (2017). AQUASTAT *Database Query Results*; FAO: Rome, Italy
- Gerlach, E., & Franceys, R (2009). Regulating water services for the poor: The case of Amman. *Geoforum*: 40, 431-441.
- Geotz, A.-M. (2007). Gender Justice, Citizenship and Entitlements - Core Concepts, Central Debates and New Directions for Research. In M. S. Mukhopadhyay, *Gender Justice, Citizenship and Development*, 15-57. Ottawa: International Development Centre.
- Gine-Garriga, R., Jimenez-Fernandez de Palencia, A., & Perez-Foguet, A (2013). Water-sanitation-hygiene mapping: An improved approach for data collection at local level. *Science of the Total Environment*, 700-711.
- Glaser, B. G (1965). The constant comparative method of qualitative analysis. *Social Problems*, 12; 436-445.
- Glaser, B (1978). *Theoretical Sensitivity: Advances in the methodology of grounded theory*. Mill Valley, CA: Sociology Press.
- Google. (2020). [Closer examination of the study sites]. Retrieved August 31st, 2020, from https://www.google.ca/maps/@32.32734,35.5622918,10z/data=!3m1!4b1!4m2!6m1!1s1hdjK3vVLD3cceM5Hd_Ta8i5R2MRvoeax
- Haddadin, M. J (2006). *Water Resources in Jordan: Evolving policies for development, the environment, and conflict resolution*. Washington, DC: Resources for the future.
- Halalsheh, M., Dalahmeh, S., Sayed, M., Suleiman, W., Shareef, M., Mansour, M., & Safi, M (2008). Grey water characteristics and treatment options for rural areas in Jordan. *Bioresource Technology* 99, 6635-6641.
- Hamdi, M., Abu-Allaban, M., Al-Shayeb, A., Jaber, M., & Momani, N (2009). Climate change in Jordan: A comprehensive examination approach. *American journal of environmental sciences*: 5(1), 58-68.

- Hashemite Kingdom of Jordan (2009). *Jordan National Water Security 2016-2025*. Retrieved from Minister of Water and Irrigation: [http://www.mwi.gov.jo/sites/enus/Hot%20Issues/Strategic%20Documents%20of%20%20The%20Water%20Sector/National%20Water%20Strategy\(%202016-2025\)-25.2.2016.pdf](http://www.mwi.gov.jo/sites/enus/Hot%20Issues/Strategic%20Documents%20of%20%20The%20Water%20Sector/National%20Water%20Strategy(%202016-2025)-25.2.2016.pdf)
- Hess, T.M. & Knox, J.W (2013). Water savings in irrigated agriculture: a framework for assessing technology and management options to reduce water losses. *Agriculture*. 42. 2. 85-91. Doi: 10.5367/oa.20130130
- Hijawi, N., Ng, J., Yang, R., Atoum, M. F., & Ryan, U (2010). Identification of rare and novel *Cryptosporidium* GP60 subtypes in human isolates from Jordan. *Experimental Parasitology*, 125: 161-164.
- Huda, T., Unicomb, L., Johnston, R. B., Halder, A. K., Sharker, A. Y., & Luby, S. P (2012). Interim evaluation of a large-scale sanitation, hygiene and water improvement programme on childhood diarrhea and respiratory disease in rural Bangladesh. *Social Science and Medicine*, 604-611.
- Hussein, H (2017). Whose 'reality'? Discourses and hydro politics along the Yarmouk River. *Contemporary Levant: 2(2)*, 103-115.
- Hussein, H (2018). Yarmouk, Jordan, and Disi basins: Examining the impact of the discourse of water scarcity in Jordan on transboundary water governance. *Mediterranean Politics*. Doi:10.1080/13629395.2017.1418941
- Ibrahim, M. N (2019). Assessing Groundwater Quality for Drinking Purpose in Jordan: Application of Water Quality Index. *Journal of Ecological Engineering*, 20(3): 101-111.
- International Labour Organization (2016). *Local Economic Development Strategy for Irbid Governorate 2016-2018*. Retrieved from https://www.ilo.org/wcmsp5/groups/public/---arabstates/---robeitr/documents/publication/wcms_456503.pdf.
- Intergovernmental Panel on Climate Change (IPCC) (2007). In *Climate Change 2007: Impacts, Adaptation and Vulnerability*. In: Parry ML, Canziani OF, Palutikof JP, van der Linden PJ, Hanson CE (eds). *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge
- Japan Emergency NGO (2013). *The Syrian Refugee Crisis in Jordan*. Retrieved from https://www.jen-npo.org/en/concept/pdf/nl_Jordan2013March_May.pdf.
- Jarrah, S.M., & Kamel, A.A. (2012). Attitudes and practices of school-aged girls towards menstruation. *International Journal of Nursing Practice*. 18: 308-315

- JISM (2001). Jordanian Institution for Standards and Metrology (JISM), Technical Regulations No. 286/2001 Date 16/09/2001 for Tap Drinking Water, and No. 1214/2001 Date 16/09/2001 for Water-Bottled Drinking Water.
- JISM (2004). Jordanian Institution for Standards and Metrology (JISM), Technical Regulation No. 1528/2004 Date 16/09/2004 for Water-Desalinated Drinking Water in Private Plants.
- Jordan Response Platform (2016). *Jordan Response Plan for the Syria Crisis 2016 2018*. Retrieved from https://reliefweb.int/sites/reliefweb.int/files/resources/JRP16_18_Document-final%2Bdraft.pdf
- Jordan University of Science & Technology (nd). *GIS Maps*. Retrieved from Department of Civil Engineering http://www.just.edu.jo/FacultiesandDepartments/FacultyofEngineering/Departments/CivilEngineering/Pages/gis_maps.aspx
- Jumare, A.M.; Bashir, M.A.; Ankoma-Sey, V.R (2015). Analysis on Students' Late-coming factors in selected secondary schools in Zaria: Implications for educational managers. *Journal of Educational Practice*. 6, 56–61.
- Khan SM, Bain RES, Lunze K, Unalan T, Beshanski-Pedersen B, Slaymaker T, et al (2017) Optimizing household survey methods to monitor the Sustainable Development Goals targets 6.1 and 6.2 on drinking water, sanitation and hygiene: A mixed-methods field-test in Belize. *PLoS ONE* 12(12): e0189089. <https://doi.org/10.1371/journal.pone.0189089>
- Khashman, K (2016). Arab Countries Water Utilities Association. *Syrian refugee crisis Impact on Jordan Water-Wastewater Sector* [PowerPoint Slides]. Retrieved from http://waterforfood.nebraska.edu/wp-content/uploads/2016/05/Presentation_USA_KKFinal.Pdf
- King, W. D., Marrett, L. D., & Woolcott, C. G (2000). Case-Control Study of Colon and Rectal Cancers and Chlorination By-Products in Treated Water. *Cancer Epidemiology*, 9: 813-818.
- Klassert, C., Sigel, K., Gawel, E., & Klauer, B (2015). Modeling Residential Water Consumption in Amman: The Role of Intermittency, Storage, and Pricing for Piped and Tanker Water. *Water*: 7, 3643-3670.
- Klassert, C., Sigel, K., Klauer, B., & Gawel, E (2018). Increasing Block Tariffs in an Arid Developing Country: A Discrete/Continuous Choice Model of Residential Water Demand in Jordan. *Water*, 10: 248.
- Kumpel, E., Nelson, K (2013). Comparing microbial water quality in an intermittent and continuous piped water supply. *Water Research*. 47. 5176-5188

- Lezzaik, K., & Milewski, A (2018). A quantitative assessment of groundwater resources in the Middle East and North Africa region. *Hydrogeology Journal*, 26, 251-266.
- Lienhoop, N., Al-Karablieh, E. K., Salman, A. Z., & Cardona, J. A (2014). Environmental cost– benefit analysis of decentralised wastewater treatment and reuse: a case study of rural Jordan. *Water Policy*, 16; 323-339.
- Mahmood, Q., Pervez, A., Zeb, B. S., Zaffar, H., Yaqoob, H., Waseem, M., Afsheen, S (2013). Natural Treatment Systems as Sustainable Ecotechnologies for the Developing Countries. *BioMed Research International*, 19.
- Mahmood, Y. H., Al-Hilali, B. M., & Kalaf, A. T (2018). Concentration of Residual Chlorine and Its Health Effects on The Drinking. *Institute of Natural and Applied Science Journal*, 11:1, 29-37.
- Maimon, A., Friedler, E., & Gross, A (2014). Parameters affecting greywater quality and its safety for reuse. *Science of the Total Environment* 487, 20-25.
- Maimon, A., Tal, A., Friedler, E., & Gross, A (2010). safe on-site reuse of greywater for irrigation - a critical review of current guidelines. *Environmental Science Technology*, 33: 3213-20.
- March, C., Smyth, I., & Mukhopadhyay, M (1999). *A Guide to Gender-Analysis Frameworks*. Oxford: Oxfam.
- Maxwell, J (2010). Using Numbers in Qualitative Research. *Qualitative Inquiry*: 16(6), 475-482.
- Melloul, A., Amahmid, O., Hassani, L., & Bouhoum, K (2002). Health effect of human wastes use in agriculture in El Azzouzia (the wastewater spreading area of Marrakesh city, Morocco). *International Journal of Environmental Health Research*, 12:1, 17-23.
- Merriam, S.B (1998) *Qualitative Research and Case Study Applications in Education*. Jossey-Bass Publishers, San Francisco.
- Mexal, J. G., Zachritz, W. H., & Sammis, T. W (2002). Trees are the solution to wastewater treatment for small communities. In R. K. Dumroese, L. E. Riley, & T. Landis, *National Proceedings: forest and conservation nursery associations 1999, 2000, and 2001. Proceedings RMRS-P-24* (pp. 327-335). Ogden, UT: US Department of Agriculture Forest Service, Rocky Mountain Research Station.
- Miiró, G.; Rutakumwa, R.; Nakiyingi-miiró, J.; Nakuya, K.; Musoke, S.; Namakula, J.; Weiss, H.A (2018). Menstrual health and school absenteeism among adolescent girls in Uganda (MENISCUS): A feasibility study. *BMC Women's Health*, 18, 4.
- Miles, M., & Huberman, A. M (1994). *Qualitative data analysis: an expanded sourcebook*. Thousand Oaks, CA: Sage.

- Millennium Ecosystem Assessment (2003). *Ecosystems and Human Well-Being: A Framework for Assessment*. Washington, DC: Island Press.
- Millennium Ecosystem Assessment (2005). *Ecosystems and Human Well-Being: Synthesis*. Washington, DC: Island Press
- Ministry of Municipality Affairs (2016). *Al Shou'la Municipality: Phase 1 of planning for local economic development, institutional strengthening action plan and investment opportunities*. Government of Jordan.
- Ministry of Water and Irrigation (2008). *Water for Life - Jordan's Water Strategy 2008-2022*. Amman: Ministry of Water and Irrigation.
- Ministry of Water and Irrigation (2016). *National Water Strategy 2016-2025*. Hashemite Kingdom of Jordan.
- Ministry of Water and Irrigation (2017). *Jordan Water Sector-Facts and Figures 2017*. Amman, Jordan: Ministry of Water and Irrigation.
- Mohammad, A., Jung, H., Odeh, T., Bhuiyan, C., & Hussein, H (2018). Understanding the impact of droughts in the Yarmouk Basin, Jordan: monitoring droughts through meteorological and hydrological drought indices. *Arabian Journal of Geosciences: 11(103)*. doi:10.1007/s12517-018-3433-6
- Moser, C (1989). Gender Planning in the Third World: Meeting Practical and Strategic Gender Needs. *World Development, 17(11)*, 1799-1825.
- Moser, C. O. (1993). *Gender planning and development: theory. practice and training*. London: Routledge.
- Mukhopadhyay, M., & Singh, N (2007). *Gender Justice, Citizenship and Development* . International Development Research Centre, Zubaan, an imprint of Kali for Women, New Delhi, India. Retrieved from <https://idl-bnc-idrc.dspacedirect.org/bitstream/handle/10625/32041/IDL-32041.pdf>
- Mustafa, D., & Talozzi, S (2018). Tankers, Wells, Pipes and Pumps: Agents and Mediators of Water Geographies in Amman, Jordan. *Water Alternatives, 11(3)*: 916-932.
- Myrntinen, H., Cremades, R., Frohlich, C., & Gioli, G (2018). Bridging Troubled Waters: Water Security Across the Gender Divide. In C. Frohlich, G. Gioli, R. Cremades, & H. Myrntinen, *Water Security Across the Gender Divide* (pp. 3-11). Cham, Switzerland: Springer International Publishing AG.
- Naber, S., & Shatanawi, M (2004). The role of women in irrigation management and water resources development in Jordan. In A. Hamdy, J. Sagardoy, R. Quagliariello, & G. Trisorio-Liuzzi, *Intgration of Gender Dimension in water management in the Mediterranean region*. 97-113.

- Nazzai, Y., Mansour, M., Al Najjar, M., & McCornick, P (2000). Wastewater reuse law and standards in the Kingdom of Jordan. *Ministry of Water and Irrigation*. Amman, Jordan.
- Nimri, L.F (2003). Cyclospora cayetanensis and other intestinal parasites associated with diarrhea in a rural area of Jordan. *International Microbiology*, 6, 131–135.
- Ngai, T., Mills, O., French, G., De Oliveira, R., Lepore, C., Mattens, Sibanda, T., Sweet, M., & Graves, A (2013). A global review of capacity building organizations in water sanitation, and hygiene for developing countries. *WEDC International Conference*. Nakuru, Kenya.
- Obeidat, M., Awawdeh, M., & Al-Mughaid, H (2013). Impact of a domestic wastewater treatment plant on groundwater pollution, north Jordan. *Revista Mexicana de Ciencias Geologicas: 30(2)*, 371-384.
- Obeidat, M., Awawdeh, M., & Al-Rub, F (2013a). Multivariate statistical analysis and environmental isotopes of Amman/Wadi Sir (B2/A7) groundwater, Yarmouk River Basin, Jordan. *Hydrological Processes: 27*, 2449-2461.
- Odeh, T., Boulad, N., Abde, O., Yahya, A., Khries, N., & Abu-Jaber, N (2017). The influence of geology on landscape typology in Jordan: Theoretical understanding and planning implications. *Land: 6(51)*. doi:10.3390/land6030051
- Odeh, T., Mohammad, A., Hussein, H., Ismail, M., & Almomani, T (2019). Over-pumping of groundwater in Irbid governorate, northern Jordan: a conceptual model to analyze the effects of urbanization and agricultural activities on groundwater levels and salinity. *Environmental Earth Sciences: 78(40)*. Doi: doi.org/10.1007/s12665-018-8031-0
- Okour, A., Gharaibeh, M., & Al-Ghazawi, Z (2012). Diarrhea among children and the household conditions in a low-income rural community in the Jordan Valley. *Jordan Medical Journal*, 46(2): 108-117.
- Organization for Economic Co-operation and Development OECD (2009). *Managing Water for All: An OECD Perspective on Pricing and Financing*. Paris, France: OECD.
- Perez-Urdiales, M, & Carcia-Valinas, M.A (2016). Efficient water-using technologies and habits: A disaggregated analysis in the water sector. *Ecological Economics*. 128. 117-129.
- Polimeni, J., Almalki, A., Iorgulescu, R., Albu, L., Parker, W., & Chandrasekara, R (2016). Assessment of Macro-Level Socioeconomic Factors That Impact Waterborne Diseases: The Case of Jordan. *International Journal of Environmental Research and Public Health:13(1181)*.

- Population and Housing Census (2016). *The population of the Kingdom by Administrative Divisions, According to the General Census of Population and Housing result 2015*. Population and Social Statistics Directorate. Retrieved from http://www.dos.gov.jo/dos_home_a/main/population/census2015/No_of_pop_dep_and_on_GOV.pdf
- Potter, R. B., & Darmame, K (2010). Contemporary social variations in household water use, management strategies and awareness under conditions of 'water stress'" The case of Greater Amman, Jordan. *Habitat International*, 34: 115-124.
- Prieto, A (2018). *JOHUD's Water Wise Women wins best water conservation project*. Retrieved from <http://www.jordantimes.com/news/local/johud%E2%80%99s-water-wise-women%E2%80%99-wins-best-water-conservation-project>
- Rabi, Z. and Abo-Shehada, M.N (1995). Sanitary survey of private drinking water reservoirs in northern Jordan. *International Journal of Environmental Health Research*. 5, 255 – 61.
- Rajsekhar, D., & Gorelick, S. M (2017). Increasing drought in Jordan: Climate change and cascading Syrian land-use impacts on reducing transboundary flow. *Science Advances*. 3.
- Reig, P., & Gassert, F (2013). *World's 36 Most Water-Stressed Countries*. Retrieved from World Resources Institute: <https://www.wri.org/blog/2013/12/world-s-36-most-water-stressed-countries>
- Richards, L. and Morse, J.M (2007) *Readme First for a User's Guide to Qualitative Methods*. Sage Publications, Thousand Oaks.
- Rosenberg, D., Talozzi, S., & Lund, J (2008). Intermittent Water Supplies: Challenges and Opportunities for Residential Water Users in Jordan. *Water International*: 33(4), 488-504.
- Royal Society for the Conservation of Nature (nd). *Royal Society for the Conservation of Nature (RSCN)*. Retrieved from RSCN: <http://www.rscn.org.jo/overview>
- Royal Society for the Conservation of Nature (nd). *Integrated Water Conservation and Management in Yarmouk Forest Reserve*. Retrieved from RSCN: <http://www.rscn.org.jo/integrated-water-conservation-and-management-yarmouk-forest-reserve>
- Ryan, U., Zahedi, A., Papparini, A (2016). Cryptosporidium in humans and animals- a one health approach to prophylaxis. *Parasite Immunol*. 38. 535-547
- Saidan, M., Al-Weshah, R. A., & Obada, I (2015). Potential Rainwater Harvesting: An adaptation measure for urban areas in Jordan. *American Water Works Association*. 107(11), 594-602.

- Salameh, E., & Haddadin, M (2006). The Population- Water Resources Equation. In M. Haddadin, *Water Resources in Jordan:" Evolving Policies for Development, the Environment, and Conflict Resolution*. Washington, DC, USA: Resources for the Future.
- Salameh, E., Shteivi, M., & Al Raggad, M (2018). *Water Resources of Jordan: Political, Social and Economic Implications of Scarce Water Resources*. Cham, Switzerland: Springer International Publishing AG
- Saldaña, J (2009). *The coding manual for qualitative researchers*. Thousand Oaks, CA: Sage Publications Ltd.
- Saleh, W., & Hashemi, M (2012). Water and Political Security: Conflict in West Asia and North Africa. In H. Bigas, *The Global Water Crisis: Addressing an Urgent Security Issue. Papers for the InterAction Council, 2011-2012* (pp. 47-57). Hamilton, Canada: UNU-INWEH.
- Sandelowski, M (2001). Real Qualitative Researchers Do Not Count: The Use of Numbers in Qualitative Research. *Research in Nursing and Health*. 24, 230-240.
- Sandford, R (2017). The Human Face of Water Insecurity. In D. Devlaeminck, & Z. Adeel, *The Human Face of Water Security* (pp. 1-24). Cham, Switzerland: Springer International Publishing AG.
- Schmitt, M., Clatworthy, D., Ratnayake, R., Klaesener-Metzner, N., Roesch, E., Wheeler, E., & Sommer, M (2017). Understanding the menstrual hygiene management challenges facing displaced girls and women: findings from qualitative assessments in Myanmar and Lebanon. *Conflict and Health*. 11(19).
- Schwemlein, S., Cronk, R., & Bartram, J (2016). Indicators for monitoring water, sanitation, and hygiene: a systematic review of indicator selection methods. *International Journal of Environmental Research and Public Health*, 13, 333.
- Shangguan, Z.P., Shao, M.A., Lei, T.W., & Fan, T.L (2002). Runoff water management technologies for dryland agriculture on the Loess. *The International Journal of Sustainable Development and World Ecology*, 9:4, 341-350 DOI: 10.1080/13504500209470129
- Sharieh, A., Barham, R., & Jaradat, S (2017). Urban Sprawl Impact on Agricultural Lands in Irbid City, Jordan. *Journal of Environment and Earth Science*, 7:3: 2224-3216.
- Sharma A, Taneja D, Sharma P, Saha R (2008). Problems related to menstruation and their effect on daily routine of students of a medical college in Delhi, India. *Asia-Pacific Journal of Public Health*; 20: 234–241.

- Shentis, I., Inbar, N., Rosenthal, E., & Magri, F (2018). Numerical representation of rainfall fields in basins of the Upper Jordan River and of the Yarmouk River. *Environmental Earth Sciences: 77*, 798. Doi: <https://doi.org/10.1007/s12665-018-7976-3>
- Shove E, Franceys R, Morris J (2010). Behavioural change and water efficiency. ESRC (Economic and Social Research Council) *Seminar Series - Mapping the Public Landscape*, United Kingdom.
- Shrivastava, A.K., Kumar, S., Smith, W.A., Sahu, P.S (2017). Revisiting the global problem of cryptosporidiosis and recommendations. *Tropenmed. Parasitol. 7: 8-17*
- Siggins, A., Burton, V., Ross, C., Lowe, H., & Horswell, J (2016). Effects of long-term greywater disposal on soil: A case study. *Science of the Total Environment*, 627-635.
- Stake, R (1995). *The art of case study research* (49-68). Thousand Oaks, CA: Sage.
- Strategic Foresight Group (2015). *Women, Water and Peace: Crisis of Survival in the Middle East*. Mumbai, India. Retrieved from https://www.strategicforesight.com/publication_pdf/59345Water,%20Women,%20Peace.pdf:
- Steiner, T.S., Flores, C.A., Pizarro, T.T. and Guerrant, R.L (1997). Protozoal agents: what are the dangers for the public water supply? *Annual Review of Medicine*. 48, 329 – 40
- Suleiman, R (2003). *The Historical Evolution of the Water Resources Development in the Jordan River Basin in Jordan*. International Water Management Institute (IWMI); Jordan Valley Authority; MREA. JRB - Study Report.
- Sultana, F (2018). Gender and Water in a Changing Climate: Challenges and Opportunities. In C. Frohlich, G. Gioli, R. Cremades, & H. Myrntinen, *Water Security Across the Gender Divide*. 17-30. Cham: Springer International Publishing.
- Swedan, S., & Alrub, H. A (2019). Antimicrobial Resistance, Virulence Factors, and Pathotypes of Escherichia coli Isolated from Drinking Water Sources in Jordan. *Pathogens*, 8: 86.
- Sweetman, C.; Medland, L (2017). Introduction: Gender and water, sanitation and hygiene. *Gender Development*. 25, 153–166.
- Ta"any, R., Batayneh, A., & Jaradat, R (2007). Evaluation of groundwater quality in the Yarmouk Basin, North Jordan. *Journal of Environmental Hydrology: 15(28)*.

- Teague, J., Johnston, E. A., & Graham, J. P (2014). Water, sanitation, hygiene and nutrition: success, challenges, and implications for integration. *International Journal Public Health*. 59, 912-921.
- Tesfai, M., Sterk, G (2002). Sedimentation rate on spate irrigated fields in Sheeb area, eastern Eritrea. *Journal of Arid Environments* 50, 191–203.
- Tight, M. (2014). *Case Studies*. Sage Benchmarks in Social Research Methods.
- The Food and Agricultural Organization of the United Nations (2009). *Jordan: Water Report 34*. Retrieved from http://www.fao.org/nr/water/aquastat/countries_regions/JOR/
- The Jordanian National Commission for Women (2017). *Jordanian National Action Plan for the Implementation of UN Security Council Resolution 1325 on Women, Peace and Security: 2018-2021*.
- Thompson, J. (2016). Intersectionality and water: how social relations intersect with ecological difference. *Gender, Place & Culture*. 23(9). 1286-1301. Doi:10.1080/0966369X.2016.1160038.
- Tong, Y, Fan, L, & Niu, H (2017). Water conservation awareness and practices in households receiving improved water supply: A gender-based analysis. *Journal of Cleaner Production*. 141. 10.1016/j.jclepro.2016.09.169.
- Traboulsi, H., & Traboulsi, M (2017). Rooftop level rainwater harvesting system. *Applied Water Science*, 7: 769-775.
- Tzanakakis, V. E., Paranychianakis, N. V., Kyritsis, S., & Angelakis, A. N (2003). Wastewater treatment and biomass production by slow rate systems using different plant species. *Water Science and Technology Water Supply*.
- United Nations (nd). *Sustainable Development Goals*. Retrieved from <https://sustainabledevelopment.un.org/?menu=1300>
- United Nations (2018). Women, Water Security, and Peacebuilding in the Arab Region. Policy Brief. Retrieved from https://www.sfu.ca/content/dam/sfu/pwrc/PDFs/UN_Women-Water-Security_Policy-Brief_WEB.pdf
- United Nations Development Programme (UNDP) & United Nations Environment Programme (UNEP) (2015). *Rapid Assessment of the impact of Syrian refugee influx on the environment in Jordan*. Hashemite Kingdom of Jordan.
- United Nations Educational, Scientific and Cultural Organization (UNESCO)-International Hydrological Programme (IHP) (2012). *Strategic Plan of the Eighth Phase of IHP (IHP-VII, 2014-2021)*. Paris, France.

- United Nations Economic and Social Commission for Western Asia (UN-ESCWA) & Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) (2013). *Chapter 21: Yarmouk Basin: Basalt Aquifer System (West)*. Beirut: Inventory of Shared Water Resources in Western Asia.
- United Nations General Assembly (UNGA) (2015). *Transforming our world: the 2030 Agenda for Sustainable Development*. A/RES/70/1. Retrieved from https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_RES_70_1_E.pdf
- United Nations Human Rights Office of the High Commissioner (OHCHR) (2014). *"Jordan in constant water crisis" - UN expert urges long-term solution while tackling emergencies*. Retrieved from <https://www.ohchr.org/EN/NewsEvents/Pages/DisplayNews.aspx?NewsID=14387&LangID=E>
- United Nations High Commissioner for Refugees (UNHCR) (2013). *Solidarity and Burden-Sharing: Background papers for the High-Level Segment*.
- United Nations High Commissioner for Refugees (UNHCR) (2014). *Living in the Shadows: Jordan Home Visits Report*. Retrieved from <http://www.unhcr.org/54b685079.pdf>: United Nations High Commission for Refugees.
- United Nations High Commissioner for Refugees (UNHCR) (2014b). *Gender-based violence. Echoes from Syria (protection sector)*. Retrieved from <http://www.refworld.org/pdfid/53f1b2b34.pdf>: Issue 3.
- United Nations High Commissioner for Refugees (UNHCR) (2015). *Sexual and Gender-based violence: Refugees in Jordan. Sexual and Gender-based violence sub-working group*. Retrieved from https://reliefweb.int/sites/reliefweb.int/files/resources/BriefingNoteSGBV_2015_FinalJune30.pdf
- United Nations High Commissioner for Refugees (UNHCR) (2018). *Fact Sheet - Jordan*. Retrieved from https://reliefweb.int/sites/reliefweb.int/files/resources/FactSheetJordanFebruary2018-FINAL_0.pdf
- United Nations High Commissioner for Refugees (UNHCR) (2019). *Fact Sheet Jordan*. Retrieved from <https://reliefweb.int/sites/reliefweb.int/files/resources/69826.pdf>
- United Nations International Children's Emergency Fund (UNICEF) (2016). *The impact of water, sanitation and hygiene on key health and social outcomes: Review of evidence*.

- United Nations International Children's Emergency Fund (UNICEF) and World Health Organization (WHO) (2018). *Core questions on drinking water, sanitation and hygiene for household surveys: 2018 update*. New York: WHO and UNICEF. Retrieved from <https://washdata.org/sites/default/files/documents/reports/2019-03/JMP-2018-core-questions-for-household-surveys.pdf>
- United Nations International Children's Emergency Fund (UNICEF) (nd). *Water, sanitation and hygiene*. Retrieved from <https://www.unicef.org/jordan/water-sanitation-and-hygiene>
- United Nations International Children's Emergency Fund (UNICEF) (2013). *Shattered Lives: challenges and Priorities for Syrian Children and Women living in Jordan*. Retrieved from https://www.unicef.org/wash/files/Shattered_Lives_June10.pdf
- United Nations Relief and Works Agency (UNRWA) (2017). *Where We Work - Jordan*. Retrieved from <https://www.unrwa.org/where-we-work/jordan>
- United Nations Water (2013). *Water Security and the Global Agenda: UN-Water Analytical Brief*. Hamilton, Ontario: United Nations University.
- United Nations World Assessment Program (WWAP) (2012). *The United Nations World Water Development Report 4: Managing water under uncertainty and risk*. Paris, France: United Nations World Water Assessment Programme. UNESCO.
- US Geological Survey (2013). *Groundwater-Level Trends and Forecasts, and Salinity Trends, in the Azraq, Dead Sea, Hammad, Jordan Side Valleys, Yarmouk, and Zarqa Groundwater Basins, Jordan*. Reston, Virginia. Retrieved from <http://pubs.usgs.gov/of/2013/1061/>.
- Van Aken, M., & De Donato, A (2018). Gender and Water in the Middle East. Local and Global Realities. In C. Frohlich, G. Gioli, R. Cremades, & H. Myrntinen, *Water Security Across the Gender Divide* (pp. 61-80). Cham: Springer International Publishing.
- Water authority of Jordan (2015). *Water Distribution Program: Summer 2015*; Water Authority of Jordan: Amman, Jordan, 2015.
- Webb, P., & Iskandarani, M (1998). *Water insecurity and the poor: Issues and research needs. ZEF discussion papers on Development Policy, No.2*. Bonn: University of Bonn, Centre for Development Research (ZEF).
- World Health Organization (WHO) (1998). *Guidelines for Drinking Water Quality*. Second Edition, Geneva.
- World Health Organization (WHO) (2011). *Guidelines for drinking-water quality*. Fourth edition. Geneva, Switzerland: World Health Organization.

- World Health Organization (WHO) (2011a). *Water, sanitation and hygiene interventions and the prevention of diarrhea*. Retrieved from World Health Organization: https://www.who.int/elena/titles/bbc/wsh_diarrhoea/en/
- World Health Organization (WHO) (2014). *Preventing Diarrhea through better water, sanitation and hygiene: Exposures and impacts in low- and middle-income countries*. Geneva: WHO Press.
- World Bank (2017). *Reducing inequalities in water supply, sanitation and hygiene in the era of the sustainable development goals: Synthesis report of the WASH Poverty Diagnostic Initiative. WASH Synthesis Report*. Washington, DC: World Bank.
- World Health Organization (WHO) & United Nations Children's Fund (UNICEF) (2015). *Progress on Sanitation and Drinking Water – 2015 Update and MDG Assessment*. Geneva, Switzerland.
- World Health Organization (WHO) & United Nations Children's Fund (UNICEF) (2017). *Progress on Drinking Water, Sanitation, and Hygiene: 2017 Update and SDG Baselines*. Geneva. Retrieved from https://www.unicef.org/publications/index_96611.html
- World Health Organization (WHO) & United Nations Children's Fund (UNICEF) (2017a). *Safely managed drinking water - thematic report on drinking water 2017*. Geneva, Switzerland: World Health Organization;2017. Licence: CC BY-NC-SA 3.0 IGO.
- World Health Organization (WHO) & United Nations Children's Fund (UNICEF) (2017b). *WASH in the 2030 Agenda: New global indicators for drinking water, sanitation and hygiene*. Retrieved from <https://data.unicef.org/resources/wash-2030-agenda/>
- World Health Organization (WHO) & United Nations Children's Fund (UNICEF) (2018). *JMP Methodology 2017. Update and SDG Baselines; WHO: Geneva, Switzerland, 2018*. Retrieved from <https://washdata.org/sites/default/files/documents/reports/2018-04/JMP-2017-update-methodology.pdf>
- Wutich, A., Budds, J., Eichelberger, L., Geere, J., Leila, H., Horney, J., Young, S (2017). Advancing methods for research on household water insecurity: studying entitlements and capabilities, socio-cultural dynamics, and political processes, institutions and governance. *Water Security*, 2, 1-10.
- Yadav, R. K., & Cssi, I (2014). Potential of tree plantations for wastewater disposal: Long term use in Eucalyptus. *World Congress on Agroforestry*. Delhi, India.
- Youssef, M., Shurman, A., Bougnoux, M., Rawashdeh, M., Bretagne, S., Strockbine, N (2000). Bacterial, viral and parasitic enteric pathogens associated with acute diarrhea in hospitalized children from northern Jordan. *FEMS Immunology and Medical Microbiology*, 28, 257–263.

Yin, R.K (2003). *Case Study Research: Design and Methods*. Sage. Thousand Oaks, California.

Zietlow, K., Michalscheck, M., & 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.

Zozmann, H., Klassert, C., Sigel, K., Gawel, E., & Klauer, B (2019). Commercial Tanker Water Demand in Amman. *Water*, 11, 254.